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CONTENTS

Effect of Phosphatic and Potassium Fertilization Rates on Some Faba Bean Cultivars

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ABSTRACT: The present study was carried out during the winter seasons of 2013/2014 and 2014/2015 at the Agricultural Research Station, Abbis, Alexandria University, Alexandria, Egypt. The objectives ware to investigate the influence of effect of phosphorus fertilization rate (0,37 and 74 kg P_2O_5/ha) potassium fertilization rate (0,57 and 114 kg K_2O/ha) and faba bean variety (Libyan landrace, Giza 843, Nubariah3, Giza716 and Sakha1) on growth, yield and yield components. The experimental design was split split plot design with four replications. Leaf area index(LAI), crop growth rate(CGR), 100-seed weight, Number of pods/plant, Number of seeds/plant, seed yield/ha(SY) and harvest index(H.I)were characters studied. Phosphorus fertilization levels had significant effect on LAI, and number. of pods /plant in both seasons, and CGR, 100-seed weight and number. of seeds/plant in second season. Concerning the studied potassium fertilization rates, they had significant effect on CGR, 100-seed weight, number. of pods/plant in first season. Cultivars varied significantly in all studied characters, in the two seasons, except SY/ha in the second season. The interaction between phosphorus and potassium had significant effect on LAI, No. of pods/plant, Number. of seeds/plant and SY/ha in second season, and CGR, 100-seed weight and H.I in both seasons, also phosphorus*cultivars interaction had significant effect on LAI, CGR, 100-seed weight, number. of pods/plant in both seasons except number.of seeds/plant in first season and H.I in second season. Potassium*cultivars interaction was significant for the LAI, number. of seeds/plant and SY/ha in first season and CGR,100-seed weight and number.of pods/plant in both seasons. The significant three interactions, in the two seasons on all parameters except H.I in second season and LAI in both seasons. The results indicated that CGR mainfe station was a result for the combined effects of three studied factors.
Keywords: Faba bean, phosphorus, potassium, Cultivars, Seed yield.

INTRODUCTION

Grain legumes, belonging to the family Fabaceae, are an important component of the food production systems in tropical agriculture for their mature seeds or immature green pods because of their protein content (20–26%)(Carangal *et al*.,1997and Metwally *et al*.,2011). These crops are very adaptable and fix atmospheric nitrogen through symbiosis (Wood and Myers, 1997).

Faba bean (*Vicia faba*L.) is the most important legume crop in Egypt and many parts of the world (Metwally *et al*., 2011), where it is used for human consumption as a good source of vegetarian protein (Saad and El-Kholy, 2001 and Nawar *et al*.,2010) and animals (El-Gizawy and Mehasen,2009). Its seeds exhibit high levels of protein (28-36 % of seed dry matter). It is popular breakfast food which is also used as a green vegetable or fresh canned vegetable (Metwally *et al*., 2011). It is, also an important crop for soil improvement and used as a break crop in cereal rotation to keep the soil fertile and productive through nitrogen fixation (Metwally *et al*., 2011). Depending on the plant density and the field management, this plant is able to fix nitrogen up to 40kg ha^{-1} annually (Hashemabadi, 2003).

The production of faba bean in Egypt is still limited and fails to face the increasing local consumption. Therefore, increasing crop productivity is one of the major targets of the agricultural policy and can be fulfilled through-increasing the cultivated area, using high productive varieties, and Supply of appropriate and balanced levels of essential plant nutrients and weed control (Ismail and Hagag, 2005 and El Habbasha *et al.*,2007). Faba bean productivity is low due to technological gaps in adoption of balanced fertilization (Rezk *et al.*, 2013).

Phosphorus is a very important nutrient for crop growth and ensures high yield with good quality. It plays a key role in metabolic processes such as the conversion of sugar into starch and cellulose. As a result, phosphorus deficiency causes stunting, delayed maturity and shriveled seeds (Abou Hussien *et al.*,2002 and El Douby and Mouhamed, 2002). Several researchers reported that plant height, number of pods and seeds/plant as well as weight of pods and seeds/plant, straw and biological yield/feddan and seed protein content were increased due to phosphorus fertilizer applications (Mokhtar,2001 and Abdalla,2002).

Potassium is an essential element for all living organisms. In plants, it is an important cation involved in physiological pathways (Duke and Collins, 1995 and Sangakkara *et al.*,1996). In particular, the ability of ATPases in membranes to maintain active transport is highly dependent on adequate K supply. Thus efficient cell development and growth of plant tissues, translocation, storage of assimilates and other internal functions, which are based upon many physiological, biochemical and biophysical interactions, require adequate K in the cell sap (Marschner, 1995 and Lindhauer,1999). Potassium is an important nutrient for several physiological processes directly related to nodulation and N_2 fixation (Abdel Wahab and Abd-Alla, 1995 and People and Koch, 1999).The influence of K on growth and yield of food legumes has been demonstrated, to improve plant's resistance against environmental stress (Sangakkara,1990 and Hanway and Johnson,1995).

The present investigation aimed to evaluate some local and introduced faba bean varieties under varying levels of phosphorus and potassium fertilization to determine the appropriate level of the two macronutrients that would realize optimal growth and productivity of those varieties.

MATERIALS AND METHODS

The present study was carried out during the two successive winter seasons of 2013/2014 and 2014/2015 at Agriculture Research Station and Laboratories of Crop Science Department, Faculty of Agriculture, Alexandria University. This investigation aimed to evaluate some faba bean cultivars and determine the suitable phosphorus and potassium fertilizers levels to maximize plant growth and productivity of the studied varieties.

The soil of the experimental fields was silty loam and approximately homogenous. Soil of the experimental sites were analyzed in the two seasons as shown in Table (1).

Table (1). Some Physical and chemical properties of the experimental soil in 2013/2014 and 2014/2015 seasons

Soil character	Seasons	
	2013-2014	**2014-2015**
Physical properties		
Sand %	1.4	75
Silt %	72.6	17.5
Clay %	25.9	7.5
Texture	Silty Loam	Sandy Loam
Chemical properties		
Av N mg/kg	0.11	0.02
Av P mg/kg	12.00	9.60
Av K mg/kg	1.24	1.37
O.M %	1.15	1.68
pH	8.25	8.23
EC (dS/m)	2.04	5.01
Ca^{+2} meq/L	7.5	16.00
Mg^{+2} meq/L	2.5	17.00
Na+ meq/L	25.26	60.61
Cl^{-} meq/L	10.00	0.45
CO_3^{-2} meq/L	4.8	0.0
$H\,CO_3^{-1}$ meq/L	4.00	4.00
$CaCO_3$ (%)	18.39	8.20
SAR	7.99	13.13

The experimental design was split-split plot with four replications, Phosphorus fertilization (as calcium monophosphate 15.5% P_2O_5)levels (0, 37 and 74 kg P_2O_5/ha) were randomly distributed in main plots, the potassium fertilization(as potassium sulphate 48% k_2O) levels(0, 57 and 114 kg k_2O/ha) occupied the sub-plots, whereas the cultivars(Libyan,Giza843,Nubariah3, Giza716 and Sakha1) were allocated to the sub-sub plots.

The sub-sub plot size was 6.3m^2(3 ridges, 3m long and 70 cm apart). Seeds were sown on one side of ridge in hills 20 cm apart and thinned to two plants per hill. Seeds were obtained from the Agricultural Research Center in Giza, Department of Legume Crops, except for seeds of Libyan variety which were obtained from the Agricultural Research Center in Tripoli. seeding rate for all varieties was 144kg/ha. Planting dates were November 1st and 10th in 2013/2014 and 2014/ 2015 seasons, respectively. All other agricultural practices were carried out according to the recommended practices of this crop in the region.

Weed control was carried out using Stomp, as pre-emergence herbicide at the rate of 3.57 liter/ha. Fusilade super was applied at the rate of 3.57 liter/ha after germination of weeds, in the stage of four leaves, for weed control of narrow-leaved weeds. In both seasons, a 0.42 m^2 area, from each experimental unit, wastaken on I^{st} on February and March, to calculate the leaf area and dry weight of plant. The leaf area was calculated using leaf area meter, model no. Li 3000c.andleaf area index for the March sample was calculated according to Gardner *et al.*(1985), as the following equation: leaf area index (LAI) = leaf area/feeding area.

Plants were oven-dried at $70C^0$ until constant weight and crop growth rate (CGR) was calculated according to Gardner *et al.*(1985) , for the period from I^{st} February to I^{st} March. At harvest, the following measurements were determined:

1- Number of pods/plant, as an average of five plants.
2- Number of seeds/plant, as an average of five plants.
3- 100-seed weight (g), as an average of three samples.
4- Seed yield (ton/ha), as the weight of seed obtained from a guarded area of 1.75 m^2 and transformed to ton/ ha.
5- Harvest index(%), was calculated as seed yield/biological yield X100.

Where P levels occupied the main plots, K levels were allocated to the sub-plots and faba bean verities were randomly assigned to the sub sub-plots.

Statistical analysis

Statistical analysis of the experimental data, in each season, was performed according to Gomez and Gomez (1984), using SAS (Statistical Analysis System) version: 9.1. Comparison between treatment means was carried out using least significant differences at 0.05 probability level ($L.S.D_{0.05}$).

RESULTS AND DISCUSSION

The present study aimed to investigate the effect of fertilization with varying levels of phosphorus and potassium on growth and yield characters of five faba bean cultivars. The obtained results are presented as follows:

A. Growth characters

These included leaf area index (LAI) and crop growth rate (CGR) measured at first of March for LAI and the period from February 1^{st} to March 1^{st} for CGR.

Phosphorus (P levels) affected both characters in the second season and LAI only in the first season, whereas potassium (K) levels had no significant effect on LAI but significantly affected CGR in the two seasons. Moreover, cultivars (C) and significant effect on both characters in the two seasons. LAI was significantly influenced by P×K interaction (2^{nd} season), P×C interaction (in the two seasons) and K×C interaction (2^{nd} season). On the other hand, CGR was affected by 2–factor and 3–factor interactions in the two seasons; hence the effect of P×K×C interaction will be discussed (Tables 2 and 3). Increasing P application level from 0 to 37 kg P_2O_5/ ha significantly increased LAI in the two seasons, whereas further increase to 74 kg P_2O_5/ha level resulted in insignificant increase in that character. Concerning CGR, increasing P level from 0 to 37 or 74 kg P_2O_5/ha showed progressive increase in CGR that was significant in the second season only. Phosphorus is an important macronutrient that plays an important role in biochemical processes in plants through its contribution in energy transformations. Agegnehu and Tsige (2006) reported that leaves dry weight of faba bean plants was positively influenced by increased P applications. Similarly, Saad and El-Kholy (2001) and Ahmed and El-Abagy (2007) concluded that the highest P application rate produced the most significant values of growth characters including LAI and CGR.

Potassium had insignificant effect on LAI, in the two seasons, but showed a trend of progressive increase in that character with increasing K level up to 114 kg K_2O/ha. On the other hand, K levels had significant influence on CGR in the two seasons. Increasing K level resulted in significant progressive increment in CGR up to 114 kg K_2O/ha.

The P×K interaction, in the second season, showed that increasing P application to 37 kg P_2O_5/ ha and K fertilization rate to 57 kg K_2O/ha resulted in a significant increase in LAI. Further increase of P to 74 kg P_2O_5/ha and K to 114 kg K_2O/ha gave insignificant increase in LAI compared to the two intermediate levels. Hence, the value of P×K interaction for intermediate levels (4.52) wastatistically similar to that of the highest levels of both macronutrients (4.74). Ebrahem and Abd El-Mohsen (2010) reported that growth parameters of faba bean plants, including LAI, increased with balanced applications of both phosphorus and potassium fertilizers. Significant differences between cultivars and P× cultivars interaction in the two seasons, and K×cultivars in the second season, may be explained by the differences in genetic constitution of cultivars and the response of genetic makeup to the applied levels of P and K. Means in (Table 2) revealed that LibyanI, Nubariah 3 and Giza 716 had significantly higher LAI values compared to Giza 843 and Sakha 1. The data, also, showed that Libyan 1 with 74.0 kg P_2O_5/ha, or 114 kg K_2O/ha, gave the highest values for LAI, whereas Sakha 1 with P or K fertilization gave the lowest values for LAI. Application of phosphorus, or potassium, enhances plant growth through activation of various biochemical processes, uptake N_2 fixation and nodules activity and increases nutrients uptake from the soil, leading to more vigorous plant growth and higher leaf area. Similar findings were reported by El-Hadidy and Sweelam (2000), Abdallah (2002), Weldua *et al*. (2012) and Mohammad (2014), who confirmed the positive effect of increasing P and/or K levels on faba bean growth, and the variation of cultivars response to applied P and/or K fertilization levels.

The significant three-factor interaction, in the two seasons, indicated that CGR manifestation was a result for the combined effects of the three studied factors (Table 3). The highest values for CGR were obtained for Giza 843 with

74 kg P_2O_5/ha and 114 kg K_2O/ha in the first season (6.55 g/m^2/day), whereas in the second season, both LibyanI and Nubariah 3 exhibited the highest values for CGR (6.33 g/m^2/day for both genotypes) at the same levels of P and K. On the other hand, Sakha 1 gave the lowest values for CGR when neither phosphorus nor potassium were applied (1.25and 0.08 g/m^2/day in the first and second season, respectively). These results emphasize the importance of application of both P and K fertilizers, in balanced proportion, for proper growth of faba bean plants. El-Habbasha *et al*. (2007), Osman and Elaziz (2010) and Farhan (2012) reported positive influence of P and K application on dry matter production, leading to increased dry weights of both shoots and roots, in faba bean plants and differential varietal response to applied levels of both macronutrients. It should be noted that faba bean varieties with higher LAI values produced higher CGR values, in the two season. That implies a close relationship between functional leaf area and accumulation of dry matter in plants. Kurdali *et al*. (2002) and Abd El-Latif and Moursi (2006) reported a positive relationship between the two growth parameters.

B. Yield characters

This group of characters included number of pods/ plant, number of seeds/ plant, 100-seed weight, seed yield/ ha and harvest index P levels significantly affected number of pods/ plant in the two seasons, number of seeds/ plant and 100-seed weight in the second season. K fertilization levels significantly influenced all studied characters, in the two seasons, except number of pods/plant in the second season. Cultivars varied significantly in all studied characters, in the two seasons, except seed yield/ ha in the second season. The 3– factors interaction had significant effect on all studied characters, in the two seasons, except harvest index in the second season (Tables 4 to 8).

Increasing P application from 0 to 37 then 74 kg P_2O_5/ha resulted in significant increase in number of pods/ plant in the two seasons,number of seeds/ pod and 100-seeds weight in the second season. Seed yield/ ha and HI showed the same trend but did not reach the level of significance in the two seasons. Bolland *et al.* (2001) concluded that P is a major nutrient element for seed production of faba bean in neutral and alkaline soils. Ahmed *et al.* (2005) and Agegnehu and Fessehaie (2006) reported that the highest P level resulted in highest number of pods and seeds/ plant. Similarly, Ahmed and El-Abagy (2007) found that seed yield and yield components increased with foliar application of P.

Concerning K levels, increasing application from 0 to 57 then to 114 K_2O/ ha significantly increased number of pod/ plant in the first season, number of seeds/ plant and 100-seed weight in the two seasons, seed yield/ha and HI up to 57 kg K_2O/ha in the first season and up to 114 kg K_2O/ ha in the second season. Several researchers reported the beneficial effects of increasing K application level on seed yield and yield components of faba bean (Metwally *et al*., 2011, Shaban *et al*., 2012, Jasimand Obaid, 2014 and Sadeghi *et al*., (2014). They all concluded that the enhancement effect of K, as a major nutrient, on growth, dry matter production and translation positively affected yield components and finally increased seed yield.

Cultivars varied significantly for yield components and harvest index, in the two seasons, and in seed yield in the first season only. LibyanI exhibited the highest values for number of pods/ plant, 100-seed weight and harvest index in the two seasons, while Sakhal gave the lowest value for the same characters in the two seasons. Concerning number of seeds/plant, Giza 843 gave the highest values, whereas Giza 716 exhibited the lowest values in the two seasons. Regarding seed yield/ ha, Nubariah 3 gave the significantly highest value (2.54 t/ha) while Sakhal gave the lowest value (2.18 t/ ha) in the first season. The same trend was obtained in the second season but did not reach the statistical level of significance. Similar variations between yield and yield components of faba bean cultivars were reported by Saad and El-Kholy (2001) and Talaat and Abdallah (2008), who concluded that these variations may be attributed to differences in genetic constitution of the varieties which affects their response to environment. Its worth mentioning the noticeable variation in seed yield and yield components between the two seasons, where the recorded values for those characters varied from one season to another. That variation is a natural phenomenon in faba bean and is, principally, influenced by the percentage of flower shedding caused by environmental conditions such as win and amount of rainfall druing flowering stage. Similar findings were reported by Masri (2001) and Khalil *et al.* (2004).

The three factor interaction revealed that varieties differed in their performance, under the influence of applied phosphorus and potassium levels, for seed yield and yield components characters. Application of the highest levels of P (74 kg P_2O_5/ ha) and K (114 kg K_2O/ ha) gave the highest values in the two seasons, for number of pods/ plant with LibyanI, for number of seeds/ plant with Sakhal, for 100-seed weight with LibyanI, for seed yield/ ha with Giza 716 in the first season and Giza 843 in the second season, and for harvest index with Giza 843 in the first season. On the other hand, the lowest values were obtained with zero application of both macronutrients with Sakhal for number of pods/ plant, 100-seed weight, seed yield/ha and harvest index in the two seasons, and number of seeds/ plant in the second season, whereas Nubariah 3 gave the lowest number of seeds/ plant in the first season. Interaction between cultivars and P and/or K level were reported by Khalil *et al.* (2004), Ahmed and El-Abagy (2007), Ahmed *et al.* (2010) and El-Aal(2015).

The present investigation revealed the importance of appropriate fertilization with phosphorus and potassium for obtaining enhanced vegetative growth, higher seed yield and yield components. Fertilization with 74 kg P_2O_5 and 114kg K_2O /ha gave the highest seed yield indicating the importance of both macronutrients in acheiving high seed yield from faba bean. The results also indicated the importance of growing of faba been variety that performs well under the applied phosphorus and potassium levels, in addition to its stable response to changing seasonal environmental conditions.

Table (2). Leaf area index as affected by phosphorus, potassium fertilization levels and faba bean cultivars during 2013-2014 and 2014-2015 seasons.

Phosphorus Levels (kg P_2O_5/ha)	Potassium Levels (kg K_2O/ha)	leaf area index											
		2013-2014						2014-2015					
		Cultivars						Cultivars					
		Libyan1	Giza843	Nubariah3	Giza716	Sakha1	Mean	Libyan1	Giza843	Nubariah3	Giza716	Sakha1	Mean
0	0	5.1	4.25	4.54	4.36	4.05	4.46	4.31	3.72	4.38	4.06	2.97	3.89
	57	5.24	4.49	5.11	4.61	4.59	4.81	4.47	4.36	4.39	4.2	4.28	4.34
	114	5.38	4.66	5.12	5.02	4.64	4.96	4.48	4.41	4.44	4.28	4.43	4.41
	Average	5.24	4.74	4.92	4.66	4.43	4.8	4.42	4.16	4.4	4.18	3.89	4.21
37	0	5.41	4.72	5.25	5.2	4.56	5.03	4.58	4.47	4.53	4.48	4.43	4.5
	57	5.42	4.73	5.35	5.32	4.83	5.13	4.59	4.47	4.53	4.53	4.47	4.52
	114	5.43	5.01	5.36	5.33	4.84	5.19	4.59	4.46	4.6	4.6	4.48	4.55
	Average	5.42	4.82	5.32	5.28	4.74	5.12	4.59	4.47	4.55	4.54	4.46	4.52
74	0	5.52	5.09	5.48	5.39	4.85	5.27	4.74	4.63	4.6	4.53	4.53	4.61
	57	5.54	5.16	5.5	5.5	5.09	5.36	4.77	4.63	4.61	4.68	4.52	4.64
	114	5.55	5.26	5.52	5.52	5.18	5.41	4.91	4.64	4.76	4.7	4.67	4.74
	Average	5.54	5.17	5.5	5.47	5.04	5.34	4.81	4.63	4.66	4.64	4.57	4.66
Potassium Levels (kg k_2O/ha)	0	5.34	4.69	5.09	4.98	4.49	4.92	4.54	4.27	4.5	4.36	3.98	4.33
	57	5.4	4.79	5.32	5.14	4.84	5.10	4.61	4.49	4.51	4.47	4.42	4.5
	114	5.45	4.98	5.33	5.29	4.89	5.19	4.66	4.5	4.6	4.53	4.53	4.56
Average for Cultivars		5.4	4.82	5.25	5.14	4.74	5.07	4.6	4.42	4.54	4.45	4.31	4.46

Means followed by the same letters are not significantly different at 0.05 level of probability.

LSD at 5% level for:

Phosphorus=	0.355	0.173
Potassium=	n.s	n.s
Phosphorus x Potassium =	n.s	0.220
Cultivars=	0.313	0.208
Phosphorus x Cultivars =	0.542	0.360
Potassium x Cultivars=	n.s	0.360
Phosphorus x Potassium x Cultivars=	n.s	n.s

Table (3). Crop Growth Rate as affected by phosphorus, potassium fertilization levels and faba bean cultivars during 2013-2014 and 2014-2015 seasons.

phosphorus Levels (kg P_2O_5/ha)	Potassium Levels (kg K_2O/ha)	Crop Growth Rate (g/m^2/day)											
		2013-2014						2014-2015					
		Cultivars						Cultivars					
		Libyan1	Giza843	Nubariah3	Giza716	Sakha1	Mean	Libyan1	Giza843	Nubariah3	Giza716	Sakha1	Mean
0	0	2.85	0.52	1.27	2.09	1.25	1.6	0.95	0.25	0.56	0.29	0.08	0.43
	57	3.27	2.66	1.84	2.20	1.68	2.33	2.31	0.54	1.93	0.80	0.27	1.17
	114	4.04	2.74	2.17	2.28	1.71	2.59	3.18	1.54	2.66	1.16	0.88	1.88
	Average	3.39	1.97	1.76	2.19	1.55	2.17	2.15	0.78	1.72	0.75	0.41	1.16^c
37	0	4.24	2.87	2.41	2.75	2.39	2.93	3.20	1.82	3.37	1.84	1.55	2.36
	57	4.80	3.83	4.14	3.92	2.92	3.92	3.48	2.77	3.74	2.35	2.82	3.03
	114	5.06	3.14	4.19	4.73	2.99	4.02	3.73	2.81	4.53	3.45	3.17	3.54
	Average	4.7	3.28	3.58	3.8	2.77	3.63	3.47	2.47	3.88	2.55	2.51	2.98
74	0	4.8	3.93	4.25	4.02	3.66	4.13	4.03	2.99	3.89	3.51	3.51	3.59
	57	5.25	4.34	5.42	4.83	4.13	4.79	4.44	4.61	3.97	4.33	3.58	4.19
	114	5.91	6.55	6.49	6.24	5.24	6.09	6.33	4.92	6.33	5.59	5.75	5.78
	Average	5.32	4.94	5.39	5.03	4.34	5.00	4.93	4.17	4.73	4.48	4.28	4.52^a
Potassium Levels (kg k_2O/ha)	0	3.96	2.44	2.64	2.95	2.43	3.18	2.73	1.69	2.61	1.88	1.71b	2.2
	57	4.44	3.61	3.8	3.65	2.91	4.14	3.41	2.64	3.21	2.49	2.22a	3.23
	114	5.00	4.14	4.28	4.42	3.31	4.62	4.41	3.09	4.51	3.40	3.27a	4.4
Average for Cultivars		4.47	3.40	3.57	3.67	2.88	3.60	3.52	2.47	3.44	2.59	2.4	2.88

Means followed by the same letters are not significantiydifferent at 0.05 level of probability.

LSD at 5% level for:

Phosphorus =	n.s	1.01
Potassium =	0.470	0.866
Phosphorus x Potassium =	0.813	1.500
Cultivars =	0.553	0.767
Phosphorus x Cultivars =	0.956	1.328
Potassium x Cultivars=	0.956	1.328
Phosphorus x Potassium x Cultivars =	1.657	2.301

Table (4). 100-seed weight (g) as affected by phosphorus, potassium fertilization levels and faba bean cultivars during 2013-2014 and 2014-2015 seasons.

phosphorus Levels (kg P_2O_5/ha)	Potassium Levels (kg K_2O/ha)	100-seed weight (g)											
		2013-2014						2014-2015					
		Cultivars						Cultivars					
		Libyan1	Giza843	Nubariah3	Giza716	Sakha1	Mean	Libyan1	Giza843	Nubariah3	Giza716	Sakha1	Mean
0	0	87.59	91.63	79.97	76.65	68.79	80.93	83.39	78.70	80.62	81.83	74.50	79.81
	57	90.19	80.34	81.57	81.23	69.24	80.51	84.53	82.27	81.14	83.48	77.77	81.84
	114	93.18	82.57	81.75	83.05	71.96	82.5	89.46	82.35	83.50	84.81	79.55	83.93
	Average	90.32	84.85	81.1	80.31	70	81.31	85.79	81.11	81.75	83.37	77.27	81.86
37	0	99.20	83.79	83.75	84.61	73.65	85	92.14	83.04	84.89	85.77	80.95	85.36
	57	102.47	85.72	86.56	85.01	75.10	86.97	93.80	83.23	89.70	86.34	81.01	86.82
	114	107.01	86.87	86.86	87.11	73.66	88.3	97.64	84.57	90.18	89.95	81.96	88.86
	Average	102.89	85.46	85.72	85.58	74.14	86.76	94.53	83.61	88.26	87.35	81.31	87.01
74	0	107.54	90.13	89.66	88.44	77.63	90.68	98.10	94.85	93.66	90.06	82.17	91.77
	57	121.50	92.47	92.91	94.07	77.63	95.72	98.43	95.26	96.46	90.74	85.94	93.37
	114	140.71	95.29	95.88	97.68	81.33	102.2	107.31	98.67	102.38	91.58	86.65	97.32
	Average	123.25	92.63	92.82	93.4	78.86	96.19	101.3	96.26	97.5	90.79	84.92	94.15
Potassium Levels (kg k_2O/ha)	0	98.11	88.52	84.46	83.2	73.36	85.54	91.21	85.53	86.39	85.89	79.21	85.64
	57	104.72	86.18	87.01	86.77	73.99	87.73	92.25	86.92	89.1	86.85	81.57	87.34
	114	113.63	88.24	88.16	89.28	75.65	90.99	98.14	88.53	92.02	88.78	82.72	90.04
Average for Cultivars		105.49	87.65	86.54	86.42	74.33	88.09	93.87	86.99	89.17	87.17	81.17	87.67

Means followed by the same letters are not significantly different at 0.05 level of probability.
LSD at 5% level for:

Phosphorus =	n.s	2.394
Potassium =	1.400	1.473
Phosphorus x Potassium =	2.424	2.550
Cultivars =	1.070	1. 681
Phosphorus x Cultivars =	1.854	2.912
Potassium x Cultivars =	1.854	2.912
Phosphorus x Potassium x Cultivars =	3.211	5.044

Table (5).No. of pods/Plant as affected by phosphorus, potassium fertilization levels and faba bean cultivars during 2013-2014 and 2014-2015 seasons.

phosphorus Levels (kg P_2O_5/ha)	Potassium Levels (kg K_2O/ha)	No. of pods/Plant											
		2013-2014						2014-2015					
		Cultivars						Cultivars					
		Libyan1	Giza843	Nubariah3	Giza716	Sakha1	Mean	Libyan1	Giza843	Nubariah3	Giza716	Sakha1	Mean
0	0	15.09	12.52	12.90	11.02	10.38	12.38	19.40	19.90	20.65	19.85	18.70	19.7
	57	15.50	13.46	14.68	13.11	10.81	13.51	23.75	21.15	21.25	19.85	20.55	21.31
	114	16.80	14.06	15.10	13.56	12.09	14.32	23.90	22.10	25.45	21.50	22.20	23.03
	Average	15.8	13.35	14.23	12.56	11.09	13.41	22.35	21.05	22.45	20.4	20.48	21.35
37	0	16.89	14.69	16.24	13.59	12.44	14.77	26.93	22.25	26.00	21.85	22.20	23.85
	57	16.98	14.83	18.12	14.19	12.94	15.41	28.35	25.25	27.05	22.90	23.00	25.31
	114	17.41	15.96	18.48	15.23	13.24	16.06	29.50	27.05	28.20	24.35	23.60	26.54
	Average	17.09	15.16	17.61	14.34	12.87	15.42	28.26	24.85	27.08	23.03	22.93	25.23
74	0	17.95	17.35	18.72	15.99	16.22	17.25	35.00	27.90	31.95	24.95	25.15	28.99
	57	20.50	18.84	22.75	16.87	16.41	19.07	38.10	29.05	32.05	26.70	25.80	30.34
	114	25.70	22.11	23.02	18.28	20.71	21.96	42.60	33.05	36.85	34.58	27.00	34.82
	Average	21.38	19.43	21.5	17.05	17.78	19.43	38.57	30.00	33.62	28.74	25.98	31.38
Potassium Levels (kg k_2O/ha)	0	16.64	14.85	15.95	13.53	13.01	14.8	27.11	23.35	26.2	22.22	22.02	24.18
	57	17.66	15.71	18.52	14.72	13.39	16	30.07	25.15	26.78	23.15	23.12	25.65
	114	19.97	17.38	18.87	15.69	15.35	17.45	32	27.4	30.17	26.81	24.27	28.13
Average for Cultivars		18.09	15.98	17.78	14.65	13.92	16.08	29.73	25.3	27.72	24.06	23.14	25.99

Means followed by the same letters are not significantiy different at 0.05 level of probability.

LSD at 5% level for:

	2013-2014	2014-2015
Phosphorus =	0.134	0.300
Potassium =	0.148	n.s
PhosphorusxPotassium =	n.s	0.465
Cultivars =	0.089	0.177
PhosphorusxCultivars =	0.166	0.313
PotassiumxCultivars =	0.166	0.313
Phosphorus x Potassium x Cultivars =	0.280	0.542

Table (6). No. of seeds/ plant as affected by phosphorus, potassium fertilization levels and faba bean cultivars during 2013-2014 and 2014-2015 seasons.

phosphorus Levels (kgP_2O_5/ha)	Potassium Levels (kg K_2O/ha)	No. of seeds/ plant											
		2013-2014						2014-2015					
		Cultivars						Cultivars					
		Libyan1	Giza843	Nubariah3	Giza716	Sakha1	Mean	Libyan1	Giza843	Nubariah3	Giza716	Sakha1	Mean
0	0	46.09	48.88	38.73	23.35	50.19	41.45	58.45	60.70	55.40	54.35	52.00	56.18
	57	50.17	49.73	46.76	30.34	52.49	45.90	58.50	63.68	58.35	56.45	56.70	58.74
	114	50.39	55.88	58.32	33.58	55.14	50.66	62.23	75.85	61.50	57.28	67.85	64.94
	Average	48.88	51.5	47.94	29.09	52.61	46.00	59.73	66.74	58.4	56.03	58.58	59.95
37	0	52.64	59.08	51.37	38.52	58.19	52	66.90	76.30	66.08	61.55	70.23	68.21
	57	53.55	62.79	52.34	39.53	59.13	53.5	79.50	77.73	68.20	66.25	71.90	72.72
	114	60.97	64.75	60.40	43.96	60.18	58.1	80.30	82.10	70.65	67.10	86.25	77.28
	Average	55.72	62.2	54.7	40.67	59.17	54.49	75.57	78.71	68.3	64.97	76.13	72.74
74	0	63.34	68.61	63.32	44.92	62.30	60.5	80.63	88.60	72.35	69.33	89.18	80.02
	57	66.76	80.31	63.51	55.15	73.49	67.8	82.70	99.00	86.85	71.80	92.60	86.59
	114	76.28	87.85	65.35	67.25	88.16	77	83.00	103.55	95.90	87.28	108.11	95.57
	Average	68.79	78.9	64.06	55.77	74.65	68.44	82.11	97.05	85.03	76.137	96.63	87.39
Potassium Levels (kg k_2O/ha)	0	54.02	58.86	51.14	35.6	56.89	51.3	68.66	75.2	64.61	61.74	70.47	68.14
	57	56.83	64.28	54.2	41.67	61.7	55.74	73.57	80.14	71.13	64.83	73.73	72.68
	114	62.55	69.49	61.36	48.26	67.83	61.9	75.18	87.17	76.02	70.55	87.4	79.26
Average for Cultivars		57.8	64.21	55.57	41.84	62.14	56.31	72.47	80.84	70.59	65.71	77.2	73.36

Means followed by the same letters are not significantly different at 0.05 level of probability.

LSD at 5% level for:

Phosphorus =	n.s	0.403
Potassium =	0.376	0.404
Phosphorus x Potassium =	n.s	0.703
Cultivars =	0.319	0.485
Phosphorus x Cultivars =	0.549	n.s
Potassium x Cultivars =	0.549	n.s
Phosphorus x Potassium x Cultivars =	0.950	1.459

Table (7). Seed yield (ton/ha) as affected by phosphorus, potassium fertilization levels and faba bean cultivars during 2013-2014 and 2014-2015 seasons.

phosphorus Levels (kg P_2O_5/ha)	Potassium Levels (kg K_2O/ha)	Seed yield(ton/ha)											
		2013-2014						2014-2015					
		Cultivars						Cultivars					
		Libyan1	Giza843	Nubariah3	Giza716	Sakha1	Mean	Libyan1	Giza843	Nubariah3	Giza716	Sakha1	Mean
0	0	1.86	1.87	2	1.41	1.38	1.7	1.75	1.77	1.77	1.56	1.58	1.69
	57	2.24	2.06	2.19	1.93	2.02	2.09	2.00	1.89	1.84	1.59	1.67	1.8
	114	2.24	2.14	2.49	2.05	2.05	2.19	2.00	1.91	2.01	2.04	2.03	2
	Average	2.11	2.02	2.23	1.80	1.82	2.00	1.92	1.86	1.87	1.73	1.76	1.83
37	0	2.25	2.40	2.51	2.30	2.06	2.3	2.13	2.03	2.11	2.08	2.07	2.08
	57	2.43	2.42	2.57	2.40	2.21	2.41	2.17	2.19	2.30	2.17	2.09	2.18
	114	2.50	2.54	2.57	2.56	2.25	2.48	2.31	2.29	2.38	2.18	2.12	2.26
	Average	2.39	2.45	2.55	2.42	2.17	2.40	2.20	2.17	2.26	2.14	2.09	2.17
74	0	2.64	2.73	2.66	2.65	2.40	2.62	2.34	2.34	2.64	2.21	2.25	2.36
	57	2.80	2.75	2.88	3.12	2.43	2.8	2.53	2.39	2.64	2.45	2.26	2.45
	114	2.88	2.87	2.98	3.30	2.77	2.96	2.71	2.96	2.92	2.58	2.60	2.75
	Average	2.77	2.78	2.84	3.02	2.53	2.79	2.53	2.56	2.73	2.41	2.37	2.52
Potassium Levels (kg k_2O/ha)	0	2.25	2.33	2.39	2.12	1.95	2.21	2.07	2.05	2.17	1.95	1.97	2.04
	57	2.49	2.41	2.55	2.48	2.22	2.43	2.23	2.16	2.26	2.07	2.01	2.15
	114	2.54	2.52	2.68	2.64	2.36	2.55	2.34	2.39	2.44	2.27	2.25	2.34
Average for Cultivars		2.43	2.42	2.54	2.41	2.18	2.4	2.21	2.2	2.29	2.1	2.08	2.18

Means followed by the same letters are not significantly different at 0.05 level of probability.

LSD at 5% level for:		
Phosphorus=	n.s	n.s
Potassium=	0.21	0.188
Phosphorusx Potassium =	n.s	0.325
Cultivars =	0.250	n.s
PhosphorusxCultivars =	n.s	n.s
PotassiumxCultivars =	0.434	n.s
Phosphorus x Potassium x Cultivars =	0.749	0.524

Table (8).harvest index (%) as affected by phosphorus, potassium fertilization levels and faba bean cultivars during 2013-2014 and 2014-2015 seasons.

Phosphorus Levels (kg P_2O_5/ha)	Potassium Levels (kg K_2O/ha)	Harvest index(%)											
		2013-2014						2014-2015					
		Cultivars						Cultivars					
		Libyan1	Giza843	Nubariah3	Giza716	Sakha1	Mean	Libyan1	Giza843	Nubariah3	Giza716	Sakha1	Mean
0	0	31.70	26.39	30.74	22.47	19.08	26.08	27.39	19.87	26.33	15.44	19.78	21.76
	57	33.71	33.09	32.71	24.36	24.79	29.73	27.89	25.26	29.29	25.57	21.2	25.84
	114	34.30	33.36	33.29	28.79	27.22	31.39	29.54	27.09	29.7	27.84	27.44	28.32
	Average	33.24	30.95	32.25	25.20	23.70	29.07	28.27	24.07	28.44	22.95	22.87	35.31
37	0	36.69	35.44	38.23	33.77	28.35	34.5	30.49	30.06	29.75	28.47	27.74	29.3
	57	37.68	35.86	41.42	34.75	34.13	36.77	30.89	30.41	32.25	29.82	28.84	30.44
	114	38.21	36.12	41.68	36.19	35.84	37.61	31.84	31.82	33.92	33.57	29.04	32.04
	Average	37.53	35.81	40.44	34.90	32.77	36.29	31.07	30.76	31.97	30.62	28.54	30.59
74	0	38.71	37.07	42.12	40.09	38.72	39.34	34.49	34.5	35.14	32.33	30.65	33.42
	57	41.58	40.13	42.86	41.05	39.90	41.1	38.07	36.66	35.93	36.07	34.82	36.31
	114	42.02	45.38	42.91	43.86	42.44	43.32	38.24	37.83	44.98	38.92	34.93	38.98
	Average	40.8	40.9	42.63	41.7	40.4	41.26	36.93	36.33	38.68	35.77	33.47	36.24
Potassium Levels (kg k_2O/ha)	0	35.7	32.97	37.03	32.11	28.72	33.3	30.79	28.14	30.41	25.41	26.06	28.16
	57	37.66	36.36	39	33.39	32.94	35.87	32.28	30.78	32.49	30.49	28.29	30.86
	114	38.18	38.29	39.29	36.28	35.17	37.44	33.21	32.25	36.2	33.44	30.47	33.11
Average for Cultivars		37.18	35.87	38.44	33.93	32.28	35.54	32.09	30.39	33.03	29.78	28.27	30.71

Means followed by the same letters are not significantly different at 0.05 level of probability.

LSD at 5% level for:

	2013-2014	2014-2015
Phosphorus =	n.s	n.s
Potassium =	1.888	2.856
Phosphorus x Potassium =	3.269	4.947
Cultivars =	2.423	2.886
Phosphorus x Cultivars =	n.s	4.999
Potassium x Cultivars =	n.s	4.999
Phosphorus x Potassium x Cultivar =	7.268	n.s

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الملخص العربي

تأثير معدلات التسميد الفوسفاتي والبوتاسي على بعض أصناف الفول البلدي

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أجريت هذه الدراسة خلال الموسم الشتوي من٢٠١٣/٢٠١٤ إلى ٢٠١٤/٢٠١٥ بمحطة البحوث الزراعية بأبيس التابعة لكلية الزراعة جامعة الإسكندرية (الشاطبي). تهدف هذة الدراسة إلى دراسة تأثير معدلات التسميد الفوسفاتي(صفر،٣٧و 74كجم فو٢أ٥/ هكتار) ومعدلات التسميد البوتاسي(صفر،٥٧،١١٤كجم بو٢أ/ هكتار) على خمسة أصناف من الفول البلدي وهي (سلالة محلية ليبي، جيزة٨٤٣، نوبارية٣، جيزة٧١٦، سخا١) وتأثير ذلك على صفات النمو والصفات المحصولية ومكوناته. نفذت التجارب في التصميم الإحصائي قطع منشقة مرتين في قطاعات عشوائية كاملة بأربع مكررات، حيث وضعت معدلات التسميد الفوسفاتي في القطع الرئيسية ومعدلات التسميد البوتاسي في القطع المنشقة والأصناف في القطع الصغيرة. تمت دراسة صفات النمو والصفات المحصولية التالية:

صفة معامل المساحة الورقية و معدل النمو المحصولي و وزن ١٠٠ بذرة و عدد القرون/نبات و عدد البذور/نبات ومحصول البذرة/ هكتاروكذلك معامل الحصاد.

أوضحت النتائج أن تأثير معدلات التسميد الفوسفاتي كان معنويا لكل من معامل المساحة الورقية وعدد القرون/نبات في كلا الموسمين، و معدل النمو المحصولي و وزن ١٠٠ بذرة و عدد البذور/ نبات في الموسم الثاني. كذلك أظهرت النتائج أنه كان هناك تأثير معنوي لمعدلات البوتاسيوم لكل من معدل النمو المحصولي و وزن١٠٠ بذرة وعدد القرون/نبات في الموسم الأول. وكان هناك اختلافات معنوية بين الأصناف في معظم الصفات المدروسة في كلا الموسمين ماعدا صفة المحصول البذري في الموسم الثاني. كان هناك تفاعل معنوي بين كل من معدلات التسميد الفوسفاتي والبوتاسي على صفة معامل المساحة الورقية وعدد القرون/نبات وعدد البذور/نبات والمحصول البذري في الموسم الثانيو معدل النمو المحصولي و وزن ١٠٠ بذرة ومعامل الحصاد في كلا الموسمين. أما التفاعل بين الأصناف مع معدلات التسميد الفوسفاتي فكان معنوياً في صفة معامل المساحة الورقية و معدل النمو المحصولي و وزن ١٠٠ بذرة و عدد القرون/ نبات في كلا الموسمين ماعدا صفة عدد البذور/نبات في الموسم الأول ومعامل الحصاد في الموسم الثاني. وكان التفاعل الثلاثي معنوياً لكل الصفات المدروسة ما عدا صفة معامل المساحة الورقية في كلا الموسمين ومعامل الحصاد في الموسم الثاني.

Quality and Stability of Liquid Smoked Kapreeta Fish During Refrigerated Storage

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ABSTRACT: In Egypt, Kapreeta fish (like tuna) as marine fish, is not appreciated among Egyptian consumers because it is bloody dark flesh and presence of many blood vessels. Therefore, this kind of fish must be utilized as fish products through different preservation methods as canning and smoking.

The aim of this study is to investigate the effects of liquid smoking and essential oils prior smoking on the quality of smoked kapreeta fish fillets just after smoking and during refrigerated storage up to 90 days. Proximate composition was determined in fresh and smoked fish fillets. Chemical, microbiological and sensory analyses of the samples as well as fatty acids composition of fresh and smoked kapreeta fish fillets were carried out during the storage to test their quality and lipid stability. Moisture content decreased while protein, lipid and ash increased after smoking. The pH values were slightly increased by storage time. Total volatile basic nitrogen, trimethyl amine nitrogen, peroxide values, thiobarbituric acid, free fatty acids and total viable count values were increased more in untreated fish samples than smoked fish samples treated with thyme or sage essential oils, while sensory scores decreased during storage. The total polyunsaturated fatty acids content was 35.14% of total fatty acids in untreated smoked fish and 35.80% in treated samples with 5% thyme oil and 36.14% in treated samples with 5% sage oil prior to smoking, with eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) being the prominent polyunsaturated fatty acids. The decrease of PUFAs may indicate the oxidation of these unsaturated fatty acids during storage. Such changes were not observed in sage or thyme extracts treated lots.

According to the results of physicochemical, microbiological and sensory analyses, it was found that untreated smoked kapreeta fish samples were in high quality and lipid stability for 30 days under refrigerated storage and smoked kapreeta fish samples treated with 5% thyme oil or sage oil were in high quality till 60 and 75 days under refrigerated storage. It can be concluded that kapreeta fish fillets treated with sage and thyme essential oils prior to liquid smoking have positive effect on quality and shelf life of smoked fish as well as induced the stability of fatty acids profiles without altering their composition and minimize oxidation.

Key words: Kapreeta fish, quality, shelf life, smoked fish, essential oils, Chemical and microbiological analyses, sensory evaluation

INTRODUCTION

Fish constitutes a very important component of diet for many people, and often provides much needed nutrients for human health. Fish serves as a principal source of dietary protein, which is very inexpensive in relation to other protein foods (Fawole *et al*., 2007).

Fish is known to contain high quality of lipids. The long chain polyunsaturated fatty acids (PUFAs), especially the n-3 PUFAs family including eicosapentaenoic acid (EPA or 20:5 n-3), docosapentaenoic acid (DHA or 22:6 n-3) present in marine lipids have beneficial health effects (Osman *et al*., 2001, Boran *et al*., 2006, Stołyhwo *et al*., 2006 and Karlsdottir *et al*., 2014).

Fresh fish have soft tissues and high amount of water and this enhances its susceptibility to microbial contamination (Olayemi *et al*., 2012). So that fresh fish is highly perishable and various preservation techniques such as chilling, freezing, drying, salting, and smoking have been used universally to extend shelf life. In developing countries, the most affordable and widely used fish preservation methods are drying and smoking (Oduor-Odote *et al.*, 2010a,b and Darvishi *et al.*, 2013).

Smoking of fish is one of the most ancient processing technology and one of many different preservation methods. Smoking is commonly carried out at temperatures of 70–80℃ (Marc *et al.*, 1997 and Erkan *et al.*, 2011). In contrast, cold smoking is achieved without thermal treatment usually at temperature ≤ 30℃ (Goulas and Kontominas, 2005). Smoked fish products are commonly salted. The use of salt is essential to complement the bacterial inhibitory effect of smoke by reducing water activity. For health and acceptability reasons, the practice is to have products with low salt content. Nevertheless, one of the problems faced in smoking process is no standard process implemented yet so that the quality of smoked fish produced can change. Different smoking temperature, different smoking duration, different number of smoking materials, different quality of smoking material, and different water content have caused different quality of smoked fish produced affecting the consumer's demand level (Oduor-Odote *et al.*, 2010a,b and Salindeho and Mamuaja, 2015)

Liquid smoke is a natural smoke from plant based material which has been condensed into a liquid and then refined to remove certain toxic compounds from it. Liquid smoke is used in several applications on meat and fish to impart the flavour, colour and preservative characteristics of natural smoke devoid of the toxic tar compounds (Varlet *et al.*, 2010). These may be used to preserve quality and ensure safety of foods (Martin *et al.*, 2010). The use of liquid smoke has several advantages over traditional smoking procedures having no detectable levels of benzo α-pyrene and no mutagenic activity. Liquid smoke performs all the desired functions, allows more rigid flavor control and has the added advantages of lowering costs, less environmental damage and greater availability and variety of application methods (Dillon *et al.*, 1994). The liquid smoke is applied on the food by either marinating, drenching, spraying or injecting the food with the liquid smoke before heat processing. The liquid smoke can also be applied to the food through liquid smoke coatings or liquid smoke nets (Jenkins, 2010). The use of liquid smoke has been shown to be four to five times more efficient in converting wood biomass to useable smoke than the traditional smoking process (Red Arrow, 2014).

Although smoking increases shelf life of the fish products, hygienic standards of the fish products before, during and after smoking are suspects. However, investigations have shown the presence of microbial contaminants even on smoked fish (Nyarko *et al.*, 2011). Most of the post processing microbial contaminants such as bacteria and fungi originate from poor handling practices while some could be from the air, the source of the fish, or from other degrading substances.

Oxidation of lipids that occurs in fish during processing, heat treatment, and in the final products during subsequent storage, is one of the basic processes causing rancidity in fish products (Donelli and Robinson 1995). Such oxidative deterioration may affect on the quality and the organoleptic characteristics, including taste and aroma making the final product unacceptable for consumption. Therefore, several investigations have been undertaken with the aim to enhance the shelf-life extension, the stability of lipid containing products and food quality.

The use of synthetic antioxidants such as butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA) has been very effective in controlling rancidity (Frankel, 1993 and Karpinska *et al.* 2001). However, synthetic antioxidants have frequently been associated with certain health problems (Thompson and Trush, 1986 and Siripongvutikorn *et al*., 2009). This has necessitated the use of natural antioxidants, such as spices, herbs, and vegetable extracts in the prevention of rancidity in chilled and smoked fish (Kahkonen *et al*., 1999 and Patrick-Iwuanyanwu *et al*., 2007) due to their antioxidant and antimicrobial properties (Akhtar *et al.* 1998 and Abdel-Hamied *et al*., 2009). The spices, notably the Lamiaceae family, are well known for their antioxidative properties, especially rosemary, sage and thyme, which have been reported to have strong such characteristics (Aruoma *et al*., 1992, Al-Flailih, 2009).

Thyme has been commonly used as a spice to add flavor to food (Maksimovic *et al*., 2008). The phenolics monoterpene, thymol and carvacrol are the main compounds have identified with significant antioxidant and antibacterial activities (Lacroix *et al.* 1997 and Viuda-Martos *et al*., 2008).Sage extracts have exhibited potent antioxidant activity and are widely used in the food industry. The antioxidant activity of sage extracts has been associated with the presence of several phenolic diterpenes such as carnosic acid, carnosol and rosmarinic acid which break free radical chain reactions by hydrogen atom donation (Basaga *et al*., 1997). A number of researchers have reported the effectiveness of sage extracts for achieving higher sensory scores and retarding lipid oxidation in various foods (Stoick *et al*., 1991 and Zaki, 2010).

In Egypt, Kapreeta fish (like tuna) as marine fish, is not appreciated among Egyptian consumers because it is bloody dark flesh and presence of many blood vessels. Therefore, this kind of fish must be utilized as fish products through different preservation methods such as canning and smoking (Abou Tor, 2002 a,b and Korish *et al*., 2008).

The objective of the present work was to study the effect of liquid smoking on the quality and lipid stability of Kapreeta fish fillets treated with essential oils of sage and thyme as natural antioxidants during refrigerated storage.

MATERIALS AND METHODS

Materials

Kapreeta fish (*Scombromous* spp.) like Tuna was purchased from the Max Bay, Alexandria during the summer season of 2015. Fish samples (six fish with 30 kg) transported in iceboxes to fish Processing and Technology laboratory, National Institute of Oceanography and fisheries, Alexandria.

Sensory Evaluation of raw fish included eye, gill, belly and texture were carried out.
Liquid smoke composition was 90% water, 2% phenols, 4% acids, 3% carbonyl and 1% tar.
All chemicals used for analysis were of analytical grade.

Methods
1. Preparation of fish samples

Fish samples were washed with tap water, beheaded, eviscerated, skinned and filleted. After traces of blood were removed by tap water, one hundred and twenty (120) fillet samples were prepared as steaks with the dimension of 10 cm (length), 5 cm (width) and 1.5 cm (thickness). The weight of each fillet sample was 135 ± 5 g.

2. Extraction of essential oils

Fresh thyme and sage obtained from Siwa Oasis were properly cleaned, washed and ground. Essential oils were extracted by hydrodistillation procedure as described by Balbaa *et al.* (1981) and modified by Iheagwara, (2013). The essential oils were dried over anhydrous sodium sulphate and stored at 5 °C for further analysis.
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3. Liquid smoking of fish fillet samples and storage

The cleaned, brined and spiced fish samples were soaked for 30 min in 1000 ml of diluted liquid smoking solution (300 ml concentrated liquid smoke + 700 ml water in rectangle glass Jar) containing 0.0% (control), 5.0% and 10.0% of thyme essential oil (60 fish fillet samples) or sage oil at the same concentrations (60 fish fillet samples) with 10% salt. Hot smoking was carried out with liquid smoke, essential oils and salt at a temperature of 80 ± 2°C for 3 hours.Samples were stored at refrigerated temperature (5 ± 1°C) for three months and samples were analyzed every 15 days. Chemical and microbial analysis and organoleptic evaluation were determined.

4. Physico-Chemical Analysis
1. Salt Content

Sodium chloride content in smoked fish samples was determined by volumetric method of Volhard (AOAC, 1990).

2. Determination of pH

pH value was estimated according to Goulas and Kontominas (2005) as follows. Ten g of sample was homogenized in 100 ml of distilled water and the mixture was filtered. The pH of filtrate was measured using a pH meter (HANNA pH213) at ambient temperature.

3. Proximate Composition

Proximate composition included moisture, protein, fat and ash contents of the fresh and smoked fish samples were determined using the standard methods of AOAC (2007).

4. Determination of Total Volatile Basic Nitrogen (TVB-N)

Total Volatile Base Nitrogen (TVB-N) value was estimated by the semi-micro distillation procedure (AMC, 1979; Kirk and Sawyer, 1991). The bases are steam distilled into standard acid and back-titration with standard alkali.

5. Determination of Trimethylamine Nitrogen

Trimethylamine Nitrogen (TMAN) was determined using the above mentioned TVBN method after appropriate modification: formaldehyde was used to block the primary and secondary amines (AMC, 1979).

6. Extraction of Lipids

Lipid was extracted from the mixed smoked fish samples with a mixture of chloroform / methanol (2: 1 v/v) according to the method described by Folch *et al*. (1957).

7. Determination of 2-Thiobarbituric Acid (TBA)

2-Thiobarbituric acid (TBA) value of smoked fish samples was determined colorimetrically by using the method published by Kirk and Sawyer (1991).

8. Determination of Peroxide Value

Peroxide value (PV) was expressed in unit's meq / kg lipid was determined by the titration method (Kirk and Sawyer, 1991).

9. Free fatty acids

Free fatty acid content of the fish samples was determined according to the method of Kirk and Sawyer (1991). A mixture of diethyl ether (25 mL), ethanol (70% v/v) (25 mL) and 1% phenolphthalein solution (1 mL) was prepared then neutralized with 0.1 M NaOH solution. Two grams quantities of fish samples were blended in the neutral solvent prepared above for about 20 min, and then titrated with 0.1 M NaOH with constant shaking until a pink color was formed which persisted for about 15 s. All samples were analyzed in triplicate and the free fatty acid content was expressed as oleic acid equivalent.

10. Fatty acid composition

Fatty acids Methyl Esters (FAMEs) were obtained by the method described by Metcalfe *et al*. (1966) and modified by Selmi and Sadok (2008). Ten gram of the lipid extract was saponified with 0.5 mol/L NaOH in methanol followed by a methylation in 12% boron trifluoride in methanol (BF_3/MeOH). The methylated sample was then extracted with n-hexane. All of these reactions were performed in quadruplicate for each sample. The resulting methyl esters were analysed by gas chromatography (GC) using an Agilent Technologies chromatograph 6890N (Agilent Technologies, Palo Alto, CA, USA) equipped with a flame ionization detector (FID), a splitless injector and a polar INNOWAX 30 M silica capillary column (0.25 mm i.d. & 0.25 µm film thickness). The temperature of the injector and detector were 220 °C and 275 °C, respectively. Helium was used as a carrier gas with a flow rate of 1.5 ml/min. Peaks were identified by comparison of their retention times with FAMEs standards (SUPELCO). The sequences of fatty acids were ranged according to their chromatographic retention times and the values are given as percentages of the total fatty acids methyl esters.

Microbial analysis

Total bacterial count (TBC) was determined by using Nutrient agar, MacConkey agar, and Potato Dextrose agar media according to the procedures described by APHA (1976). The mould counts in the smoked fish samples were determined, according to the method described by Fawole and Oso (1995).

Sensory quality assessment

Organoleptic attributes of appearance, juiciness, saltiness, rancidity, flavour and general acceptability of the smoked fish samples were evaluated by a 10 selected members. A 9-point hedonic scale was used with 9 for like extremely, down to 1 for dislike extremely (Carbonell *et al.*, 2002). For the evaluation, the samples were rinsed with water for 1 min, covered with aluminum foil, heated in an oven at 80°C for 30 min and allowed to cool at ambient temperature, before presentation to the panelists.

RESULTS AND DISCUSSION

1. Sensory Evaluation of Raw Fish

Score sheet of sensory evaluation used was based on Egyptian Organization for Standardization (2005).Eye, gill, belly and texture of fresh kapreeta (like tuna) fish were tested by five panelists with 10 for highest score. The results are present in Table (1). Samples of raw materials used for study were generally of high organoleptic value with the characteristics of eyes perfectly fresh, convex black pupil, translucent cornea, bright red gills, no bacterial slime, outer slime water-white or transparent, bright opalescent sheen. No reddening along the backbone and no discoloration of the belly flaps. The fish was fresh ‘seaweedy‘ odours with firm, elastic to the finger touch.

2. Proximate composition

Preliminary experiments were carried out on pretreatments with concentrations from 1- 5% sage or thyme extracts prior fish filets liquid smoking. Sensory evaluation recorded that adding 5% of essential thyme oil or essential sage oil to kapreeta fish fillets for 30 min prior smoking were generally of highest organoleptic values.The results of proximate composition are presented in Table (2). Moisture content decreased from 71.75% in fresh fish to 53.28% in liquid smoked kapreeta fish fillet without pretreatment, while decreased to 54.50% in smoked fish fillet pretreated with 5% thyme oil and to 54.74% in smoked fish fillet pretreated with 5% sage oil. The lower moisture content values with the sample might be due to the loss of water during smoking (Asiedu *et al.*, 1991). Industrial specifications for smoked finished products generally are recommended with water content in the fish flesh of less than 65% (Cardinal *et al.*, 2001). Kolodziejska *et al.* (2002) also reported that moisture content of smoked Mackerel was 56.7% while Goulas and Kontominos (2005) reported that the moisture content of smoked chum Mackerel samples varied from 58.1% to 59%.

Moisture content of treated smoked fish fillet was 54.50% and 54.74% for smoked fish pretreated with 5% thyme oil or sage oil, respectively. These results are in agreement with Iheagwara (2013) who found that pretreatment with ginger extract prior smoking effect on moisture content of mackerel fish.
The protein, lipid and ash contents of fresh Kapreeta fish samples were 24.54%, 2.11% and 1.60%, respectively increased after liquid smoking in untreated smoked fish to be 36.15%, 4.13% and 5.84%, respectively. Decrease of moisture content and increase of protein, fats and ash contents due to reduction of moisture were the most prominent changes after smoking (Daramola *et al*., 2007, Bilgini *et al*., 2008 and Al-Reza *et al*., 2015).

Protein content of smoked fish treated with 5% thyme oil (36.90%) or 5% sage oil (37.03%) were slightly increased than untreated samples, while lipid content decreased to 3.40% in smoked fish treated with 5% thyme oil and to 3.02% in smoked fish treated with 5% sage oil. These results are in agreement with Iheagwara (2013) who found that pretreatment with ginger extract prior smoking effect on the increasing of protein and decreasing of lipid content.

3. Quality and lipid oxidation parameters of kapreeta fish fillets

The quality parameters of raw and smoked kapreeta fish fillets are given in Table (3).

1. Salt content

Salt content of the Kapreeta smoked fish sample was analyzed to be 1.75%. Birkeland and Bjerkeng (2005) reported that acceptable salt content of smoked fish was 1.80g and it was increased in experimental sample by increasing the time of salting. Jittinandana *et al*. (2002) found that salt content of products soaked in higher brine concentration was greater than of those from the lower brine concentration for the same brining time. In this study, the salt content increased during storage of untreated smoked fish and slightly increased in kapreeta fish treated with essential oils prior smoking during storage at 5 ± 1°. This increase in sodium chloride content was oftentimes accompanied by partial dehydration and clear shortage of free water (Dessoiki, 1971 and El-Akeel, 1988).

2. pH

The pH of fresh kapreeta (like tuna) fish flesh was approximately neutral (6.4) which decreased to 6.1 after smoking (Table 3). This decrease could be due to the presence of different smoke components like acids which get deposited on the fish during the smoking process. These values are partially in agreement with that of Goulas and Kontominas (2005) who found that a pH value of 6.22 for smoked chub mackerel. pH slightly increased during storage. The increase in pH may be attributed to the decomposition of nitrogenous compounds and the production of volatile basic components such as ammonia, trimethylamine and total volatile nitrogen by fish spoilage bacteria which indicates a loss of quality (Ruiz-Capillas and Moral, 2005, Can. 2011 and Topuz *et al.,* 2014).

3. Total volatile base nitrogen (TVB-N)

Total volatile base nitrogen(TVB-N) is widely used as an indicator of fish spoilage; its increase is related to the activity of spoilage bacteria and endogenous enzymes and TVB-N levels are often used as an index to assess the quality and shelf life of products (Ruiz-Capıllas and Moral 2005, Ozogul *et al.,* 2006 and Ucak *et al.,* 2011).

In the present study, TVB-N of Kapreeta fresh fish was 14.1 mgN/100g and decreased after liquid smoking to be 11.2 mgN/100g in untreated smoked fish fillets and to 9.4 and 8.1 mgN/100g in smoked kapreeta fish fillet treated with 5% thyme oil or 5% sage oil, respectively, prior smoking. This could be associated with lower moisture content and higher salt level which reducing spoilage bacteria growth and activity of endogenous enzymes. Results of current findings showed that on day 0, smoked fish fillets were within the accepted TVBN limits for raw and smoked fish samples, because fish samples had values less than 30 mgN/100 g (Daramola *et al.*, 2007). Pearson (1982) and Connell (1995) reported and also recommended that the limit of acceptability of fish is 20 to 30 mgN/100 g, while Huss (1988) and Kirk and Sawyer (1991) suggested a value of 30 to 40 mgN/100 g as the upper limit. The TVB-N content of fresh chela was found 7.10 mgN/100 g of sample, which is below the level of 35 mgN/100 g, has been suggested as border line for various fish and fish products (Ghaly *et al*., 2010). Values similar to our TVB-N data have been reported for smoked fish (Gokoglu *et al.*, 2004, Kilinc and Cakli, 2005, Can and Ersan, 2013 and Topuz *et al.*, 2014).

During storage period at 5 ± 1 °C, TVB-N values were increased. Untreated smoked Kapreeta fish fillets increased to 23.3 after 15 days and to 32.2 after 30 days and to 48.1 mgN/100 g after 45 days, while smoked kapreeta fish fillet treated with 5% thyme oil increased to 25.3 after 45 days and to 32.1 mgN/100 g after 60 days. On the other hand, smoked kapreeta fish fillets treated with 5% sage oil increased to 27.3 after 60 days and to 33.2 after 75 days and reach to 38.1 mgN/100 g after 90 days storage. The highest TVB-N values were recorded in untreated fish fillets, while the lowest were shown in treated with sage followed by thyme essential oils.

Treated fish fillets with 5% sage oil recorded lowest TVB-N during storage because of the lower bacteria count (Erkan *et al.*, 2011). Sage essential oil has stronger antibacterial effect than thyme essential oil (Mejlholm and Dalgaard, 2002). In the present study, the results establish the effectiveness of thyme and sage essential oils as antioxidants and antimicrobials due to reduction in TVB-N on treated samples as observed in Table (3).

4. Trimethylamine Nitrogen (TMA-N)

Trimethylamine Nitrogen (TMA-N) is produced from Trimethylamine Oxide (TMAO) possible partly by action of intrinsic enzymes but certainly through bacterial action, is the main component responsible for a pleasant "fishy" odor (Rodriguez *et al.*, 1999 and Shakila *et al.*, 2003). In the present study TMA-N content of fresh fish was 5.5 mg N/100 g and decreased after liquid smoking to be 4.2 mg N/100 g in untreated smoked kapreeta fish fillet but increased to 9.8 after 30 days and to 11.4 after 45 days. Treated fish fillets with

5% thyme or sage oils recorded lowest TMA-N during storage at 5 ± 1 °C. Treated samples with 5% thyme oil reached to 8.5 after 45 days and to 9.3 mg N/100 g after 60 days storage and in treated samples with 5% sage oil, TMA-N decreased to 7.1 after 45 days and to 9.4 mg N/100 g after 75 days refrigerated storage. According to the Egyptian Organization for Standardization (2005). for TMN-A values of smoked fish (10 mg N/100 g), smoked kapreeta fish fillets treated with sage oil had higher shelf life followed by thyme oil. Lower production of TMA-N in smoked kapreeta fish samples may be due to the antibacterial properties of thyme and sage essential oils (Erkan, 2012 and Yıldız, 2016).

5. Lipid oxidation parameters

Lipid oxidation is a major quality problem especially in fatty marine species. The highly unsaturated fatty acids found in fish lipids are very susceptible to oxidation. It leads to the development of off odours and off-tastes in edible oils and fat containing foods, known as oxidative rancidity. To evaluate the degree of lipid oxidation, the Thiobarbituric Acid (TBA) and Peroxide Value (PV) were determined. The TBA index value is an index of lipid oxidation measuring MDA content. MDA is formed through hydroperoxides, which are the initial reaction products of polyunsaturated fatty acids with oxygen (Rezaei *et al.*, 2008).

In the present study, PV and TBA of fresh Kapreeta fish fillet were 2.1 meq peroxide/kg fish fat and 1.1 mg malonaldhyde/kg, increased after smoking to be 2.6 meq peroxide/kg fish fat and 2.9 mg malonaldhyde/kg in untreated smoked Kapreeta samples at zero time storage. On the other hand, PV and TBA of treated fish fillets were less than untreated samples (1.9 meq peroxide/kg fish fat and 1.8 mg malonaldhyde/kg treated with 5% thyme oil and to 1.7 meq peroxide/kg fish fat and 1.7 mg malonaldhyde/kg for treated with 5% sage oil). According to Augbourg and Ugliano (2002) and Yanar *et al.* (2007) lipid oxidation was enhanced by method of salting, salting time, smoking and drying method. In the present study lipid, oxidation values were lower than the general PV and TBA limit for smoked fish as mentioned by Egyptian Organization for Standardization (2005). which reported that PV values should not be above 10-20 meq/kg fish fat and TBA values not exceed 4.5 mg malonaldhyde/kg (Frangos *et al.*, 2010 and Emir and Ozpolat, 2013).

During storage period at 5 ± 1 °C, PV and TBA increased more than recorded by Egyptian Organization for Standardization (2005)., untreated smoked fish fillets increased to 15.4 meq peroxide/kg fish fat and 4.6 mg malonaldhyde/kg after 30 days. PV and TBA of treated fish fillets were less than untreated samples (12.5 meq peroxide/kg fish fat and 4.5 mg malonaldhyde/kg after 60 days for 5% thyme oil and 11.4 meq peroxide/kg fish fat and 4.5 mg malonaldhyde/kg for 5% sage oil after 75 days storage).

In food suitable for consumption, the TBA values might reach the upper limit of 7 to 8 mg of MDA kg^{-1} (Emir and Ozpolat 2013); in “perfect material,” the TBA value should be less than 3 mg of MDA/kg, and in “good material,” the TBA value should be no more than 5 mg of MDA kg^{-1}. The TBA values indicate the degree of rancidity of products, and values greater than 3-4 mg of MDA kg^{-1}

indicate a loss of product quality (Papadopoulos *et al*., 2003 and Frangos *et al.,* 2010).

The use of thyme essential oil to protect muscle foods against oxidation has been reported in the literature. Mariutti *et al*. (2008) and Erkan *et al*. (2011) observed that sage oil and thyme oil was an effective means of controlling lipid oxidation in chicken and fish meat, as reflected in thiobarbituric acid reactive substance values. There are two possible reasons for this phenomenon in the effectiveness of this product: 1, reduction in TBARS using thyme and sage is related to peroxide-scavenging enzyme activity, which could reduce unsaturated fatty acid and total unsaturated fatty acid oxidation and 2, some active components in the sage and thyme essential oils may involve desaturase and elongase activities (Mariutti *et al*., 2008).

The initial free fatty acids (FFA) value for fresh kapreeta fish was 1.7% increased after smoking (zero time storage) in untreated smoked fish to 2.9 and to 2.6 and 2.2 oleic acid percentage in treated samples with 5% thyme oil and 5% sage oil, respectively. FFA values increased with storage time (Table 3); however the values in the control samples were higher than other samples during storage. FFA values found to be 4.6% after 30 days in untreated smoked fish and to 4.1 and 4.2 oleic acid percentage in treated samples with thyme or sage essential oils after 60 and 75 days. FFA is said to contribute to off flavor of the product and cause textural alterations by complexing with protein (Al-Reza *et al*., 2015). The results established the effectiveness of sage and thyme essential oils as antioxidants which were greater in activities to inhibit the synthesis of free fatty acid in the treated samples than control samples during refrigerated storage.

6. Fatty acids composition

Fatty acids composition of fresh and smoked kapreeta fish fillets during refrigerated storage are presented in Tables (4). In fresh kapreeta fish, polyunsaturated fatty acids (PUFAs) constitute the majority of the fatty acids composition (36.23% of total fatty acids), followed by saturated (33.07% SFAs) and monounsaturated fatty acids (30.70% MUFAs). The total polyenes content included eicosapentaenoic acid 20:5 (n-3) (EPA) and docosahexaenoic acid 22:6 (n-3) (DHA) were being the prominent polyunsaturated fatty acids. In smoked kapreeta fish, saturated (SFAs) constitute the majority of the fatty acids composition (37.26% of total fatty acids), followed by polyunsaturated fatty acids (35.14% PUFAs) and monosaturated fatty acids (27.60% MUFAs). Fatty acid profiles were followed and observed after storage. SFAs and MUFAs levels increased more while PUFAs levels deceased more in untreated samples during refrigerated storage.

The decrease of PUFAs percentage may indicate the oxidation of these unsaturated fatty acids during storage. Such changes were not observed in sage or thyme treated lot. The uses of natural antioxidant in fish fillets have induced the stability of fatty acids profiles without altering their composition and minimize oxidation. These results are in accordance with those reported by Serdaroglu and Felekoglu (2005). Due to their high degree of unsaturation, EPA and DHA are readily oxidized. Such characteristic has suggested the use of the polyene index [(EPA + DHA)/16:0] and PUFAs/SFAs to evaluate oxidative deterioration of polyunsaturated fatty acid in fish lipids (Wada and Fang, 1992 and Rahimabadi *et al*., 2016). In this study, the polyene index and PUFAs/SFAs values in control samples decreased from 1.70 % to 1.52 % and from 1.35 % to 1.20 % following 15 days of storage, respectively. No changes were observed in polyene index and PUFAs/SFAs values for thyme treated lot. It has been reported that sardines treated with rosemary extract and onion juice, retained ratio of [EPA + DHA/16:0] statically constant during storage (Serdaroglu and Felekoglu 2005 and Colakoglu *et al*., 2011).

4. Microbial quality

The activity of microorganisms is the most important factor limiting the shelf life of fish and fish products. Total viable count (TVC) is the most common microbiological method aimed to detect and enumerate high proportion of the microbial population as possible. In practice, this usually means mesophilic, aerobic or facultatively anaerobic bacteria, which account for the major part of the microflora in fish. A TVC method can only provide an estimate of the microbial population based on those cells that are recoverable under the test conditions.

TVC of fresh kapreeta fish was 4.2 log10 cfu/g (Table 3) indicating good fish quality, but after the samples were subjected to hot smoking, the TVC was reduced to 2.8 log10 cfu/g in untreated samples and to 1.8 and 1.2 log10 cfu/g in treated samples with 5% thyme and 5% sage essential oils at day 0 of storage. Karra (1978) reported that smoking caused a decrease in total microbial count by an average of 94.7% of the original number in dogfish fillets. This occurrence could be attributed to the effects of dehydration and antimicrobial activity of the smoke constituents besides the high temperature during hot smoking (Rorvik, 2000).

TVC increased exponentially with storage time. At day 15 of storage, TVC in untreated samples was 4.1 log10 cfu/g and increased to 5.6 log10 cfu/g at day 30. On the other hand, TVC in smoked kapreeta fish fillets treated with 5% thyme or 5% sage oils was 2.9 and 2.1 log10 cfu/g at day 15 and increased to 4.5 and 3.3 log10 cfu/g at day 45. Microbial load sharply increased on the 75th day of storage and reached 7.3 and 6.2 log10 cfu/g in both treated smoked fish fillets. TVC is an important criterion for quality evaluation; the maximum recommended bacterial count for good quality products is 5.7 log10 cfu/g, and the maximum recommended bacterial count for marginally acceptable quality products is 7 log10 cfu/g (ICMSF, 1986). Considering these values, it is possible to say that TVCs of smoked kapreeta fish exceeded the microbiological limits of acceptability after 15 days of storage for untreated samples and for 60 days storage for treated samples with 5% thyme oil and 75 days for treated samples with 5% sage oil. Kolodziejska *et al.* (2002) reported that the initial TVCs of hot smoked mackerel were 1.6 log10 cfu/g prior to storage and 4.7 log10 cfu/g after 21 days of storage at 8˚C. These results showed that thyme and sage essential oils having the greatest antimicrobial activity. A number of essential oils and some of their components have been reported to have antimicrobial activity against a wide range of spoilage and pathogenic bacteria (Lambert *et al*. 2001; Burt 2004). Thyme contains high concentrations of phenolic compounds including carvacrol, thymol, pcymene and ɣ-terpinene (Komaki *et al.*, 2015). The thyme and sage essential oils can be considered effectively inhibitory on the total aerobic flora. Similar results were observed by several researchers (Cadun *et al.*, 2008, Duman *et al.*, 2012; Can and Ersan, 2013). According to the results of fish quality and lipid stability, smoked Kapreeta fish fillets treated with 5% sage oil prior smoking recorded highest quality and high shelf life (up to 75 days), followed by fish fillets treated with 5% thyme extract (up to 60 days), while untreated fish fillet recorded the lowest quality and shelf life (from 15 to 30 days).

5. Sensory quality

Sensory evaluation together, with chemical and microbial characteristics have been used extensively to assess the quality of smoked kapreeta fish fillets. Therefore, the effect of storage at refrigerated temperature (5 ± 1°C) on the organoleptic attributes of appearance, flavour, texture and overall acceptability of smoked fillets was studied. Sensory evaluation in this study was conduct by panelists. A nine point hedonic scale was used, a score of nine being the best, one being the worst and four being the borderline of acceptability. The obtained results are shown in Table (5).The appearance of smoked fish is one of the most important organoleptic propertied mainly due to its effect on the acceptability of these product by consumer. Smoked fish fillets showed a good appearance score 8 after smoking at 0 time storage in both untreated and treated smoked fish fillets with %5 thyme or sage essential oils prior smoking. During storage the appearance scores tended to decrease until the smoked samples were completely rejected organoleptically after 30 days for untreated smoked fish samples (5) and after 60 days for smoked fish samples treated with 5% thyme oil (5) prior smoking and after 75 days for smoked fish samples treated with 5% sage oil (5) prior smoking. These data indicated the effect of thyme and sage extracts on the appearance scores acceptability of treated smoked kapreeta fish during storage.

Regarding to the effect of storage on the texture scores acceptability of smoked kapreeta fish fillets, the obtained results illustrated that the untreated texture score and treated with 5% thyme or 5% sage of smoked fish at 0 time storage was 7. The texture scores of smoked kapreeta fish fillets during storage showed the same trend as for appearance scores acceptability.Flavour is a major sensory attribute for smoked fish quality. The specific aroma and taste of smoked fish were formed due to the effect of volatile compounds from smoking and essential oils as sage and thyme extracts. Fresh smoked kapreeta fish fillets (0 time storage) recorded very good flavour (taste and odor). The flavour scores of smoked kapreeta fish fillets during storage showed the same trend as for appearance and texture scores acceptability. It could be observed that the overall acceptability scores of smoked fillets did not alter within 15 days of untreated fish and within 45 and 60 days of treated fish fillets with 5% thyme or 5% sage essential oils prior smoking, respectively. These finding for sensory evaluation were in a good agreement with the chemical and microbial characteristics of smoked kapreeta fish fillets. Similar results have been reported in other recent studies (Ozpolat *et al.,* 2010, Duman *et al.,* 2012, Egbal *et al.*, 2013 and Yildiz, 2016).

CONCLUSION

From the above results, it can be concluded that liquid smoking can significantly influence the physicochemical properties of smoked kapreeta fish fillets by imparting antioxidant and antimicrobial properties and by influencing the sensory attributes.The present work has demonstrated that sage and thyme essential oils have antioxidative and antimicrobial properties that can retard oxidative rancidity and inhibit microbial growth, thus, extending the shelf life of the smoked fish. This is justified by the low TBA and peroxide values, as well as microbial count of the sage or thyme treated samples, compared to the untreated samples. Organoleptically, the general pattern of consumer preference to the products indicates that smoked kapreeta fish fillets treated with sage oil followed by thyme oil samples were most acceptable in relation to storage stability compared with control samples. According to the present results, the shelf life of kapreeta fish fillets was estimated as 15 days for untreated smoked fish and 60 days for smoked fish treated with 5% thyme oil and 75 days for smoked fish treated with 5% sage oil under refrigerator storage. Further research is required to focus on understanding the mechanisms of action, in particular concentrations of active ingredients of both sage and thyme essential oils which applied to liquid smoked fish products.

Table (1). Sensory evaluation of purchased fresh kapreeta (like tuna) fish

Panelist	Specification				
	Eye	Gill	Belly	Texture	Average
1	8	7	8	7	**7.5**
2	8	8	9	9	**8.5**
3	8	7	7	8	**7.5**
4	9	8	9	8	**8.5**
5	8	8	9	9	**8.5**
Average	**8.2**	**7.6**	**8.2**	**8.2**	**8.1**

Table (2). Proximate composition of fresh and liquid smoked Kaprreta (like tuna) fish filets (mean ± SE).

	Moisture (%)	Protein (%)	Fat (%)	Ash (%)
Fresh fish	71.75 ± 2.45	24.54 ± 1.2	2.11 ± 0.40	1.60 ± 0.34
Smoked fish (no treatment)	53.28 ± 1.80	36.15 ± 1.50	4.13 ± 0.66	5.84 ± 0.86
Smoked fish (pretreated with 5% thyme oil)	54.50 ± 1.68	36.90 ± 1.22	3.40 ± 0.46	5.60 ± 0.76
Smoked fish (pretreated with 5% Sage oil)	54.74 ± 1.74	37.03 ± 1.20	3.02 ± 0.36	5.21 ± 0.46

Table (3). Quality and lipid stability parameters of smoked Kaprreta (like tuna) fish filets during refrigerated storage at 5 ± 1 °C for 90 days (mean ± SE)

Storage Period (days) / Fish treatments	Salt (g)	pH	TVB (mgN/100g)	TMA (mgN/100g)	Peroxide value (meq peroxide/kgfat)	TBA (mg malonaldehyde/kg fat)	FFA (oleicacid %)	TVC log10 cfu/g
Fresh fish	1.7 ± 0.02	6.4 ± 0.2	14.1 ± 1.1	5.5 ± 0.2	2.1 ± 0.1	1.1 ± 0.2	1.7 ± 0.1	4.2 ± 0.2
Smoked fish								
No Treatment								
0 days	1.75 ± 0.02	6.1 ± 0.1	11.2 ± 1.2	4.2 ± 0.3	2.6 ± 0.1	2.9 ± 0.2	2.9 ± 0.1	2.8 ± 0.2
15 days	1.78 ± 0.03	6.3 ± 0.1	23.3 ± 1.5	6.6 ± 0.4	8.3 ± 0.1	3.3 ± 0.3	3.3 ± 0.1	4.1 ± 0.2
30 days	1.80 ± 0.03	6.6 ± 0.2	32.2 ± 1.8	9.8 ± 0.4	15.4 ± 0.2	4.6 ± 0.3	4.6 ± 0.1	5.6 ± 0.2
45 days	1.85 ± 0.03	6.7 ± 0.1	48.1 ± 2.2	11.4 ± 0.5	19.8 ± 0.2	5.8 ± 0.4	5.4 ± 0.1	6.8 ± 0.2
60 days	1.85 ± 0.03	6.7 ± 0.1	53.2 ± 2.4	12.6 ± 0.4	24.1 ± 0.3	9.5 ± 0.4	5.9 ± 0.1	8.9 ± 0.2
75 days	1.90 ± 0.03	6.8 ± 0.1	55.8 ± 2.5	14.2 ± 0.4	27.7 ± 0.3	11.7 ± 0.5	6.6 ± 0.1	12.1 ± 0.3
90 days	1.90 ± 0.03	6.9 ± 0.2	58.9 ± 2.5	15.8 ± 0.5	32.8 ± 0.5	13.7 ± 0.5	6.9 ± 0.1	15.8 ± 0.3
5% Thyme oil								
0 days	1.75 ± 0.02	6.1 ± 0.2	9.4 ± 0.8	4.1 ± 0.1	1.9 ± 0.1	1.8 ± 0.1	2.6 ± 0.1	1.8 ± 0.1
15 days	1.75 ± 0.02	6.2 ± 0.1	12.5 ± 1.1	5.6 ± 0.2	3.1 ± 0.1	1.9 ± 0.1	2.2 ± 0.1	2.9 ± 0.1
30 days	1.75 ± 0.02	6.3 ± 0.1	18.4 ± 1.3	7.5 ± 0.3	7.8 ± 0.2	2.2 ± 0.2	2.8 ± 0.1	3.3 ± 0.1
45 days	1.77 ± 0.02	6.4 ± 0.1	25.3 ± 1.5	8.5 ± 0.3	10.5 ± 0.2	3.5 ± 0.2	3.3 ± 0.1	4.5 ± 0.1
60 days	1.78 ± 0.02	6.4 ± 0.1	32.1 ± 1.1	9.5 ± 0.4	12.4 ± 0.3	4.5 ± 0.2	4.1 ± 0.1	4.5 ± 0.2
75 days	1.80 ± 0.02	6.5 ± 0.1	36.2 ± 1.3	11.4 ± 0.4	16.8 ± 0.2	5.3 ± 0.3	5.3 ± 0.1	7.3 ± 0.2
90 days	1.85 ± 0.02	6.6 ± 0.2	43.7 ± 1.4	13.6 ± 0.4	28.8 ± 0.2	6.5 ± 0.2	5.8 ± 0.1	10.3 ± 0.2
5% Sage oil								
0 days	1.75 ± 0.02	6.1 ± 0.2	8.1 ± 0.5	3.7 ± 0.1	1.7 ± 0.1	1.7 ± 0.1	2.2 ± 0.1	1.2 ± 0.1
15 days	1.75 ± 0.02	6.1 ± 0.1	11.1 ± 0.5	4.5 ± 0.1	2.9 ± 0.1	1.8 ± 0.1	1.7 ± 0.1	2.1 ± 0.1
30 days	1.77 ± 0.02	6.2 ± 0.1	15.3 ± 0.7	5.5 ± 0.2	4.7 ± 0.1	2.5 ± 0.1	2.2 ± 0.1	2.6 ± 0.1
45 days	1.79 ± 0.02	6.2 ± 0.1	18.2 ± 1.1	7.1 ± 0.2	7.9 ± 0.1	3.1 ± 0.1	2.8 ± 0.1	3.3 ± 0.1
60 days	1.79 ± 0.02	6.3 ± 0.1	27.3 ± 1.2	8.5 ± 0.3	9.5 ± 0.2	3.4 ± 0.2	3.3 ± 0.1	4.3 ± 0.2
75 days	1.80 ± 0.02	6.4 ± 0.1	33.2 ± 1.4	9.4 ± 0.3	11.4 ± 0.2	4.5 ± 0.2	4.2 ± 0.1	6.2 ± 0.2
90 days	1.82 ± 0.02	6.5 ± 0.2	38.1 ± 2.1	10.8 ± 0.3	15.5 ± 0.2	5.3 ± 0.2	5.2 ± 0.1	7.1 ± 0.2

Table (4). Fatty acid composition of fresh and smoked Kaprreta (like tuna) fish filets during refrigerated storage at 5 ± 1 °C for 90 days Values are % of total fatty acid expressed as mean of three replicates

Fatty acids	Fresh fish	Smoked fish (no treatment)				5% Thyme extract				5% Sage extract			
		0 day	30 days	60 days	90 days	0 day	30 days	60 days	90 days	0 day	30 days	60 days	90 days
12:0	0.80	0.43	0.53	0.85	0.80	0.45	0.48	0.52	0.55	0.43	0.40	0.40	0.45
14:0	5.40	6.30	7.40	7.20	7.25	5.80	6.67	6.65	6.90	5.30	5.90	5.90	6.20
16:0	21.10	23.52	24.58	25.52	25.60	23.50	23.40	24.50	25.40	23.52	23.20	23.75	23.90
18:0	5.22	6.26	7.20	7.50	8.20	6.10	6.30	6.70	6.90	6.26	6.00	6.00	6.65
22:0	0.55	0.75	0.70	0.75	0.70	0.80	0.75	0.75	0.75	0.75	0.75	0.75	0.75
SFAs	**33.07**	**37.26**	**40.41**	**41.82**	**42.55**	**36.65**	**37.60**	**39.12**	**40.50**	**36.26**	**36.25**	**36.80**	**37.95**
16:1 n-7	8.60	8.30	8.00	8.10	8.10	8.10	8.10	8.05	8.00	8.30	8.40	8.40	8.30
18:1 n-9	19.60	17.20	17.00	17.05	17.10	17.15	17.10	17.05	17.00	17.20	17.90	17.80	17.30
20:1 n-9	2.50	2.10	2.05	2.05	2.10	2.45	2.10	2.10	2.05	2.10	2.20	2.20	2.10
MUFAs	**30.70**	**27.60**	**27.05**	**27.20**	**27.30**	**27.55**	**27.30**	**27.20**	**27.05**	**27.60**	**28.50**	**28.40**	**27.70**
18:2 n-6	9.40	9.24	8.74	8.24	8.10	9.20	9.10	8.80	8.50	9.24	9.20	9.10	9.05
18:3 n-3	4.50	3.10	2.80	2.39	2.25	2.90	2.80	2.70	2.65	3.10	3.40	3.30	3.20
20:4 n-3	1.76	1.60	1.50	1.50	1.40	1.50	1.50	1.45	1.40	1.60	1.60	1.60	1.50
20:5 n-3 (EPA)	8.40	5.50	5.10	5.05	5.10	5.80	5.50	5.40	5.10	5.60	5.50	5.30	5.20
22:5 n-3	ND	1.50	1.30	1.40	1.20	1.30	1.50	1.40	1.30	1.40	1.45	1.40	1.30
22:6 n-3 (DHA)	12.17	14.20	13.10	12.40	12.10	15.10	14.70	13.93	13.50	15.20	14.10	14.10	14.10
PUFAs	**36.23**	**35.14**	**32.54**	**30.98**	**30.15**	**35.80**	**35.10**	**33.68**	**32.45**	**36.14**	**35.25**	**34.80**	**34.35**
PUFAs/SFAs	**1.1**	**0.94**	**0.81**	**0.74**	**0.71**	**0.97**	**0.93**	**0.86**	**0.80**	**1.00**	**0.97**	**0.95**	**0.91**

Table (5). Organoleptic quality of smoked kaprreta (like tuna) fish during storage at 5 ± 1 ℃ for 90 days (mean ± SE)

Storage Period (days) / Smoked Fish treatments	Appearance	Texture	Flavour	Overall acceptability
No Treatment				
0 days	8	7	9	8
15 days	6	5	7	6
30 days	4	4	4	4
45 days	3	3	3	3
60 days	2	2	2	2
75 days	1	1	1	1
90 days	1	1	1	1
5% Thyme extract				
0 days	8	7	9	8
15 days	8	8	8	8
30 days	5	6	6	6
45 days	5	5	5	5
60 days	5	5	5	5
75 days	4	4	4	4
90 days	2	2	2	2
5% Sage extract				
0 days	8	7	9	8
15 days	8	8	8	8
30 days	7	7	7	7
45 days	6	6	6	6
60 days	6	6	6	6
75 days	5	5	5	5
90 days	3	3	3	3

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المخلص العربي

جودة وثبات سمك الكبريتة المدخن بسائل التدخين خلال التخزين المبرد

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يتواجد سمك الكبريتة في مصر ضمن الأسماك البحرية ولكن لا يلقي قبولا لدي المستهلك المصري لإغمقاق لون اللحم المشوب بالدم ووجود الدم ضمن خلايا اللحم بالداخل لذا فإن هذا النوع من الأسماك يجب تصنيعه وحفظه بطرق مختلفة منها التعليب والتدخين. الهدف من هذا البحث هو دراسة تأثير التدخين بالسائل والزيوت العطرية الطيارة وإضافتها للسمك قبل التدخين علي جودة لحم سمك الكبريتة خلال التخزين المبرد لمدة ٩٠ يوم. تم تقدير التحاليل الأولية في السمك الطازج والمدخن وكذا التحاليل الكيماوية والميكروبيولوجية والحسية لجميع العينات المدخنة كم تم التعرف على تركيب الأحماض الدهنية خلال مراحل التخزين وذلك لتقدير الجودة وثبات اللبيدات لسمك الكبريتة المدخن.

أوضحت النتائج انخفاض في نسبة الرطوبة وزيادة كل من نسب البروتين واللبيدات والرماد بعد التدخين. وقد ارتفع قليلا قيم pH بالتخزين. كما أوضحت النتائج أن كل من (TVB-N) النتروجين الكلي المتطاير ومركب التراي مثيل أمين (TMA) ورقم البيروكسيد وتقدير حمض الثيوبيوترك (TBA) وكذا الأحماض الدهنية الحرة (FFA) كلها ارتفعت خلال التخزين بشكل أعلي في السمك غير المعامل عن السمك المعامل بالزيوت الطيارة لكل من الزعتر والمريمية وذلك التخزين. بينما انخفضت معدلات التقديرات الحسية خلال التخزين. وقد أوضح تركيب الأحماض الدهنية أن نسبة ٣٥.١٤% أحماض دهنية عالية درجة عدم التشبع متواجد في السمك غير المعامل وازداد إلى ٣٥.٨٠% في السمك المعامل بواسطة ٥% زيت الزعتر وإلى ٣٦.١٤% في السمك المعامل بواسطة ٥% زيت المريمية وكانت أحماض (EPA) إيكوزا بنتا إينويك، (DHA) ديكوزا هيكسا إينويك هي أعلي نسبة للأحماض الدهنية عالية عدم التشبع. وانخفاض مستوي الأحماض غير المشبعة يوضح مدي حدوث الأكسدة خلال مراحل التخزين وكان هذا الانخفاض والتغير في الحد الأدني في عينات السمك المعاملة بالزيوت الطيارة لكل من الزعتر والمريمية قبل التدخين. ووفقا لنتائج التحاليل الكيماوية والميكروبيولوجية والحسية فقد وجد أن سمك الكبريتة المدخن كان له درجة جودة عالية وثبات للبيدات لمدة صلاحية ٣٠ يوم في السمك غير المعامل وازدادت فترة الصلاحية إلي٦٠ يوم في السمك المعامل بزيت الزعتر وازدادت أكثر إلى ٧٥ يوم في السمك المعامل بزيت المريمية تحت ظروف التخزين المبرد.

ويمكن تلخيص أن فيلية سمك الكبريتة المعامل بالزيوت الطيارة للزعتر والمريمية قبل التدخين كان له تأثير إيجابي فعال علي الجودة وفترة الصلاحية للسمك المدخن وكذا الاحتفاظ بثبات الأحماض الدهنية دون التأثير عليها وبالتالي تقليل الأكسدة.

Heat Unit's Applications for Forecasting of Emergence and Population of The Different Developmental Stages of The Pink Bollworm, *Pectinophora gossypiella* (Saund.)

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ABSTRACT: The influence of constant temperatures (20, 25, 30 and 35 ℃) as accumulated heat units (day degrees) on the emergence and stages of development of the pink bollworm (PBW) (*Pectinophora gossypiella*).has been studied under laboratory conditions of the constant temperatures of 20, 25, 30 and 35℃ The observed incubation periods, rate of development, the theoretical lower threshold of development (t_0) and the degree days (DD_S) of each stage were estimated. Generally, the obtained results showed a negative relationship between incubation temperatures (℃) and lengths of incubation periods for all PBW stages. Referring to the constant temperatures, the PBW stage periods were varied between 20℃ and 35℃, hence, They ranged from 7.2 to 2.87, 30.89 to 7.76, 24.4 to 9.83, 4.28 to 1.26, 6.3 to 2.8 and from 6.1 to 2.6 days for eggs, larvae, pupae, pre-oviposition period, oviposition period, post-oviposition period , consequently. The estimated lower threshold temperature (t_0) has been differed according to the developmental stage. The (t_0) values were 10.63, 14.82, 9.28, 12.19, 8.44 and 7.53 ℃ for eggs, larvae, pupae, pre-oviposition, oviposition, post-oviposition periods, respectively. The thermal units as degree days (DD's) were also calculated for each immature and mature stages. The heat unit's accumulations as a part of IPM could be of benefit for forecasting population of the different PBW stages, which were highly important for the predicting pest population and applying insecticides at the optimum time to obtain timely insect control.

Keywords: Heat Unit, Pink Bollworm, Prediction, Accumulated degree days (dd's), Lower threshold (t0).

INTRODUCTION

The Pink bollworm, *Pectinophora gossypiella* (Saund.) [Lepidoptera:Gelechiidae] is one of the most important pests that attacks cotton squares and bolls in Egypt and many countries in the worldwide . Many of the full –grown larvae spend late autumn, winter and early spring in the form of diapausing larvae inside cotton seeds and dry bolls. The emerging moths are considered as a source of renewing infestation to the new cotton crop next year Rashad (1992).

The timing of emergence is a critical point in the life history of any pest; It is the beginning of the life cycle that seriously cause crop damage and to yield loss. The influence of temperature in determining the emergence and development of insect Population was well established (Eckenrode and Chapman, 1972; Lves, 1973; Aliniazee 1976; Riedl *et al*., 1976 and Toscano *et al* ,1979). Thermal unit or effective day-degrees accumulation system has implications for pest management well as well as areas of applied entomology. The degree – days system is a fundamental basis for temperature–dependent population models, which have been widely used for prediction of population events of many insect species (Whalon and Smilowitz ,1979).

Application of heat unit accumulations and the pink bollworm were discussed by several authors (Gutierrez *et al*; 1977 ; Watson 1980; Gutierrez *et al;*1981 and Metwally *et al* ;1996).

A method of heat summation reported by Sevacherian *et al;* (1977) was utilized to predict the spring pattern emergence of the pink bollworm by monitoring daily maximum and minimum temperatures and summing heat unit (i.e., degree – days). Accumulating degree- days has been proved to be the accurate means for forecasting cumulative pink bollworm moth emergence under both cage and field conditions in Imperial Valley, California, USA, for four years (Sevacherian *et al.,* 1977). Toscano *et al*. (1979) mentioned that no significant difference at the 90% level in PBW population peaks between insecticides treated and untreated fields, thus treated and untreated field were compared and used for peak prediction by thermal summation.

In Egypt, many authors' applied the heat unit applications for forecasting the emergence of many insect pests, some of those are: (Al-beltagy, 1999(1,2) and Yones *et al*., 2011). The present work as a part of series of studies that had been subjected to the forecasting of PBW emergence and population dynamics and to related study the effectiveness of different constant temperature degrees on both immature and adult stages of *P. gossypiella* for estimating their theoretical development thresholds (t0) and the accumulated thermal units (K) required to complete development of each stage.

MATERIAL AND METHODS

Eggs of the pink bollworm *P. gossypiella* were obtained from the Division of Bollworms, Plant Protection Research Institute, Agric. Res. Center, Egypt resulting from susceptible strains reared in the laboratory for at least twenty generations on an artificial diet.

The pink bollworm (PBW) stages were kept under the four constant temperatures of 20, 25, 30 and 35 °C to determine the rate of development. Eggs were transferred to glass vials (2.0 X 7.5 cm); four replicates of 25 eggs / each were used for each of the assigned temperatures. Observations were made daily to record the time of hatchability. To study the larval development, 100 newly hatched larvae were transferred, each in a separate glass tube (7.5 x 2.5 cm.) 25 larvae/replicate as (4 replicates). The larvae were left in the vials until pupation. Daily observations were made to count the pupated larvae, larval developmental rate and duration and recorded.

Newly formed pupae were collected on the same day of pupation and placed in glass tubes (one pupa for each) and plugged tightly with a piece of cotton wool. Four replicates (25 pupae, each) were placed at each of the tested temperature and observed daily till adult emergence. After being sexed, the newly emerged moths of each group resulted from the same temperature were isolated in pairs, one pair for each kept in a separate tube (15 cm long - 5 cm diam.) opened at each end, provided with a small piece of absorbent cotton wool previously soaked in 20% sucrose solution for adult feeding. The two ends of each tube were covered with a piece of cotton, secured rubber band, and a small strip of muslin cloth was put as a suitable site of oviposition. Five replicates, each has 2 adults (1 male +1 female), were tested at each tested temperature. Daily observations were made to record the adult survival.

Duration of different stages and other biological aspects were recorded for each temperature degree. Data obtained in the present work were subjected to the statistical analysis by t-test.

The rate of development for *P. gossypiella* stages (eggs, larval, pupae and adults) and other biological aspects { pre-oviposition period, oviposition period, and post- oviposition period} were also determined by the simple formula ($1/t \times 100$) for the considered temperatures .

To determine the threshold of development (zero of development) of the different stages of *p. gossypiella,* the duration of those stages at 20,25, 30 and 35°C were calculated . Threshold of development (t0) for each immature and mature stages, was established as the point at which the extended velocity – temperature line meets the abscissa. This line was previously gained by regressing development velocity against temperature according to the regression formula:

$$Y = a + b\,x$$
$$(t0) = -a / b \quad \& \quad K = 1 / b$$

On the other hand, the required thermal units (K) for complete development of each stage were determined according to the equation of thermal summation (Blunk, 1923):

$$K = y\,(T - t0)$$

Where y = developmental duration of a given stage; T= temperature in degree centigrade; t0 = lower threshold of development and K = thermal units (Degree-Days (DD's).

Statistical analysis:

Replicates means were computed and the obtained data were statistically analyzed, using the analysis of variance (ANOVA) to know the significance of differences among treatments. The least significant differences between treatments (L.S.D.) were determined according to Duncan (1955).

Regression equation and confidence limits were calculated according to probit analysis computer program (Finney 1971). Regression equations was also applied to predict mortality percentages (Y) for any applied concentration (X), whereas (a) was the intercept from (Y) axis and (b) slop of the linear regression

RESULTS AND DISCUSSION

Effect of certain constant temperatures on *P. gossypiella*, with reference to its requirements and developmental stages:

1. Egg stage

The presented data shown in Table (1) indicated the effect of 4 constant temperatures and their thermal requirements on the egg stage of the *P. gossypiella.* Figure, (1) also illustrated the regression line that represented the relationship between temperature degrees (℃) and corresponding incubation periods (day) for PBW eggs.

Results revealed that the embryogenesis periods of PBW eggs varied from 7.2 days at 20℃ to 2.87 days at 35℃, with an average of 4.67 days. Additionally, the corresponding rate of development varied from 13.89% to 34.84%, respectively.

The obtained data showed that there was a negative relationship between embryogenesis periods and degrees of temperatures (℃), while the relationship between temperatures (℃) and rate of development (%) was positive. These relationships were calculated by applying the regression equation between temperatures (℃) (X-axis) and rate of development (Y- axis), which has been obtained by (Y= 1.44(X)-15.28).

The obtained lower threshold temperature for egg stage development (t_0) was (10.63 ℃). The thermal units (resembled by K) of the degree days (DD's) that required for egg development had been obtained by applying its equation (K = 1/b). Meanwhile, the average of these thermal units (DD's) was 69.60. Where, (t_0) = -a/b for the lower threshold temperature and K= 1/b for the degree days (DD's). The least DD's was 67.43 resulting from the incubation temperature of 20℃. Accordingly, the required thermal units for egg stage were 67.43, 73.26, 67.78 and 69.93 for 20, 25, 30 and 35 ℃, consequently, with an average of 69.60 ℃.

Table (1). Development of *P.* gossypiella egg's stage under the different constant temperatures and thermal requirements.

Temp. (℃)	Observed		Expected		(t_0˚C)	Degree Days (DD´s)
	Incubation Period (days)	Rate of Development %	Incubation period (days)	Rate of development %		
20	7.2[a]	13.89	7.43	13.45		67.43
25	5.1[b]	19.61	4.85	20.64	**10.63**	73.26
30	3.5[c]	28.57	3.59	27.82		67.78
35	2.87[c]	34.84	2.86	35.00		69.93
Average	**4.67**	**24.23**	**4.68**	**24.23**		**69.60**
L.S.D 0.05	**0.716**					

* Means followed by the same letter(s) in each column are not significantly different at P ≤ 0.05 level.

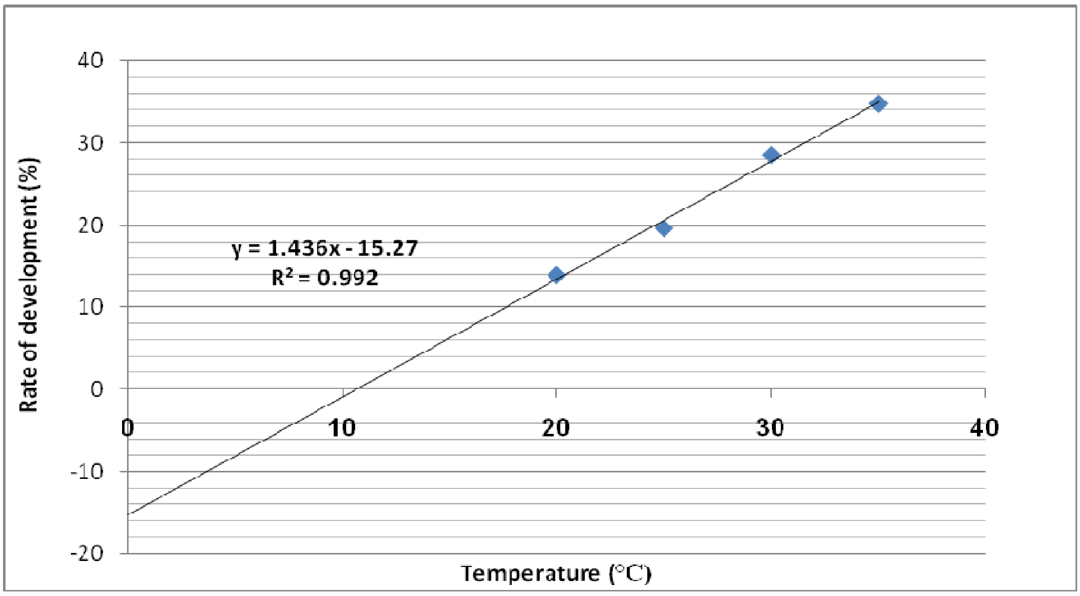

Figure (1). Regression line of the relationship between Temperature (°C) and the corresponding rate of development (%) for PBW eggs.

2. Larval stage

Results in Table (2) included the effect of the constant temperatures on the duration period of PBW larval stage and its thermal requirements. Figure (2) illustrate also the regression line representing the relationship between temperature degrees (°C) and corresponding incubation periods (day) for PBW larvae.

The data revealed that the periods of PBW larvae varied from 30.89 days at 20°C to 7.76 days at 35°C, with an average of 16.14 days. Correspondingly the rate of development varied from 3.24 % to 12.89 %, in respect.

Furthermore, the data approved that there was a negative relationship between larval stage periods and degrees of temperatures (°C). Conversely, the relationship between temperatures (°C) and rate of development (%) was positive that resulted statistically from applying the obtained regression equation (Y= 0.63 X -9.34) between temperatures (°C) (X-axis) and rate of development (Y- axis.).

The obtained lower threshold of larval development (t_0) was (14.82 °C) as obtained from the regression line of the relationship between temperature (°C) and corresponding incubation periods (day) for PBW larvae in Fig. (2), where (t_0)=-a/b. The degree days (DD's) required for development were also estimated using its equation (K= 1/b). The average of these thermal units (DD's) was 158.70 (Table, 2 and Figure, 2).

Table (2). Development of *P.* gossypiella larvae and thermal requirements under different constant temperatures.

Temp.(°C)	Observed		Expected		(t_0°C)	Degree Days (DD´s)
	Larval duration (days)	Rate of Development %	Larval duration (days)	Rate of development %		
20	30.89[a]	3.24	30.60	3.27		160.15
25	15.05[b]	6.64	15.58	6.42		153.28
30	10.85[c]	9.22	10.45	9.57	**14.82**	164.75
35	7.76[d]	12.89	7.86	12.72		156.63
Average	**16.14**	**8.00**	**16.12**	**8.00**		**158.70**
$L.S.D_{0.05}$	**2.483**					

* Means followed by the same letter(s) in each column are not significantly different at P ≤ 0.05 level.

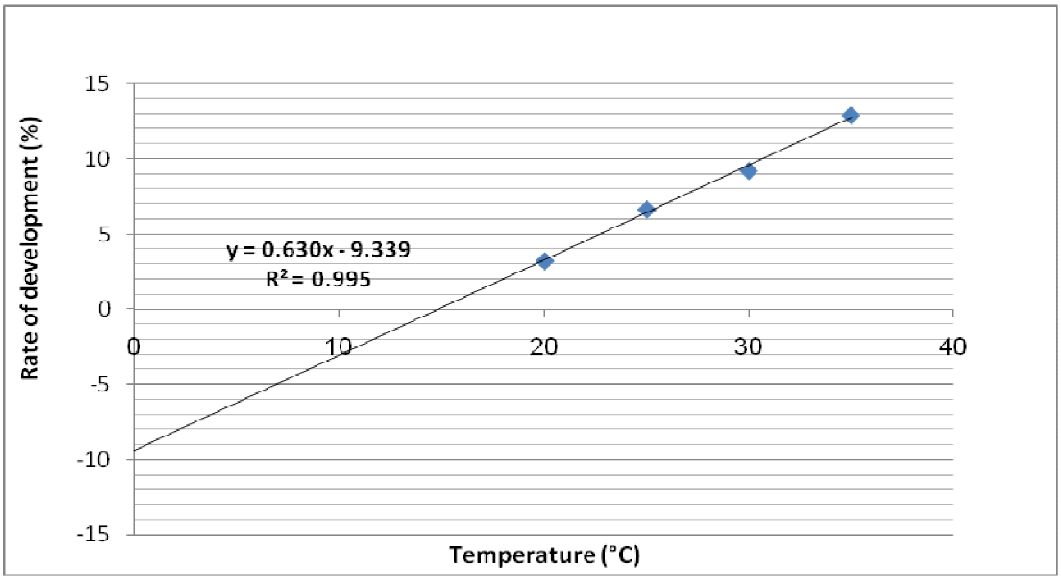

Figure (2). Regression line of the relationship between temperature (°C) and the corresponding rate of development (%) for PBW larvae.

3. Pupal stage

Table (3) exhibited the pupal periods of PBW that varied from 24.4 day at 20°C to 9.83 days at 35°C, with an average of 15.21 days. Likewise, the corresponding rate of development varied from 4.10 % to 10.17%, respectively.

Employing the obtained regression equation (Y= 0.41(X) - 3.77) between temperatures (°C) and rate of development indicated that there was a negative relationship between incubation periods of pupal stage and the constant temperature degrees (°C), while the relationship between temperatures (°C) and rate of development (%) was positive.

Moreover, the developmental zero (t_0) for this stage was (9.28 °C). Also, the required average of these thermal units as degree days (DD's) for development was 247.56 (Table, 3 and Figure, 3).

Table (3). Development of *P. gossypiella* pupae and its relation with thermal requirements under different constant temperatures.

Temp. (℃)	Observed		Expected		(t_0˚C)	Degree Days (DD´s)
	Pupal duration (days)	Rate of Development %	Pupal duration (days)	Rate of development %		
20	24.4[a]	4.10	22.97	**4.35**	**9.28**	261.64
25	15.1[b]	6.62	15.67	**6.38**		237.42
30	11.5[c]	8.70	11.89	**8.41**		238.31
35	9.83[c]	10.17	9.58	**10.44**		252.86
Average	**15.21**	**7.40**	**15.03**	**7.40**		**247.56**
L.S.D$_{0.05}$	**4.472**					

* Means followed by the same letter(s) in each column are not significantly different at P ≤ 0.05 level.

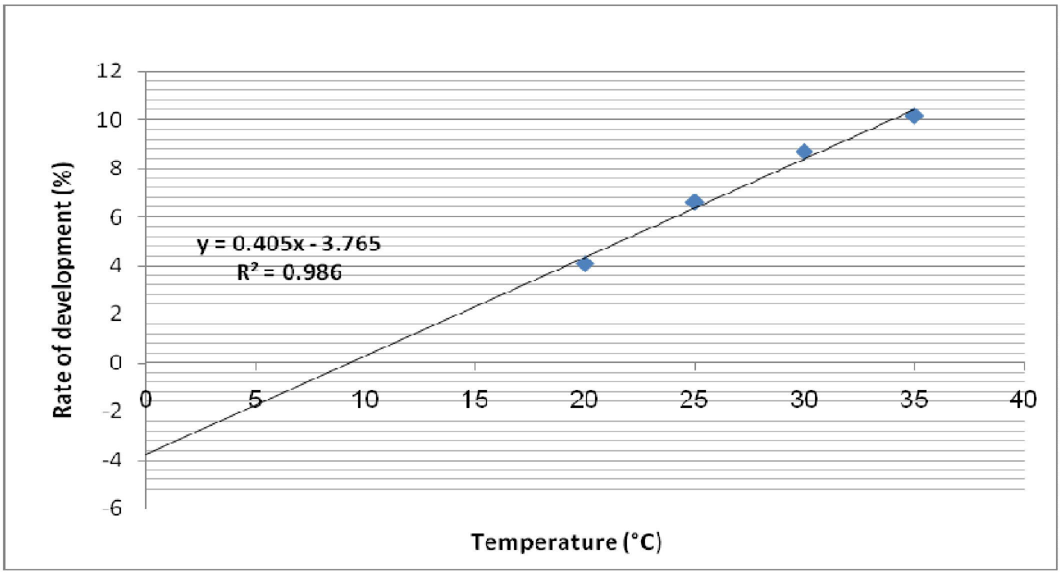

Figure (3). Regression line of the relationship between temperature (℃) and the corresponding rate of development (%) for PBW pupal stage.

4. Adult stage
4.1. Pre-oviposition period

Results in Table (4) reffered to the pre-oviposition period which varied from 4.38 day at 20℃ to 1.26 days at 35℃, with an average of 2.24 days. The corresponding rate of development varied also from 22.83 % to 79.37%, respectively.

The data indicated that there was a negative relationship between periods and degrees of temperatures (℃), while the relationship between temperatures (℃) and rate of development (%) was positive in case as using the regression line equation:

(Y=3.67(X) – 44.8).

The theoretical lower threshold of development (t_0) was 12.19 ℃. In addition, the highest degree days (34.20 DD's) required for the pre-oviposition period was resulted from using incubation temperature of 20 ℃. However, he average of these thermal units (DD's) was 28.13 (Table, 4 and Figure, 4).

Table (4). Duration periods of *P. gossypiella* pre-oviposition and its thermal requirements under different constant temperatures.

Temp.(℃)	Observed		Expected		(t_0˚C)	Degree Days (DD´s)
	Pre-oviposition period (days)	Rate of development %	Pre-oviposition period (days)	Rate of development %		
20	4.38[a]	22.83	3.48	28.70	12.19	34.20
25	1.84[b]	54.35	2.12	47.07		23.57
30	1.46[bc]	68.49	1.53	65.45		26.00
35	1.26[c]	79.37	1.19	83.82		28.74
Average	**2.24**	**56.26**	**2.08**	**56.26**		**28.13**
L.S.D$_{0.05}$	**0.491**					

* Means followed by the same letter(s) in each column are not significantly different at P ≤ 0.05 level.

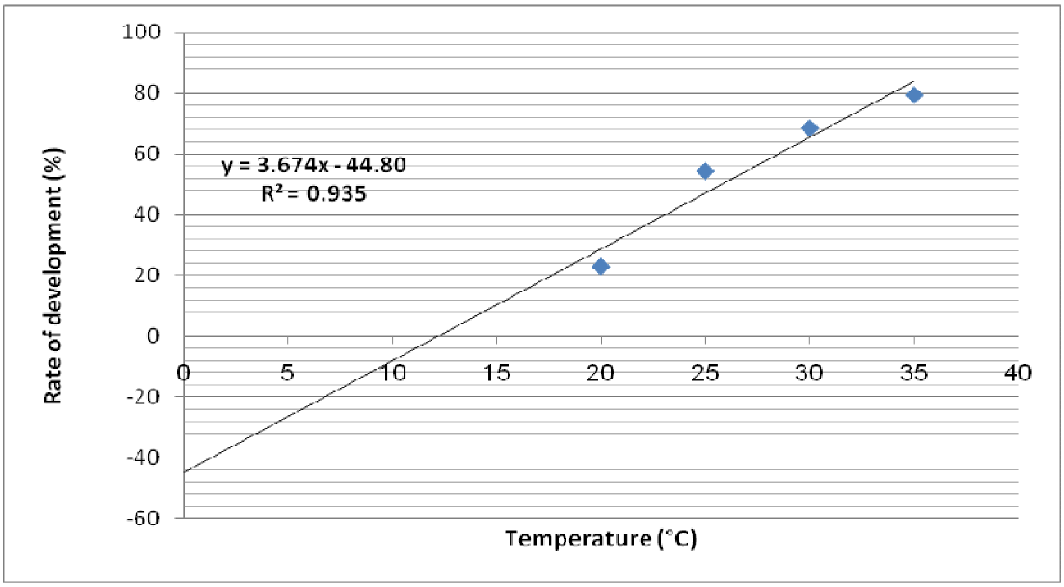

Figure (4). Regression line of the relationship between temperature (℃) and the corresponding rate of development (%) for PBW pre-oviposition adult stage.

4.2. Oviposition period

Table (5) concluded that the oviposition periods of PBW significantly varied from 6.3 days at 20℃ to 2.8 days at 35℃, with an average of 4.18 days. The corresponding rate of development varied from 15.87 % to 35.71%, respectively. These data indicated that there was a negative relationship between oviposition period and the assigned degrees of temperatures (℃), while the relationship between temperatures (℃) and rate of development (%) was positive, which determined from the regression line equation: Y= 1.39 (X) – 11.74.

The estimated lower threshold of development (t_0) was 8.44 ℃. The least (66.84) and highest (74.52) degree days were recorded by the incubation temperatures of 30 and 25℃, respectively. Consequenctly, the average of these thermal units (DD's) was 72.14 (Table, 5 and Figure, 5).

Table (5). Duration of *P. gossypiella* -oviposition period and its thermal requirements under different constant temperatures.

Temp.(℃)	Observed		Expected		(t_0˚C)	Degree Days (DD´s)
	oviposition period (days)	Rate of development %	oviposition period (days)	Rate of Development %		
20	6.3^a	15.87	6.22	16.08	8.44	72.83
25	4.5^b	22.22	4.34	23.04		74.52
30	3.1^c	32.26	3.33	29.99		66.84
35	2.8^c	35.71	2.71	36.95		74.37
Average	**4.18**	**26.52**	**4.15**	**26.52**		**72.14**
L.S.D$_{0.05}$	**0.953**					

* Means followed by the same letter(s) in each column are not significantly different at P ≤ 0.05 level.

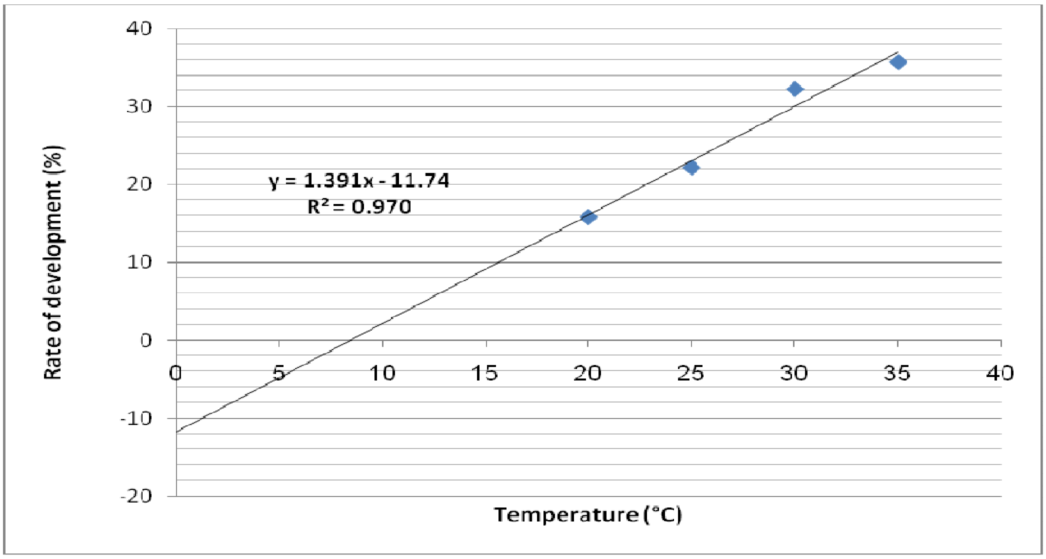

Figure (5). Regression line of the relationship between temperature (℃) and the corresponding rate of development (%) for PBW oviposition adult stage.

4.3. Post-oviposition period

The listed results in Table (6) revealed that the post-oviposition periods of PBW varied from 6.1 days at 20℃ to 2.6 days at 35℃, with an average of 3.88 days. Furthermore, the corresponding rate of development varied from 16.39 % to 38.46%, respectively.

The data clarified that there was a negative relationship between the post-oviposition periods and the degrees of temperatures (℃), while the relationship between temperatures (℃) and rate of development (%) was positive by utilizing the regression equation of Y= 1.43 (X) – 10.75 (Figure, 6).

These findings cleared that the lower threshold of development (t_0) was 7.53 ℃. On the other hand, the thermal requirements as expressed in degree days changed with the change of incubation temperatures. Consequently, the average of the DD's was 70.46.

Table (6). Duration of *P. gossypiella* post-oviposition period and its thermal requirements under different constant temperatures.

Temp.(℃)	Observed		Expected		(t_0˚C)	Degree Days (DD´s)
	Post-oviposition period (days)	Rate of development %	Post-oviposition period (days)	Rate of development %		
20	6.1[a]	16.39	5.61	17.82		76.08
25	3.7[b]	27.03	4.01	24.96	**7.53**	64.65
30	3.1[c]	32.26	3.11	32.11		69.67
35	2.6[c]	38.46	2.55	39.25		71.43
Average	**3.88**	**28.54**	**3.82**	**28.54**		**70.46**
$L.S.D_{0.05}$	**0.580**					

* Means followed by the same letter(s) in each column are not significantly different at P ≤ 0.05 level.

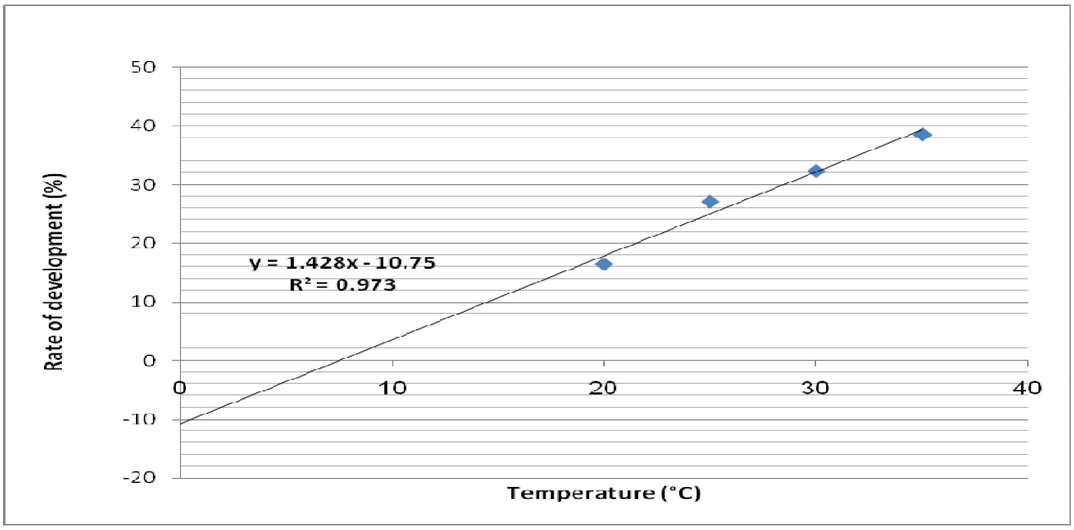

Figure (6). Regression line of the relationship between temperature (℃) and the corresponding rate of development (%) for post-oviposition adult stage.

CONCLUSION

We conclude from that study that there is the effect of temperature on some biological aspects of the pink bollworm, expressed as the amount of accumulated thermal units. Conducted this study to calculate the zero growth phases the theoretical threshold of development (t0)) to bollworm, pink as well as the necessary heat units each phase separately. The lower thresholds of development (t0) were 10.63, 14.82, 9.28, 12.19, 8.44 and 7.53 ℃ for eggs, larvae, pupae, pre-oviposition period, Oviposition period and post- Oviposition period respectively. The average accumulated heat units required for development was 69.60, 158.70, 247.56, 28.13, 72.14 and70.46 degree-days for egg, larvae, pupae, pre-oviposition period, Oviposition period and post-Oviposition period respectively. The lower threshold of development (t0). The time required for embryogensis, larval duration and pupal duration decreased as the temperatures increased from 20 to 35°C and thus can be expected to predict when or application control means or different strategies to combat the scourge.

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الملخص العربى

تطبيقات الوحدات الحرارية للتنبؤ بظهور دودة اللوز القرنفلية لمراحل التطور المختلفة

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تهدف هذه الدراسة المعملية الى دراسة تاثير اربع من درجات الحرارة الثابتة (٢٠، ٢٥ ، ٣٠ ، ٣٥)°م على ظهور ومراحل تطور دودة اللوز القرنفلية من خلال هذه الدراسة تم تحديد الاحتياجات الحرارية المطلوبة لنمو وتطور كل طور على حدة و عتبة النمو الاقتصادي (صفرالنمو البيولوجى) للاطوار المختلفة لدودة اللوز القرنفلية (مرحلة البيض – اليرقة – العذراء– مرحلة ماقبل وضع البيض – مرحلة وضع البيض – مرحلة مابعد وضع البيض على التوالى).وانتهت الدراسة الى تحديد الاحتياجات الحرارية اللازمة لنمو وتطور كل الاطوار وبلغت (٦٩.٦، ١٥٨.٧، ١٤٧.٥٦، ٢٨.١٣، ٧٢.١٤، ٧٠.٤٦) وحدة حرارية يومية لكل من (مرحلة البيض – اليرقة – العذراء– مرحلة ماقبل وضع البيض – مرحلة وضع البيض – مرحلة مابعد وضع البيض على التوالى) وكذلك بلغ الحد الحرج للنمو (عتبة النمو الاقتصادى او صفر النمو البيولوجى) (١٠.٦٣، ١٤.٨٢، ٩.٢٨، ١٢.١٩، ٨.٤٤، ٧.٥٣) °م لكل من مرحلة (البيض – اليرقة – العذراء– مرحلة ماقبل وضع البيض – مرحلة وضع البيض – مرحلة مابعد وضع البيض على التوالى)

عموما، أظهرت النتائج المتحصل عليها وجود علاقة سالبة بين درجات حرارة الحضانة وفترات الحضانوة لجميع المراحل.

تعتبر الوحدات الحرارية المتراكمة التى تستحدم فى التنبؤ بالمراحل المختلفة للأفة والتى تعتبر من الاعتبارات المهمة فى برامج المكافحة المتكاملة فيما يخص توقع اوالتنبؤ بموعد تطبيق وسائل المكافحة او الاستراتيجيات المختلفة لمكافحة الافة.

Response of Some Egyptian Wheat (*Triticum aestivum L.)* Genotypes to Salinity Stress

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ABSTRACT: A pot experiment was carried out under greenhouse conditions to test the reaction of different wheat genotypes to salt stress. The seeds of 15 wheat genotypes were grown in pots containing sandy loam soil and later on the seedlings were subjected to 3 levels of saline irrigation water after 2 weeks of seed germination. The selected wheat cultivars included Shakha 93, Sakha 94, Misr1, Sids1, Sids12, Sids13, Giza168, Giza171, Sahel 1, Shandawil 1, Gemmiza 7, Gemmiza 9, Gemmiza 10, Gemmiza 11 and Gemmiza 12. The salinity of irrigation water was prepared by dissolving an appropriate amount of NaCl in tap water and adjusted to give 4500 and 8500 mg/l, beside the control treatment of tap water (500 mg/l). After 5 months of saline water application, the plants were harvested, whereas plant growth indices, grain and straw yields, as well as the harvest index were recorded. The results have shown that plant growth characteristics and yield potentials were significantly suppressed with increasing the salinity stress levels, but the rate of decline varied considerably among all trails. The more serious effect of the salinity exposure was manifested on grain yield, being 39.8 and 54.5% at 4500 and 8500 mg/l, respectively. Wheat genotypes, namely Gemmiza 7, Gemmiza 9 and Sids 1 were more superior in grain yield performance, even at the highest concentration level of irrigation water. Unlike, Gemmiza 11, 12; Misr 1, Sakha 94, Giza 168, 171, Shandweel 1 and Sids 12, 13 were reacted as the more salt-sensitive cultivars. The remaining genotypes were intermediate in reaction. On the evaluation and screening wheat cultivars to salt stress, the simple regression equation of the type $y=a + b\sqrt{X}$ was considered to give a better expression for the quantitative assessment. According to our calculations, genotypes, i.e. Gemmiza 7, Gemmiza 9 and Sids1 were classified as salt tolerant cultivars and Sakha93, Sahel 1 & Gemmiza 10 as moderately salt tolerant and the remaining cultivars showed higher sensitivity to salt tolerance. It could be concluded that the more salt tolerant varieties could be used as a valuable cultivars in breeding programs under salt-stressed condition.
Keywords: wheat genotypes – salinity stress – screening –salt tolerant

INTRODUCTION

Soil salinity is one of the major abiotic stresses affecting agricultural production in semi-arid regions and has negative impacts on plant growth and global crop productivity (Dehdari *et al*., 2005; Munns *et al*., 2006 and Huang *et al*., 2008).The salinity problems in these areas may be a result of limited water availability, unsuitable irrigation practices, improper drainage, and high evaporation (Abd Alrahman *et al.,* 2005). In order to sustain food crop production in such regions, it is necessary to introduce cultivars with enhanced salinity tolerance (Munns *et al*., 2006; Abu Hasan *et al*., 2015).

Wheat, as the most important crop for human consumption in the world, is frequently grown in regions with saline and alkaline soils. Therefore, breeding for realizing salt tolerance would be an effective mean for improving yield and yield stability under such conditions (Genc *et al*., 2007). Many investigators have reported marked retardation in the germination and plant growth of seedlings of several field crops at the higher salinity levels (Bernstein, 1961). However plant species differ in their sensitivity or tolerance to salts (Torech and Thompson, 1993).

Screening large numbers of genotypes to salt stress in the field is difficult, due to spatial heterogeneity of soil chemical and physical properties and to the seasonal fluctuations in rainfall (Munns and James, 2003). Screening techniques that can be carried out under controlled environments have therefore often been used as measurements of growth (root elongation, leaf elongation, biomass or yield), measurements of injury (Leakage from leaf discs, chlorophyll content or chlorophyll fluorescence) and specific ion accumulation, including Na^+ and/or Cl^- exclusion and K^+/Na^+ ratio (Munns and James, 2003). Large numbers of bread and durum wheat genotypes have been screened for the relative salt tolerance in glasshouses, using the criteria of biomass production at high salinity up to 250 mM NaCl (Kingsbury and Epstein, 1984; Martin *et al.*, 1994).

The effects of salt stress on wheat plant growth and development have been attributed to the retardation of seed germination and seedling growth performances (Almansouri *et al.*, 2001), reduced grain yields (Maas and Poss, 1989) via accelerating apex development (Grieve *et al.*, 1992; Katerji *et al.*, 2005), shortening the spiklelet development, reducing number of spikelets per spike (Frank *et al.*, 1987), kernels per spike, and the number of spike tillers (Maas and Grieve,1990; Katerji *et al.*, 2005) due to the disruption of water uptake and nutritional supply in rooting zone.

The main goal of the present study is being proposed to evaluate the salt tolerance, growth and yield performance of some different wheat genotypes to salt stress in Egypt.

MATERIALS AND METHODS

This investigation was performed to test the reaction of 15 different wheat genotypes to salt stress. The plant materials were provided from the Crop Research Institute, Agricultural Research Center (ARC) in Giza, Egypt. The selection was, however, considered to cover the crop adaptation to all environmental conditions prevailing in Egypt. Based on this concept, 15 wheat cultivars, namely, Sakha 93, Sakha 94, Misr 1, Sids 1, Sids 12, Sids 13, Giza 168, Giza 171, Sahel 1, Shandawil 1, Gemmiza 7, Gemmiza 9, Gemmiza 10, Gemmiza 11 and Gemmiza 12 were selected to test their salt tolerance under greenhouse conditions at the Soil Salinity Department, ARC- Alexandria. The seeds were planted in pots (30cm in diameter and 30cm in height) containing sandy loam soil (15 kg), during the growing season 2013/2014. The initial chemical and physical properties of the used soil and the tap water characteristics are given in Table 1.

A factorial trait, comprising of 15 wheat genotypes and 3 saline irrigation water levels, i.e., 500, 4500 and 8500 mg/l NaCl, were replicated 3 times in a complete randomized block design. After seed germination (8 December 2013), the seedlings were thinned, keeping the stand at 5 plants /pot. The growing plants were subjected to salt stress after 3 weeks up to the harvest time. Nitrogen and potassium were applied as ammonium nitrate and potassium sulfate fertilizers, at rates of 100 kg N/fed and 48kg K_2O/fed, respectively, partitioned in 3 equal doses for N (at planting, 3 weeks after the planting date and before tillering stage). While phosphorus fertilizer rate 15.5 kg P_2O_2/fed was initially incorporated to the soil before cultivation. K was applied, in a single dose, after 6 weeks of planting date.

At maturity (May 2014), the plants were harvested and agronomic data including plant height, grain yield (GY), straw yield (SY), number of tillers and number of spikes for the different wheat cultivars were recorded.

The term "harvest index, HI %" is being introduced to relate the GY to total plant biomass. Accordingly, HI was calculated using the following relation:

$$HI\ (\%) = \{GY/\ (GY+SY)\}\ X\ 100$$

The obtained data were subjected to the analysis of variance (ANOVA) using CoSTAT Program described by Co Hort (1986). The significant differences among treatment means were evaluated on the basis of the calculated values of LSD (Duncan, 1965). Besides, regression/correlation analyses were carried out to give a quantitative expression on the reaction of the involved wheat genotypes to salt tolerance.

Table (1). Soil and tap water characteristics

Characteristics	Soil	Tap water
Soil pH (1:2 soil-water)	7.73	7.50
Soil EC (1:2 soil-water) (dSm^{-1})	1.70	0.78
Soluble cations (meq/L)		
Calcium (Ca^{++})	7.00	3.20
Magnesium (Mg^{++})	4.00	1.75
Sodium (Na^{+})	5.60	2.50
Potassium (K^{+})	0.59	0.35
Soluble anions (meq/L)		
Bicarbonate (HCO_3^{-})	4.64	1.60
Chloride (Cl^{-})	9.00	3.85
Sulphate (SO_4^{--})	3.55	2.3
Total $CaCO_3$ (%)	15.5	-
Total nitrogen (%)	0.02	-
Total phosphorus (%)	0.15	-
Total potassium (%)	3.56	-
Organic matter (%)	0.16	-
Mechanical analysis (%)		
Clay	2.8	-
Silt	77.8	-
Sand	Sandy loam	-
Soil texture		-

RESULTS AND DISCUSSION

The analysis of variance (ANOVA) presented in Table (2) revealed that the main effects, including wheat genotypes and the salt stress exposure as well as their interaction imposed significant trend on the all selected traits at $P \leq 0.05$. To eliminate the diversion effects of the single and combined treatments on GY and SY performances, the term "harvest index percentage; HI %" and relative grain yield are being introduced to relate the GY to total plant biomass and GY at S_0 treatment, respectively.

Table (2). Analysis of variance (ANOVA) for plant growth indices , grain and straw yield records

SOV	df	Significant level						
		Plant growth indices			Grain & Straw yield records			
		Plant height(cm)	Spikes No /pot	Tilleres No /pot	Straw yield g/pot	Grain yield g/pot	Harvest Index % (HI)	Relative yield %
Blocks	2	ns	ns	ns	ns	ns	ns	ns
Main Effects								
varieties	14	**	**	**	**	**	**	**
salinity	2	**	**	**	**	**	**	**
Interaction								
varietiesXsalinity	28	*	**	**	**	**	**	**
MS Error		8.09	1.96	23.22	15.02	8.92	13.45	20.69

ns = No significant difference ** = Significant at 1 % level * = Significant at 5 % levels

1. Main treatment effects

1.1. Effect of saline irrigation water

Regardless to the main effects of wheat genotypes, the plant growth indices, including plant height, spikes and tillers numbers per pot, yield components (straw, grain yields and harvest index) and relative grain yield (RGY) were significantly decreased with increasing salinity levels from S_o to S_2 (Table 3a and Figure1). Relative to the control treatment, increasing the salinity level to 8500 mg/l decreased the plant height and the number of spikes by 13.9 and 29.5%, respectively, accompanied by extensive drop in the number of tillers (44.8%). The calculated inhibiting effects on yield components at the highest salt stress exposure accounted for marked significant decrements, defined by 39.8 and 54.5% for straw and grain yields, respectively. Similar trend was recorded on HI % and RGY, but the depressive effect varied considerably between the respective traits from 6.6 to 46.1%, respectively. The correlation analysis between the agronomic data (Table 3b) revealed that there are highly positive correlation between the all possible combination of the studied traits under salt stress conditions, whereas the r values ranged between 0.92 and 0.99 (below the diagonal line). However, the corresponding coefficient of determination was, subsequently, 85-98%.

Growth and yield reduction could explained to a number of reasons, basically to the inhibitory effect of the osmotic effects of salt in the soil solutions, that causes acting to induce the acceleration senescence due to leaf water deficit or hormonal disruption from rooting system (Dura *et al.*, 2011). Under such conditions, it seems possibly that nutrients uptake and its translocation to the aerial plant parts are being disturbed, due to the excessive Na^+ accumulation. This holds true, because the highest concentrations of irrigation water may induce toxic effects on leaves as result of excessive salt accumulation in cytoplasm or cell wall (Sairam and Tyagi, 2004). These results are in agreement with the data reported by Chartzoulakis and Klapaki (2000) indicating that salinity affected plant growth processes; in terms of plant height, fresh and dry weights of roots, stem and leaves expression grain yield potentials and deterioration of the product quality.

Table (3a). Main effect of salinity and wheat cultivars treatments on grain yield and the attendent tillering

	Treatments	Plant growth indices			Yield components			
		plant Height(cm)	No. of spikes/pot	Tilleres No /pot	Straw yield g/pot	Grain yield g/pot	Harvest Index %	Relative Yield %
Salinity	S_0	78.49	17.63	27.56	51.70	44.02	47.09	100.00
	S_1	72.42	14.76	16.78	39.72	30.42	43.76	70.03
	S_2	67.82	12.43	15.22	31.09	19.96	40.48	46.13
	L.S.D.	1.19	0.59	2.02	1.62	1.25	1.54	1.91
Wheat cultivars	Sakha 93	62.78	12.88	18.33	35.81	26.89	42.68	75.47
	Sakha 94	69.78	15.83	23.89	40.34	33.56	43.71	69.43
	Misr 1	73.00	16.83	27.78	43.20	34.72	44.88	68.61
	Sids 1	79.11	18.67	26.11	64.93	32.96	33.80	81.94
	Sids 12	72.56	8.11	11.67	29.40	27.52	48.41	64.54
	Sids 13	60.78	18.44	26.11	29.64	32.59	52.19	65.68
	Giza 168	69.11	15.33	23.89	37.60	31.72	46.01	67.80
	Giza 171	79.00	11.44	17.78	25.31	33.44	55.09	67.11
	Sahel 1	76.44	15.67	21.67	46.84	35.48	42.48	73.78
	Shandweel 1	75.39	15.67	21.11	49.42	30.60	37.21	68.18
	Gemmiza 7	78.11	11.05	13.89	40.90	30.13	42.34	85.10
	Gemmiza 9	75.00	19.44	20.56	52.48	31.44	37.98	86.13
	Gemmiza 10	70.11	16.56	16.67	36.32	32.57	46.97	71.20
	Gemmiza 11	80.17	12.44	13.33	43.13	30.03	40.92	69.21
	Gemmiza 12	72.33	15.72	15.00	37.21	28.31	41.96	66.62
	L.S.D.	2.66	1.31	4.51	3.63	2.80	3.44	4.26

Table (3b). Correlation analysis between grain yield and some agronomic data

		Varieties			
		Grain yield	Straw yield	Spikes No	Tilleres No
Salinity	Grain yield		ns	ns	ns
	Straw yield	0.99**		0.55 *	ns
	Spikes No	0.99**	0.98**		0.74**
	Tilleres No	0.92**	0.92**	0.90**	

* ,** = significant at 5% and 1 % levels, respectively - ns= nonsignificant

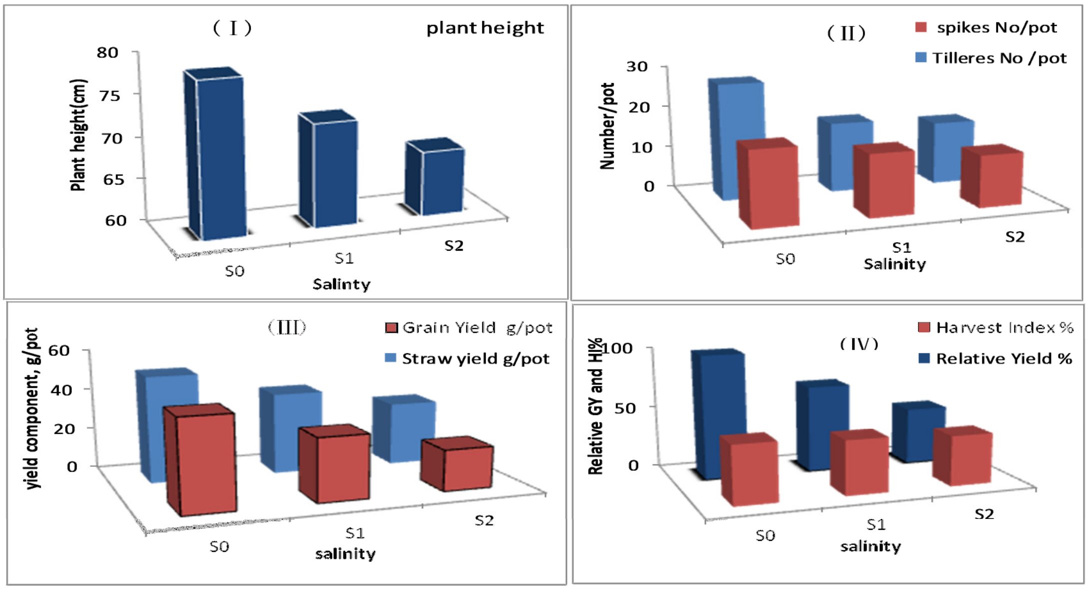

Fig.(1). Main effect of salinity on plant height (I), growth index term (II), yield component (Ⅲ) and relative yield (Ⅳ) of wheat plant.

1.2. Varietal effect of wheat genotypes:

Irrespective to the salinity treatment, the results given in Table 3a indicated that there are wide variations in all traits among wheat genotypes. Despite of the insignificant trend existed between sids1 and Gemmiza 9, particularly, in the number of spikes, GY and RGY data, as revealed from LSD comparisons, opposite significant trend were detected on plant height, number of tillers and HI (Table 3a). The present data demonstrated that the number of spikes, GY and RGY for sids1 were 18.67, 32.19 g/pot and 81.94%, respectively. The respective records for Gemmiza 9 were, subsequently, 19.44, 31.44 g/pot and 86.13%. The reaction of the remaining wheat cultivars with respect to their performance on plant growth indices and yield components as well as RGY is not clearly defined. Except the detected positive correlations existed between SY and the number of spikes and/or spikes and tillers numbers (above the diagonal line), weak correlation were appeared between the remaining traits (Table 3b). Such variations would suggest that there are several interacting factors have been taken place within the plant under salt-stressed conditions affecting the pathway of metabolic processes including marked differentiation on the mode of plant growth and yield components (Sharma, 2013).

It seems possibly that such variation could be also inferred the inherent capacity and the presence of marked genes that control the plant capability to salt stress (Naz *et al*., 2015). In this regard, Naz *et al.* (2015) stated that the salt tolerance within plant species and/or cultivars could be ascribed to the dominant genes (Krishania *et al*., 2015).

The superior plant growth of the more salt tolerant cultivars (Sids1 & Gemmiza 9) than sensitive ones (Sids 12 & Sids 13) could be due to the reduction in Na+ accumulation and mobilization of the defense mechanisms including antioxidative enzymes which might have suppressed the Na^+ transport to further tissues (Gupta and Huang, 2014).The reduction in fresh and dry biomass with increasing salinity can be attributed to reduced photosynthesis rate and other physiological functions. These results are in agreement with Khan *et al.*(2004); *Kanwal et al.* (2011); Rao *et al.* (2013) and El-Haddad and Mostafa (2007).

2. The 2-way interaction:

The interaction study of the two involved treatments indicated that the differences in plant growth, in terms of plant height, between the coupled cultivars, e.g., Sahel 1, Schandweel 1 and Gemmiza 7 at any given salinity were not significant at $P\leq0.05$ (Table 4a and Fig.2). The results also showed that although the variations in plant height criteria between S_0 and S_2 for Sakha 93, Giza 168 and Gemmiza 12 cultivars were significant, the reaction of respective cultivars did not exhibit any significant trend between S_0 and S_1 (Table 4a & Fig.2). In contrast, the differences in plant height between the all comparisons at any given salinity level of the remaining wheat cultivars imposed marked significant variations at $P\leq 0.05$.

Except the reaction of Misr 1, Sids 1, Sahel 1, Shandweel 1 and Gemmiza 12, the results detected on the number of spikes per pot demonstrated that the variations in this criteria between S_1 and S_2 for all cultivars were significant at $P\leq 0.05$ (Table 4a and Fig.2). Based on the LSD comparisons, the insignificant trend was also recorded on the variation of spikes numbers between S_0 and S_1 for cultivars Sakha 93, Sids 12, Giza 171, Gemmiza11 and 12.

Table (4a). The interaction effect of salinity and wheat varieties treatments on plant growth indices

wheat varieties	Plant Growth Indices								
	Plant height (cm)			Spikes No /pot			Tillers No/pot		
	S_0	S_1	S_2	S_0	S_1	S_2	S_0	S_1	S_2
Sakha 93	65.7	62.7	60.0	15.7	13.7	9.3	26.7	18.3	10.0
Sakha 94	76.3	70.3	62.7	19.5	15.5	12.5	33.3	23.3	15.0
Misr 1	81.7	71.0	66.3	19.2	16.0	15.3	43.3	20.0	20.0
Sids 1	84.0	81.3	72.0	23.0	16.7	16.3	43.3	16.7	18.3
Sids 12	80.7	71.0	66.0	10.0	8.0	6.3	13.3	8.3	13.3
Sids 13	66.3	61.3	54.7	20.7	18.7	16.0	40.0	20.0	18.3
Giza 168	71.7	69.0	66.7	17.7	15.3	13.0	35.0	18.3	18.3
Giza 171	82.7	80.0	74.3	13.0	12.0	9.3	21.7	16.7	15.0
Sahel 1	81.3	75.0	73.0	18.0	15.0	14.0	28.3	18.3	18.3
Shandweel 1	81.5	75.0	69.7	19.0	15.0	13.0	30.0	16.7	16.7
Gemmiza 7	81.3	78.0	75.0	12.5	11.7	9.0	16.7	13.3	11.7
Gemmiza 9	83.0	73.0	69.0	24.0	18.7	15.7	23.3	18.3	20.0
Gemmiza 10	77.7	68.0	64.7	20.0	16.7	13.0	18.3	15.0	16.7
Gemmiza 11	88.2	78.3	74.0	14.7	13.0	9.7	18.3	11.7	10.0
Gemmiza 12	75.3	72.3	69.3	17.7	15.5	14.0	21.7	16.7	6.7
Mean	78.5	72.4	67.8	17.6	14.8	12.4	27.5	16.8	15.2
L.S.D at 5%		4.6			2.3			6.8	

Table (4b). The interaction effect of salinity and wheat varities treatments on straw and grain yield records

wheat varieties	Grain and straw yield records											
	Straw weight, g/pot			Grain yield, g/pot			Relative Grain yield %			Harvest Index %		
	S_0	S_1	S_2	S_0	S_1	S_2	S_0	S_1	S_2	S_0	S_1	S_2
Sakha 93	49.5	36.2	21.8	35.6	29.6	15.4	100.0	83.1	43.3	41.8	45.0	41.2
Sakha 94	48.1	41.2	31.7	48.3	35.1	17.2	100.0	72.6	35.6	50.1	46.0	35.1
Misr 1	63.0	43.0	23.6	50.6	33.2	20.4	100.0	65.5	40.3	44.5	43.6	46.5
Sids 1	84.8	55.5	54.5	40.2	32.9	25.8	100.0	81.7	64.1	32.2	37.2	32.0
Sids 12	39.4	33.2	15.7	42.6	22.5	17.4	100.0	52.9	40.8	52.0	40.6	52.6
Sids 13	24.9	34.1	29.9	49.6	30.5	17.6	100.0	61.6	35.4	66.4	47.3	42.8
Giza 168	57.3	32.8	22.8	46.8	28.4	20.0	100.0	60.7	42.7	45.1	46.5	46.4
Giza 171	28.0	26.1	21.9	49.8	31.3	19.1	100.0	62.9	38.4	64.0	54.6	46.7
Sahel 1	57.7	38.4	44.5	48.1	35.1	23.3	100.0	73.0	48.4	45.5	47.6	34.3
Shandweel 1	58.6	55.7	34.0	44.9	29.9	17.0	100.0	66.6	37.9	43.4	34.9	33.4
Gemmiza 7	47.5	40.5	34.7	35.4	31.9	23.1	100.0	90.1	65.2	42.9	44.2	40.0
Gemmiza 9	72.2	45.1	40.1	36.5	34.3	23.5	100.0	94.0	64.4	33.6	43.4	37.0
Gemmiza 10	46.7	35.1	27.2	45.7	28.6	23.3	100.0	62.6	51.0	49.5	45.0	46.4
Gemmiza 11	61.8	39.4	28.1	43.4	28.9	17.8	100.0	66.7	41.0	41.2	42.7	38.9
Gemmiza 12	36.1	39.5	36.0	42.5	23.9	18.5	100.0	56.3	43.5	54.2	37.8	33.9
Mean	51.7	39.7	31.1	44.0	30.4	20.0	100.0	70.0	46.1	47.1	43.8	40.5
L.S.D at 5%		6.3			4.86			7.39			5.97	

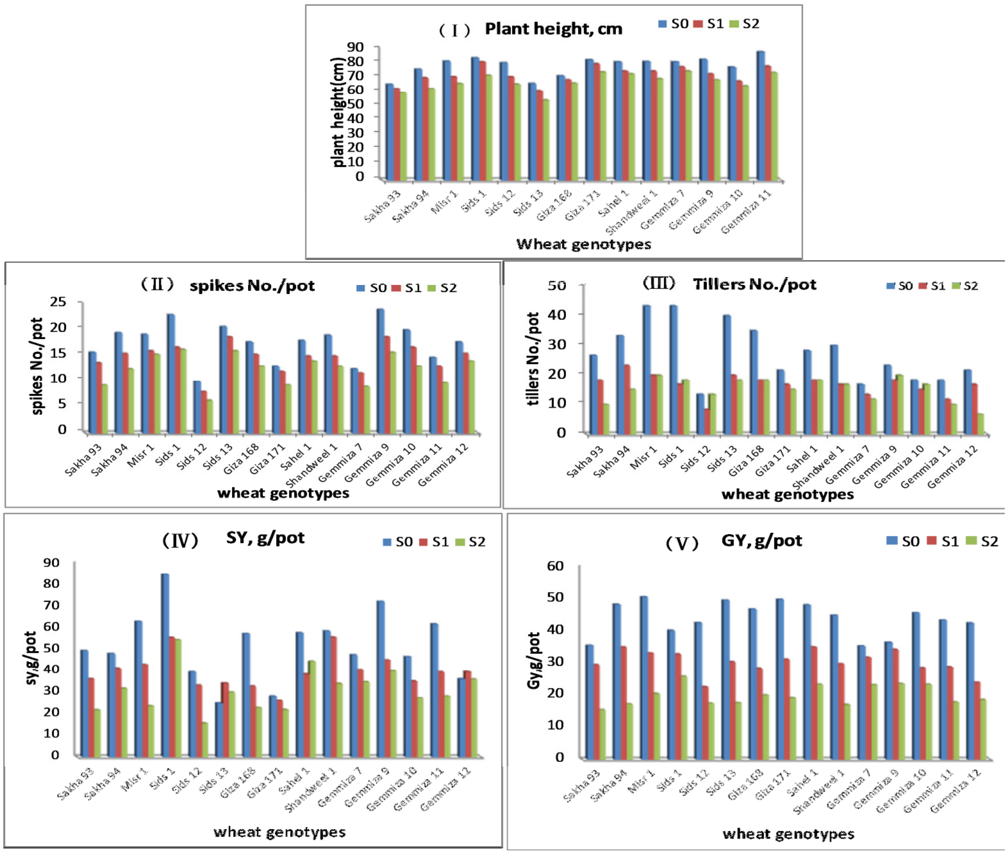

Fig. (2). Effect of saline irrigation water on growth indices (Ⅰ, Ⅱ, Ⅲ) and yield records (Ⅳ & Ⅴ) of wheat genotypes

The performance of remaining wheat cultivars imposed remarkable significant trend on the variations of this trait between all the comparisons at each salinity level.

The results outlined on the number of tillers per pot showed that the variations in these criteria between S_1, S_2 for all cultivars except the reaction of Sakha 93, 94 and Gemmiza 12 were not significant (Table 4a and Fig.2). Based on the LSD comparisons, the insignificant trend was also registered on the variation of tillers numbers between S_0 and S_1 for Sids 12, Gemmiza 7, 9, 10, 11 and 12 cultivars. The performance of the remaining wheat cultivars exerted remarkable significant trend on the variations of this trait between the all comparisons of salt treatments.

Moreover, the interaction study of the two implicated salinity treatments indicated that the differences in straw yield between the coupled salinity levels, e.g., S_1 and S_2 were not significant at $P \leq 0.05$ for sids 1, sids 13, giza 171, sahel 1, gemmiza 7, 9 and 12 cultivars (Table 4a, Fig. 2). The results also revealed that the variations in straw yield criteria between S_0 and S_1 for Sids 12, Giza 171 and Gemmiza 12 cultivars were also limited with no significant trend (Table 4b and Fig.2). The performance of the other wheat cultivars showed significant trend on the variations of this criteria between all the comparisons of salt treatments.

In accordance to the LSD comparison, only, the variations in grain yield data between S_0 and S_1 for Gemmiza 7 and 9 cultivars were insignificant at $P \leq 0.05$ (Table 4b and Fig.2). The differences in this criteria between all the comparisons at any given salinity level for the remaining wheat cultivars showed marked significant trend at $P \leq 0.05$.

On the other hand, when the grain yield of salt- treated cultivars were compared as a percent of maximum yield (relative grain yield, RGY), the differences in this criteria for all the comparisons between the salinity treatment for any given wheat cultivars imposed significant variations (Table 4b). The results documented in Table 4b proved that wheat cultivars ,namely , Sakha 93, Misr 1, Sids 1, Giza 168, Gemmiza 7 and 11 behaved similarly with respect to the attendant variations in harvest index (HI), unlike the reaction of the remaining wheat cultivars exerted remarkable and significant variations in (HI) across the salt exposure treatments.

3. Salt tolerance assessment of wheat genotypes

The results given in Table (5) showed that wheat cultivars exhibited differential response in grain yield potentials across the all levels of salinity exposure. Such differences are being expected, due to the genotypic variability of the respective plant materials (Naz *et al.*, 2015). Quantitative screening to salt tolerance, under such condition, is apparently difficult. To meet the objectives, all the actual records of grain yield data were expressed in terms of relative values (Table 3a). Accordingly, a quantitative rating system of the respective wheat cultivars on the basis of a fixed scale was, however, realized to evaluate the performance of salt tolerance concept. In this regard, different types of regression equations were preliminary tested to select the best expression that describes the reaction of wheat cultivars. This concept has been previously proposed by Soliman *et al.* (1978) and is being applicable, taking into account the highest correlation coefficient (r) and/or R^2, together with the lowest standard error of the calculated regression coefficient (b). Our trails proved that the simple regression equation, namely, $y=a + b\sqrt{X}$ gave the best fitting for grain yield data and more impressive if it is compared with the other tested equations.

Since the regression coefficient value (b) give an accurate indication for the rate grain yield depression across the salinity level, the calculated values (Table 5) showed that Gemmiza 7, Gemmiza 9 and Sids 1 cultivars behaved similarly and were relatively the highest in salt tolerance and the least in salt injury providing minimum b values(-0.466, -0.475 and -0.502, respectively). These results are being confirmed by comparing the bs' values, whereas the ratio accounted for 1.0, 1.02 and 1.08 for the respective cultivars. In this respect, the predicted salt concentration of the irrigation water, associated with 50% of the relative grain reduction, as defined by (Richards, 1954), accounted for 18475, 17984 and 15401 mg/l, respectively. On the contrary, Gemmiza 11, Misr 1, Sakha 94, Giza 168, Shandweel 1, Gemmiza 12, Giza 171, Sids 13 and Sids 12 cultivars were relatively more salt sensitive. The corresponding salt concentration of irrigation water incorporated for the 50% reduction in relative grain yield were subsequently, 6982, 6817, 6811, 6725, 6626, 6489, 6407, 6029 and 5974 mg/l. The attendant ratio of bs' values were relating the highest, being 1.79, 1.81, 1.90, 1.78, 1.87, 1.82, 1.88, 1.97 and 1.87, respectively, and consequently these cultivars were rated as the more sensitive cultivars (Tables 4a and 4b). The remaining cultivars namely, Sakha 93, Sahel 1 and Gemmiza 10 imposed intermediate salt reaction, where the bs' values ranged between 1.54 and 1.64. The corresponding salinity levels inducing 50% reduction in relative grain yield accounting for 8822, 8715 and 8120 mg/l, respectively.

Many reports from the literature cited on the salt tolerance of wheat (Meiri and Shalhevest, 1973) revealed that when the salt concentrations in the soil reached 10-14 dS/m, yields were reduced from 25-50%. They added that further increase in salt stress from 14-16 dS/m, the yield potentials were severely dropped by 50% or more. The unequal trend between the critical salinity levels, associated with 50% reduction in grain yield, in our experimental data and the predicted values defined by Meiri and Shalhevest (1973) is being directed to their assessment of ECs' values in the soil extract, which is quite different from our calculations, that takes into account the ECs' values of irrigation water. Besides, the genotypic variations of plant materials (Sharma, 2015) and the changes in climatically and environmental conditions (Xu, 2016) are among of the important factors that contribute well for such deviations.

Table (5). Quatitive evalution of the relative grain yield and salt tolerance index of wheat varities under salt stress condition using the linear regression ($y = a + b\sqrt{x}$) *

Varieties	a	b	bs' ratio	r	R^2	Calculated Salt Conc. for 50 % of RGY (mg/l)
gemmiza7	113.34	-0.466	1	0.907	0.823	18475
gemmiza9	113.7	-0.475	1.02	0.999	0.808	17984
sids1	112.3	-0.502	1.08	0.966	0.934	15401
Sakha93	121.57	-0.762	1.64	0.914	0.836	8822
sahel1	117.59	-0.724	1.55	0.962	0.925	8715
gemmiza10	114.61	-0.717	1.54	0.978	0.956	8120
gemmiza11	113.69	-0.834	1.79	0.991	0.982	6982
misr1	119.77	-0.845	1.81	0.989	0.978	6817
sakha94	123.04	-0.885	1.90	0.952	0.906	6811
giza168	117.9	-0.828	1.78	0.981	0.962	6725
shandweel1	120.98	-0.872	1.87	0.978	0.956	6626
gemmiza12	116.78	-0.85	1.82	0.984	0.969	6489
giza171	120.12	-0.876	1.88	0.998	0.996	6407
sids13	121.2	-0.917	1.97	0.99	0.98	6029
sids12	117.4	-0.872	1.87	0.978	0.956	5974

bs' ratio was calcaulated with respect to lowst b value (-0.466)

* y = relative grain yield %   a = intercept (relative grain yield at S0)

b = regression coefficient   x = salt concentration of irrigation water , mg/l

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الملخص العربي

أستجابة بعض اصناف القمح المصرية للاجهاد الملحي

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معمل بحوث الاراضي الملحية والقلوية – معهد بحوث الاراضي والمياه والبيئة

من الاهداف الهامة التي تسعى اليها مصر في الوقت الحالي هي زيادة انتاجية القمح تحت ظروف الري بالمياه المالحة في ظل نقص الموارد المائية العذبة. في اطار تحقيق هذا الهدف اجريت تجربة اصص تحت ظروف الصوبة الزراعية لدراسة تأثير الري بالمياه الملحية على التحمل النسبي للملوحة لـ ١٥ صنف من اصناف القمح المصرية . وشملت اصناف القمح المختارة سخا ٩٣، سخا ٩٤ ، مصر ١، سدس ١، سدس ١٢، سدس ١٣، جيزة ١٦٨، جيزة ١٧١، سهل ١، شندويل ١، جميزة ٧، جميزة ٩، جميزة ١٠ ، جميزة ١١، جميزة ١٢ . وقد تم تجهيزمياه الرى بدرجات ملوحة مختلفة عن طريق إذابة كمية مناسبة من كلوريد الصوديوم فى ماء الصنبور لنحضيرمياه رى بثلاث مستويات من الملوحة (٥٠٠ ، ٤٥٠٠ ، ٨٥٠٠ ميليجرام/لتر). اوضحت الدراسة انه عند تمام النضج وجد ان زيادة تركيز الاملاح حتى ٨٥٠٠ ميليجرام/لتر يؤدي لنقص معنوي في اطوال النباتات وعدد السنابل والخلفات لكل اصيص ومحصولي القش والحبوب. وبغض النظر عن المعاملات الملحية ، اعطت اصناف

سدس ١ ، جميزة ٩ اعلى محصول للحبوب (٣٢.٦، ٣١.٤ جم/اصيص على التوالي) بينما الاصناف سخا ٩٣ ، جميزة ١٢ اقل الاصناف (٢٦.٩ ، ٢٨.٣ جم/ اصيص على التوالي). واخيرا اعطت اصناف سدس ١ ، جميزة ٧ ، جميزة ٩ اعلى محصول حبوب نسبي (٦٤.١، ٦٥.٢، ٦٤.٤ % على التوالي) عند اعلى مستوى للملوحة (٨٥٠٠ ملليجرام/ لتر) مقارنة بباقي الاصناف موضع الدراسة بينما اعطت الاصناف سدس ١٣، سخا ٩٤ ،شندويل ١ ، جيزة ١٧١ اقل محصول نسبي عند نفس المستوى من الملوحة (٣٥.٤ ، ٣٥.٦، ٣٧.٩ ، ٣٨.٤ % على التوالي).

ومن خلال التحليل الكمي لبيانات محصول الحبوب النسبي للاصناف موضع الدراسة تم تقسيم الاصناف الى اصناف عالية التحمل للملوحة (سدس ١ ، جميزة ٧ ، ٩) واصناف متوسطة التحمل (سخا ٩٣ ، سهل ١ ، جميزة ١٠) وصنفت باقي الاصناف كاصناف حساسة للاجهاد الملحي.

وبناء على ذلك فأن الأصناف التى أظهرت أكثر تحملا للملوحة يمكن استخدامها فى برامج التربية لأستنباط أصناف جديدة يمكن زراعتها تحت ظروف الأراضى الملحية.

Effect of Potassium Fertilization on Yield and Quality of Some Potato Cultivars

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ABSTRACT: Potato is a cash money crop and plays a crucial role in Egyptian economy, but for its best growth; it demands a good fertilization program as N, P and K. Therefore, this study was conducted to find out the effect of potassium fertilizer levels, in specific, some cultivars on vegetative growth, yield and quality of potato (*Solanum tuberosum* L.). The investigation was conducted in a private farm during the two successive years of 2015 and 2016 in Maghnine village, Kom Hamada, El-Behera Governorate. Each experiment was laid out as split-plot design, with three replications for both seasons. Three cultivars; Spunta, Provento and Galactica were distributed in the main plots, while the potassium levels; 0,50,75 and 100 kg K_2O fed^{-1} were distributed in the sub-plots. The obtained results revealed that there were significant differences in the performance of the tested cultivars, regarding yield and quality parameters especially, cultivar "Galactica" which was found to be more responsive and had high yielding, where it gave the best results in most of the studied parameters. Application of potassium especially at 100 kg K_2O fed^{-1} led to the highest values of plant height (cm), plant yield (g), average of tuber weight (g), total tubers yield (ton fed^{-1}), tubers specific gravity, tubers total and reducing sugars content (%) and tubers starch content (%). Thus, it is, recommended that we should introduce potassium fertilizers to optimize productivity of potato in Egypt.

Keywords: potassium fertilizer, potato cultivars, potato tuber, vegetative and chemical characters, tuber yield and quality

INTRODUCTION

The potato (*Solanum tuberosum* L.) is a herbaceous annual plant that grows up to 100 cm tall and produces tubers. Potato is one of the more often grown crops. Also, ranks as the world's fourth most important food crop, after maize, wheat and rice (Spooner and Bamberg, 1994). Their tubers are a good source of carbohydrates, proteins, vitamins, and minerals in human nutrition (Blagoeva *et al.*, 2004). It is a major source of inexpensive energy. It contains high levels of carbohydrate and significant amounts of vitamins B and C and minerals. Moreover, potato is used in many industries, such as French fries, chips and starch (Abdel-Aal *et al.*, 1977). In Egypt, potato has an important position among all vegetable crops, where about 20% of the total area of vegetables production is devoted for potato (FAO, 2015). Egypt imports annually from 50000 to 55000 ton of potato seeds from the North West European countries, particularly from Netherland and England to be planted in the summer season in January up to middle of February.

Nevertheless, potato plants require nutrients supply through fertilization due to their shallow root system and high demand of nutrients for tuber's development. For instance, the use of potassium fertilizer is almost negligible in our country which has resulted not only in stagnation of crop yield, but also the quality of the crop. The Ministry of Agriculture of Egypt recorded more than two hundred potato cultivars that are handled in markets. These cultivars are usually subjected for several testes to determine their suitability for farming condition in Egypt. However, the productivity and economic characteristics of some recently introduced cultivars are much unknown. Therefore, developing a good management practices for potato growers in Egypt was selected and the present research was undertaken to:

i. Evaluate the three potato cultivars for tuber productivity and quality;
ii. Find out the optimal dose of potassium fertilizer in order to improve yields and economical returns to potato growers; and
iii. Examine the interaction effect between cultivars and potassium doses.

MATERIALS AND METHODS

Two field experiments were conducted in a private farm during the two successive summer years of 2015 and 2016, in clay loam soil at Maghnine village located at Kom Hamada, El-Behera Governorate to study the effect of potassium fertilizer levels and some potato cultivars on vegetative growth, yield and quality. The physical and chemical analysis of the soil prior to the initiation of the experiments is shown in Table (1). Certified imported Potato seeds of cultivars Spunta, Provento and Galactica were used after splitting. Cut seedy were planted at the 5th February, in both seasons in dry soil then irrigated. Seeds were planted in two ridges; 0.70 m wide, 6.25 m long and 0.25 m apart between hills on one side of the ridge, making an area of 8.75 m^2 for experimental plot.

Four potassium levels; 0, 50, 75 and 100 kg K_2O fed^{-1} were used. Potassium dosages were applied equally in the form of potassium sulfate (50% K_2O), at 45, 60 and75 days after seed sowing.

The experiments were laid out in split-plot system in randomized complete blocks design (RCBD), with three replications for both seasons. The cultivars were distributed in the main plots, while the potassium levels were distributed in the sub-plots. Data were, statistically, analyzed according to Snedecor and Cochran (1990). The least significant difference (LSD at 0.05) was used to compare the treatment means using CoStat (2005) program. All other agricultural practices for potato production were followed as recommended in the area. Harvesting was accomplished after 110 days of planting during both years.

Recorded data

Vegetative growth measurements

1. **Plant stand:** after complete plant emergence, 45 days after planting, the number of plants $plot^{-1}$ was counted and plant stand percentage was calculated.
2. **Number of main stems $plant^{-1}$:** it was determined after 45 days of planting, using the average number of main brunches of 10 plants.
3. **Plant height (cm):** it was measured after 75 days of planting, using the average height of 10 plants.

Yield and its components measurements

1. **Average of tuber weight (g)**: it was determined immediately after harvest, by dividing the weight of tubers yield by tuber's number of 10 plants.
2. **The number of tubers plant^{-1}**: it was determined just after harvest using the average number of tubers of 10 plants.
3. **Total tubers yield fed^{-1}:** The yield of the plot was weighed and then converted into tons fed^{-1}.
4. **Average of tuber yield plant^{-1} (g):** It was determined using the average weight of tubers of 10 plants.

Chemicals analysis

1. **Tuber specific gravity:** It was calculated as average of three grades for each treatment according to the methods of (Dinesh *et al.*, 2005) by the following formula: Specific gravity = $\frac{Weight\ in\ air}{Weight\ in\ air - Weight\ in\ water.}$
2. **Tuber starch content (%):** It was determined using the method described in (A.O.A.C, 1980) on dry matter basis.
3. **Tuber reducing sugars content (%):** It was determined using 5 g. fresh tuber root, using sulphuric acid and phenol (5%) then colorimetrically determined, according to the method of Dubois *et al.* (1956).
4. **Tuber total sugars content (%):** It was determined using Dubois *et al.* (1956) method on fresh weight basis.

Table (1). The physical and chemical soil properties of experimental site in 2015.

Physical analysis	Sand (%)	24.68
	Silt (%)	35.71
	Clay (%)	39.61
	Texture	Clay loam
Chemical analysis	pH	7.5
	E.C (dS/m)	1.47
	$CaCO_3$	3.25
	O.M (%)	١.٤٤
	Available P (mg/kg)	3.1
Soluble cations (meq L^{-1})	Ca^{++}	1.6
	Mg^{++}	5.0
	Na^{+}	7.4
	K^{+}	0.67
Soluble anion (meq L^{-1})	CO_3^{-}	zero
	$H\ CO_3^{-}$	4
	Cl^{-}	4
	SO_4^{-}	6.8

RESULTS AND DISCUSSION

A. Vegetative growth measurements

1. Plant stand (%)

Table (2) shows that there were no significant differences among cultivars on potato plants stand in both seasons. This finding could be taken place due to the physiological status of the seed tubers and cultivars. It can be noticed from Table (2) that the cultivar "Galactica" tended to increase plant stand (%) than.

Table (2). Effect of potato cultivars, potassium fertilization and their interactions on vegetative measurements of potato plants grown during 2015 and 2016 summer seasons.

Treatments	2015 season	2016 season	2015 season	2016 season	2015 season	2016 season
	Plant stand (%)		Number of stems plant^{-1}		Plant height (cm)	
Cultivar						
Spunta	68.62a	70.09a	1.86a	1.76a	68.62b	70.09b
Provento	70.65a	71.43a	1.80a	1.73a	70.65b	71.43b
Galactica	72.65a	77.46a	1.76a	1.54a	89.11a	88.04a
K_2O (kg fed^{-1})						
Control	69.24a	73.11a	1.81a	1.73a	75.05a	74.21 a
50	69.58a	72.48a	1.83a	1.61a	75.06a	76.22 a
75	70.48a	73.62a	1.76a	1.66a	75.77a	76.72a
100	73.26a	72.76a	1.83a	1.71a	78.63a	78.92a
Interaction	ns	ns	ns	ns	ns	ns

Mean values in the same column marked with the same letter(s) is (are) not significantly different at 0.05 level of probability.
ns= not significant.

The other cultivars, nevertheless this increase did not reach the significant level, during both seasons of the study. In the same context, that there was no such significant difference regarding potato plants emergence among the K_2O application treatments, during both seasons. This finding is in accordance with those of Singh and Lal (2012) and Berisha *et al*. (2014) who stated that plant emergence was not influenced by potassium applied levels. No such significant interaction effects between potato cultivars and Potassium fertilization were noticed to change plant stand % during both season of the presented study.

2. Number of main stems plants^{-1}

Data presented in Table (2) exhibited that number of main stems plants^{-1} was not, significantly, affected among the tested cultivars either in the first or second season. It is worth to be mentioned that all the plants in this study produced less than two stems, which reflected that the used mother tubers were not in a good physiological state. This observation may be arised due to the apical dominance phenomenon (Zaky, 2011). As for the potassium fertilization, there was no such a significant difference among the applied K_2O treatments, during both seasons of the study. This phenomenon can be noticed because number of main stems plants is a trait related to physiological status of the used tubers and cultivars. Also, number of stems plant^{-1} is a factor dependent variety, seed size and its physiological status; hence, stems per hill were not influenced by potassium levels (Singh and Lal, 2012). El Gamal (1985) who reported that none of N or K levels, significantly affected stem number/ plant of potato cultivars. No such significant interaction effects between potato cultivars and potassium fertilization were noticed to change the number of main stems plant^{-1} during both seasons of the presented study.

3. Plant height (cm)

Table (2) illustrated that the “Galactica” cultivar, significantly, surpassed both “Spunta” and “Provento” cultivars regarding plant height, during both seasons of the study. This result may be attributed to varietal differences. Similar conclusion was reported by Tafi *et al.* (2010). As for potassium fertilization treatments, although it resulted in a gradual increase in plant height, nevertheless, there were no any significant differences among the various tested level of K_2O, including control treatment, during both seasons. On the contrary, Singh and Lal (2012) showed that potassium had significant effect on plant height which, significantly, increased up to 100 kg K_2O/ ha. Meanwhile, the interaction effects between potato cultivars and potassium fertilization concerning plant height was insignificant.

B. Yield and its components

1. Average of tuber weight (g)

Respecting the main effect of cultivars, data of Table (3) exhibited that average tubers weight of potato was, significantly, influenced ($P \leq 0.05$) by the three used cultivars during the both seasons of the study. The cultivar “Galactica” was superior on the other two tested cultivars. Despite there was no significant difference in average tuber weight between cultivar “Provento” and “Spunta”. These varietal differences may be due to the differences among the maturity, tuber initiation time, light intersection, the physiological activity, and the ability to accumulate photosynthetically substances (Zaky, 2011). On the other hand, concerning the effect of K_2O fertilization, data claimed that potato average tuber weight, significantly and progressively, increased with increasing K levels. In the first season, maximum and minimum mean values of 154.82 and 110.61 gm per plant were arise from application of 100 kg K_2O fed^{-1} and control, respectively.

Table (3). Effect of potato cultivars, Potassium fertilization and their interactions on yield and its components of potato plants grown during 2015 and 2016 summer seasons.

Treatments	2015 season	2016 season	2015 season	2016 season	2015 season	2016 season	2015 season	2016 season
	Tuber weight (g)		Tubers number $plant^{-1}$		Plant yield (g)		Total tubers yield (ton fed^{-1})	
Cultivar								
Spunta	115.75b $^{\phi}$	115.29b	7.72ab	7.61c	891.76c	970.54b	13.02 b	13.93c
Provento	127.69b	113.79b	8.23a	9.23a	1039.73b	1043.19b	12.86 b	14.83b
Galactica	152.17a	155.79a	7.31b	8.40b	1197.45a	1303.98a	15.49 a	16.32a
K_2O (kg fed^{-1})								
Control	110.61d	111.66d	7.78a	8.88a	891.85c	946.63c	10.86d	11.83d
50	124.10c	122.38c	7.82a	7.86b	941.45c	1001.06c	12.77c	14.57c
75	137.96b	133.06b	8.1a	8.45a	1104.49b	1171.02b	15.25b	16.12b
100	154.82a	146.06a	7.32a	8.46a	1234.14a	1304.91a	16.28a	17.58a
Interaction	*	ns	ns	ns	ns	ns	ns	ns

$^{\phi}$ Mean values in the same column marked with the same letter (s) is (are) not significantly different at 0.05 level of probability. *= significant ns = not significant.

Similar results were noticed in the second season, Adhikary and Karki (2006) found a sharp response of potato to K_2O application, especially for tuber weight. Many researchers reported that K has desirable effects on potato crop and quality. As for the interaction between the tested cultivars and potassium fertilizer levels, data disclosed that there were significant differences concerning the mean values only during the first season (2015). It was clear that the highest mean value became from cultivar “Galactica” with the level of 100 Kg K_2O fed^{-1}.

2. Number of tubers $plant^{-1}$

Table (3) revealed that number of tubers $plant^{-1}$ of “Provento” cultivar was, significantly the most pronounced among the tested cultivars as recorded 8.23 in the first season, and 9.23 in the second one. The differences detected between “Spunta” and “Galactica” cultivars, regarding the average of number of tubers $plant^{-1}$ in 2015 season; appeared to be insignificant. Meanwhile, during 2016 season, there was a significant difference between both previous cultivars, where “Provento” cultivar was the first (9.23), “Galactica” cv. recorded the second rank (8.40) and “Spunta” came the third rank (7.61). This result agrees with those of Saluzzo *et al.* (1999); Tekaling and Hammes (2005) who concluded that some cultivars produced the highest total tuber yield when compared with other cultivars. On the other way, none of the tested K_2O levels, during the first season of the study has expressed such significant difference. Meanwhile, in the second season, the control treatment had the highest mean value for number of tubers per plant (8.88). Whereas, the treatment of 50 kg K_2O fed^{-1}; gave the lowest mean value (7.86) trait with significant differences among the other K_2O treatments. On the contrary, El-Gamal *et al.* (1993) reported that insufficient K; results in reduced potato yield and smaller sized tubers. There were no significant differences regarding the interaction between used cultivars and potassium doses to change number of tubers plant^{-1} during both seasons.

3. Average of tubers yield plant^{-1} (g)

Data in Table (3) disclosed that potato plant tubers yield was significantly (*P* ≤0.05) affected by used cultivars during both seasons of the study. In the first season, "Galactica" cultivar surpassed the other two cultivars, significantly. It possessed the highest mean value of average tubers yield plant^{-1} (1197.45 g), followed by "Provento" cultivar (1039.73 g) which was also, significantly, surpassed the third cultivar "Spunta". Nevertheless, in the second season, there were also significant differences among the three tested cultivars with the continued of superiority to cultivar "Galactica" (1303.98 g) over the other two cultivars. This result is consistent with that of Abdel-Aal and Imam (1984) who found a wide variation in yield and quality of tubers due to high genetic variability among different cultivars of potato under Assiut conditions. Concerning to the effect of potassium fertilization, the presented data clarified that the potassium levels, significantly, affected tubers yield plant^{-1} during both seasons. Potassium level at 100 kg K_2O fed^{-1} was superior and led to the highest plant yield mean value of tubers yield plant^{-1} (1234.14 g) and (1304.91 g), in 2015 and 2016, respectively. In the same context, Berisha *et al*. (2014) pointed out that potassium fertilizer rate, significantly, affected potato tuber yield. While, the interaction effects between potato cultivars and potassium fertilization respecting tubers yield plant^{-1} was insignificant in both seasons.

4. Total tubers yield ton fed^{-1}

The investigated cultivars declared significant (*P* ≤0.05) differences in total tubers yield fed^{-1} as shown in Table (3). The cultivar "Galactica" had the highest mean value of total tubers yield ton fed^{-1} during the both seasons of study. The difference in total tubers yield fed^{-1} between the cultivars "Spunta" and "Provento" was not significant in 2015 season, whereas cultivar "Provento" significantly, exceeded cultivar "Spunta" in 2016 season. As for the effect of potassium fertilization, data in Table (3) announced that Potassium application significantly (*P* ≤0.05) affected total tubers yield fed^{-1} compared with the control. Increasing level of K application up to 100 kg K_2O fed^{-1}, significantly and progressively, increased the total tubers yield fed^{-1}, in both seasons. Razaq *et al.* (2015) revealed that the potash levels had significant effect on potato tubers yield plant^{-1}. It, also, had a significant effect on total tubers yield ha^{-1}. There were no significant differences regarding the interaction effect between used cultivars and potassium doses in both seasons.

C. Chemicals analysis

1. Tuber specific gravity

Based on the main varietal effect on tuber specific gravity, it was found to have significant (*P* ≤0.05) differences among the varieties evaluated (Table, 4). The highest tuber specific gravity (1.092) and (1.086) was derived from cultivar

"Provento", where "Spunta" cv.; produced the lowest ones (1.064) and (1.064) in 2015 and 2016 seasons, respectively. In a similar study, Abong *et al.* (2010) found that specific gravity and dry matter contents had significant difference among potato varieties. The effect of potassium fertilization on tuber specific gravity was significant and the trend was approximately similar; in both seasons. Application of potassium fertilizer at 100 kg fed^{-1}, significantly, produced the highest tuber specific gravity, in both seasons.

Table (4). Effect of potato cultivars, Potassium fertilization and their interactions on chemicals analysis of potato plants grown during 2015 and 2016 summer seasons.

Treatments	2015 season	2016 season	2015 season	2016 season	2015 season	2016 season	2015 season	2016 season
	Specific Gravity		Tuber's total sugars (%)		Tuber reducing Sugars (%)		Tubers' starch (%)	
Cultivar								
Spunta	1.064b	1.064b	0.907a	0.905c	0.46a	0.45b	14.87a	14.19a
Provento	1.092a	1.086a	0.948a	0.969b	0.50a	0.49a	15.39a	15.21a
Galactica	1.065b	1.067b	1.010a	1.036a	0.50a	0.52a	15.57a	15.23a
K_2O (kg fed^{-1})								
Control	1.061c	1.063c	1.006a	0.978a	0.50ab	0.530a	15.94a	15.38a
50	1.071b	1.070bc	0.904a	0.970a	0.540a	0.510ab	15.07ab	15.22a
75	1.077b	1.075ab	0.959a	0.970a	0.480ab	0.480b	15.24ab	14.83a
100	1.086a	1.082a	0.944a	0.962a	0.430b	0.430c	14.85b	14.07b
Interaction	ns	ns	ns	*	ns	ns	ns	ns

Mean values in the same column marked with the same letter(s) is (are) not significantly different at 0.05 level of probability. ns = not significant. *= significant.

The sole exception was in 2016 season where the difference in tuber specific gravity between 100 and 50 kg K_2O fed^{-1} was not significant. These findings are matching with those reported by Zelelew and Ghebreslassie (2015) who declared that Potassium application had positive significant effect on specific gravity of potato tubers. Concerning the interaction effect between used cultivars and potassium fertilization was not significant, in both seasons (Table 5).

Table (5). Effect of interactions of potato cultivars and potassium fertilization on tubers specific gravity ant total sugars content (%) of potato plants grown during 2015 and 2016 growing seasons.

Treatments		Specific gravity		Tuber's Total Sugars (%)	
Cultivars	Potassium fertilization (K_2O Kg/ fed)	2015 season	2016 season	2015 season	2016 season
Spunta	Control	1.051	1.051	0.832a	0.923ab
	50	1.055	1.059	0.745a	0.875c
	75	1.069	1.067	0.805a	0.859c
	100	1.079	1.079	0.883a	0.962ac
Provento	Control	1.089	1.089	0.816a	1.012ac
	50	1.094	1.088	0.679a	0.949ac
	75	1.083	1.077	0.936a	0.982ac
	100	1.1	1.089	0.768a	0.934ac
Galactica	Control	1.041	1.047	0.879a	0.998ac
	50	1.063	1.062	0.565a	1.087a
	75	1.077	1.081	0.786a	1.069ab
	100	1.077	1.078	0.691a	0.990ac

Mean values in the same column marked with the same letter(s) is (are) not significantly different at 0.05 level of probability.

2. Tubers' starch content (%)

Regarding the main effect of cultivars, data presented in Table (4) exhibited that tuber starch content was not, significantly, affected ($P \leq 0.05$) by tested cultivars during both seasons. Saluzzo *et al*. (1999) and Tekalign and Hammes (2005) reported that potato cultivars differ in their starch contents. The impact of potassium fertilizer levels on tuber starch content was significant, in both seasons. Application of potassium fertilizer at 100 kg K_2O fed^{-1}, significantly, produced the lowest mean value of tuber starch content, whereas, the control treatment, significantly, resulted in the highest mean value of this character, in both seasons. There were significant downs starch content because of increases of potato tubers yield, especially the tubers bigger than 60 mm (Barascu *et al.,* 2015). Concerning the interaction effect between used cultivars and potassium fertilization was not significant, in both seasons.

3. Tuber's total sugars content (%)

The influence of the three tested cultivars on tuber total sugars content, significantly varied between the two seasons (Table 4). In 2015 season, no significant differences in tuber total sugars content among the three tested cultivars. In 2016 season, tuber total sugars content was significantly, remarkable in cultivar of "Galactica" followed by "Provento" and "Spunta", orderly. These results are in accordance with Olsen *et al*. (2005) who revealed that there are four major factors that influence sugar accumulation in potatoes: cultivar, maturity, stress and storage conditions. Respecting the potassium fertilizer effect, data in the same table expressed that there were no significant differences in tubers total sugars content among the various applied potassium fertilizer levels, including control treatments during both seasons. As about, the interaction effect between the two studied factors on tubers total sugars content of was not significant, in 2015 season, but the reverse was true, in 2016 season. The growing plants of cultivars "Galactica" and "Spunta" fertilized with potassium at 50 kg fed^{-1}, significantly, attained maximum and minimum tuber total sugars content, respectively.

4. Tuber reducing sugars content (%)

Data presented in Table (4) expressed that varietal influence on tuber reducing sugars content was insignificant in 2015, but significant in 2016. Tuber reducing sugars content of cultivars "Provento" and "Galactica" was, significantly, higher than "Spunta" cultivar. Difference between cultivar "Provento" and "Galactica" in tuber reducing sugars content was at par. This result was in parallel with that stated by Trehan *et al.* (2007) who mentioned that "Accent" and "Turbo" cvs.; gave a higher value of total amino acids content and the highest values in reducing, un-reducing and total sugars content of potato tubers. With respective to the main effect of K_2O fertilizer, during the first season (2015), providing the tested potato plants with 50 kg/fed, resulted in the highest mean value of tuber reducing sugars content (0.54 %) despite existence some other insignificant value among the tested treatments, except for those plants fertilized with 100 Kg/fed (0.43 %). But during the second growing season (2016), the control treatment; gave the highest mean value of tubers reducing sugars content (0.53 %) with a significant value with 75 kg/fed (0.48 %) and100 kg/fed (0.43 %), respectively. These results are in harmony with Anon (2000 and 2005) who indicated that K application through potassium sulphate improved specific gravity, chip color score and decreasing the reducing sugars content of 4 processing grade potato varieties. No interaction effects between potato cultivars and potassium fertilization were noticed to change tubers reducing sugars content during both seasons of the study.

CONCLUSIONS

In the light of all the above-mentioned data, it's possible to conclude that: The cultivar "Galactica" treated with the level of 100 kg K_2O /fed; gave the highest mean values of plant height (cm), plant yield (g), tubers average weight (g) and total yield (ton/ fed). The cultivar "Provento" applied with 100 kg K_2O /fed was the best rang of specific gravity. Generally, we could recommend the following:

- Using the potato cultivar "Galactica" especially, for more yield and quality potato production.
- Using the potassium fertilizers as 100 kg K_2O/fed where it recorded the highest mean values of yield and quality.

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الملخص العربي

تأثير التسميد البوتاسى على محصول وجودة بعض أصناف البطاطس

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أجريت هذه الدراسة في إحدى المزارع الخاصة في قرية مغنين – مركز كوم حمادة – محافظة البحيرة، خلال الموسمين الزراعيين ٢٠١٥ و٢٠١٦، وذلك بهدف دراسة تأثير مستويات مختلفة من السماد البوتاسى على نمو وإنتاجية وجودة بعض أصناف محصول البطاطس. تم اجراء التجربة بنظام القطع المنشقة مرة واحدة في ثلاث مكررات، تم زراعة ثلاثة أصناف من البطاطس هي اسبونتا، بروفنتو، جالاكتيكا، وتم التسميد البوتاسى من خلال أربعة مستويات هي الكنترول (٠)، ٥٠، ٧٥، ١٠٠ كجم من أوكسيد البوتاسيوم (K_2O) للفدان، زرعت الأصناف عشوائيا في القطع الرئيسية، بينما تم توزيع معاملات التسميد البوتاسى عشوائيا في القطع المنشقة.

أهم النتائج المتحصل عليها

- أعطى الصنف "جالاكتيكا" أعلى قيمة لارتفاع النبات.
- أعطى الصنف "بروفنتو" أعلى متوسط لعدد الدرنات لكل نبات.
- أدت زراعة الصنف "جالاكتيكا" والتسميد ب ١٠٠ كجم سلفات بوتاسيوم إلى أعلى متوسط لمحصول النبات الواحد (جم)، أعلى متوسط لوزن الدرنة (جم)، أعلى متوسط للمحصول الإجمالى (طن/فدان).
- أدت زراعة الصنف "بروفنتو" والتسميد ب ١٠٠ كجم سلفات بوتاسيوم إلى الحصول على أعلى نسبة للكثافة النوعية للدرنات.
- احتوت درنات الصنف "جالاكتيكا" على أعلى نسب من السكريات الكلية والمختزلة.
- أدى استخدام التسميد البوتاسى إلى تقليل محتوى الدرنات من السكريات المختزلة.

توصى الدراسة بزراعة صنف جالاكتيكا والتسميد ب ١٠٠ كجم سلفات بوتاسيوم للفدان للحصول على أعلى إنتاجية، وأفضل جودة للدرنات.

Sugar Beet Response to Nitrogen and Potassium Fertilization Treatments in Sandy Soil

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ABSTRACT: Two field experimental were carried out at 71 Km West Nubaryia Cairo Desert Road El- Behara Gov. Egypt during two successive seasons 2014/ 15 and 2015/ 16 to study the effects of four nitrogen fertilizer rates (without, 33.5, 67 and 100.5 kg N/ fed.), four potassium fertilizer rates (without, 16, 32 and 48 kg k_2o/ fed.) and their interactions on yield and quality of multigerm sugarbeet cultivar (Magribl) grown in sandy soil under drip irrigation system were investigated at West Noubaryia region condition. In this split plot design, the main plots were assigned to rates of nitrogen fertilizer and potassium rates were arranged to random as the sub- plots. The results indicated that increasing nitrogen and potassium fertilizer rates significantly increased yield characterizes, roots, top and sugar yields (tons/ fed.). Adding the highest rates of nitrogen (100.5 kg N/ fed.) and potassium (48 kg K_2O/ fed.) produced the highest sugarbeet yields of roots (34.98 and 29.39 tons/ fed.), top (28.73 and 22.53 tons/ fed.) and sugar (4.76 and 3.82 tons/ fed.), respectively. Increasing nitrogen rate up to 100.5 kg N/ fed. and potassium rate up to 32 Kg K_2O/ fed. significantly, increased of some juice quality, total soluble solids (T.S.S) and sucrose concentration in roots juice. While the other juice trait, purity percentage was insignificant affected by nitrogen and potassium application rates. The maximum T.S.S% (21.37 and 20.43) and sucrose% (16.90 and 16.36) was achieved by adding 100.5 Kg N and 32 Kg K_2O/ fed., respectively. Also, increasing nitrogen and potassium fertilizer rates significantly increased impurity parameters, (Na, K, α- amino nitrogen percentages and loss sugar%) as well as decreased QZ%. In conclusion nitrogen fertilizer application at a rate of 100.5 kg N/ fed. accompanied with 48 kg K_2O/ fed. was found to be the most favorable for improving the yield and quality of sugarbeet grown in a sandy.

Key words: sugarbeet, yield characters, quality, Impurities parameters nitrogen, potassium fertilizer rate.

INTRODUCTION

The population of the world will exceed 9 billion by the year 2050. It is, therefore, of vital importance to improve crop yield to match the requirements for food. However, as the environment was becoming worse, the quantity and quality of crop production were significantly decreased by a variety of biotic and abiotic stresses. The practice of intensive fertilization to support massive food production for an increasing global population is a must. However, consumption of excess N fertilization and K deficiency cause a reduction in crop yields and quality in many regions. Therefore, to enable closing yield gaps and allow for a much higher productivity in many regions, a significant increase in fertilization application is required. K is an essential plant nutrient that impacts a number of physiological and biochemical processes that are involved in plant resistance to biotic and abiotic stresses. Maintaining an optimum K nutritional status is essential for plant resistance to biotic and abiotic stresses. Balanced fertilization and efficient K usage in combination with other nutrients not only contribute to sustainable crop's growth, yield and quality, but also influence plant health and reduce the environmental risks (Wang *et al.*, 2013).

In addition, Potassium (K) is one of the essential macronutrients for higher plants, not only important for plant growth and development, but also crucial for crop yield and quality (Wang and Wu, 2015). Nitrogen (N), one of the most important mineral nutrients in higher plants, is involved in plant metabolism as a constituent of amino acids, proteins, nucleic acids, lipids, chlorophyll, co-enzymes, phytohormones, and secondary metabolites (Wang *et al.,.* 2016). The application of too little nitrogen will result in reduced root tonnage, however, the application of too much nitrogen will result in reduced sugar concentrations and increased impurities (Hergert, 2010).

Now, Egypt faces many problems that affect the productivity of crops in general and sugar crops in particular, including sugar beet, which evolves significantly at the moment. So that, it became the first source for the production of sugar in Egypt, where the production of sugar from beets has 57% (1,347 Million tons) of sugar production in Egypt**.** While the sugar cane production was 43% (1,025Million tons), (Sugar Crops Council , 2016). One of the main problems is the water after building El- Nahda Dam and the high prices of fertilizer, particularly nitrogen and potassium.

Now, there is no accurate and wide-ranging information which considers to consequence of nitrogen and potassium fertilizer rates on yield and quality of sugar beet in sandy soil under drip irrigation system at West Noubaryia region conditions.

MATERIAL AND METHODS

Two field experiments were conducted at km 71 West Noubaryia, Alex. Cairo desert Road, El Behiera governorate, Egypt during two successive seasons, 2014/ 15 and 2015/ 16, to study the effect of nitrogen and potassium fertilizer rates and their interactions on yield characters, quality and impurity parameters of multigerm sugar beet (*Beta vulgaris* L.) cv. Magribl. The nitrogen and potassium fertilizers were in the forms of urea (46 %N) and potassium sulphate (48 % K_2O), respectively, were applied as a side- dressing in two equal doses. The first was applied after thinning and the other was applied four weeks later.

- The nitrogen rates used

Without nitrogen fertilizer (N_0), 33.5 kg N/ fed. (N_1), 67 kg N/ fed.(N_2) and 100.5 kg N/ fed.(N_3)

- Potassium rates used

Without potassium fertilizer (K_0), 16 kg K_2O/ fed.(K_1), 32 kg K_2O/ fed.(K_2) and 48 kg K_2O/ fed.(K_3)

Before soil preparation, soil samples were taken at a depth of 0: 30 cm depth from different experimental sites, to determine physical and chemical properties of soil according to Piper (1950) as shown in Table (1).

Table (1). Some physical and chemical properties of the experimental soil in 2014/2015 and 2015/2016 seasons

Soil properties	2014/2015	2015/2016
A- Mechanical analysis		
Sand%	88.85	88.23
Clay%	4.30	4.80
Silt%	6.85	6.97
Soil texture	Sandy	Sandy
B- Chemical properties		
pH (1:1)	8.50	7.35
EC (dS/m) (soil : water extract)	1.20	1.14
1- Soluble cations (1:2) (meq/L))		
K^+	0.82	1.20
Ca^{++}	2.76	3.10
Mg^{++}	1.90	2.30
Na^+	4.35	4.65
2- Soluble anions (1:2) (meq/L)		
HCO^-_3	2.72	2.72
CL^-	7.90	7.09
$SO^=_4$	1.15	0.98
Calcium carbonate (%)	20.0	20.0
Available nitrogen (mg/kg)	33.00	23.00
Available Potassium (mg/kg)	115.20	112.75
Organic matter (%)	0.37	0.83

Each field experiment was including two factors in split- plot design with three replications. The main plots were assigned to rates of nitrogen fertilizer and potassium rates Z6 meters in length, thus, the area of the plot was 21 m^2 (6 x 3.5 m) 1/200 fed.

The experimental field well prepared through two ploughing, leveling, compaction, ridging, and then divided into the experimental units. Calcium super phosphate (15.5 % P_2O_5) was applied during soil preparation at the rate of 100 kg/ fed. Sugar beet balls were hand sown 3- 5 balls/ hill using dry sowing method on one side of the ridge in hills 20 cm apart on 13^{ts}october during two seasons. The plots were irrigated immediately after sowing directly. Plants were thinned at the age of 4 leaf stage to obtain one plant/ hill. The common agricultural practices for growing sugar beet according to the recommendations of Ministry of Agriculture were followed, except the factors under study.

Data Recorded:

The outer two ridges (1st and 6th) were considered as a belt, while plants of the 2nd, 3rd, 4th and 5th were kept for determination of yield characters and technological qualities.

I- Yield characters

At harvest, plants that produced from the four ridges (from 2 to 5) of each sub sub-plot were collected. Roots and tops were separated and weighted in kilograms, then converted to estimate:

1. Roots yield (tons/fed)
2. Top yield. (tons/fed)
3. Sugar yield (tons/fed)

It was calculated by multiplying roots yield × sucrose percentage

II- Juice Quality

Total soluble solids percentage (TSS %) in roots.

It was measured in juice of fresh roots by using Hand Refractmeter (Me Ginnis 1982).

1. Sucrose percentage.
2. Purity percentage.

III- Impurities parameters:

1. Sodium (Na ; meq/100 g)
2. Potassium (K; meq/100 g)
3. α- amino nitrogen (α- AN; meq/100 g)
4. Extractable white sugar % (ZB%).

Correct sugar content (white sugar) of beet was calculated by linking the beet non K, Na and α-amino Nitrogen expressed a (meq/100 g) according to Reinfeld *et al*. (1974) as described by Harvey and Dutton (1993) as follows

$$ZB = (Pol- 0.29) - 0.343 (K + Na) - 0.094 \ \alpha\text{-amino-N}$$

5. <u>Quality% (QZ%)</u>
   $QZ = (ZB \times 100)/ (\alpha\text{-amino-N})$

6. <u>Alkalinity Coefficient (AK)</u>
   was determined as described by Harvey and Dutton (1993) as follows:
   $AK= (K + Na) / (\alpha\text{-amino-N})$

7. <u>Loss Sugar %</u>
   Loss Sugar % = Gross sugar % - White sugar%
   Gross sugar % = Sucrose%
   White sugar% = Extractable white sugar% (ZB%)

Sucrose, quality, purity and impurity parameters were determined in Sugar Nile Company.

Statistical analysis:

All data were statistically analyzed according to combine of two seasons by “MSTAT” Computer software package and least significant difference (LSD) method was used to test the differences between treatment means at 5% levels of probability.

RESULTS AND DISCUSSION

The effects of different nitrogen, potassium fertilizer rates and their interactions on sugarbeet yield characters, quality and impurity parameters in sandy soil field under drip irrigation system are illustrated in Tables (2 to 5).

I- Yield characters:

Data of the effects of different nitrogen, potassium fertilization rates and their interactions on sugarbeet yield characters i.e. roots yield, top yield and sugar yield were recorded in Table (2).

I-1- Roots yield (tons / fed.)

The result in Table (2) cleared that the roots yield (tons/fed.) was significantly increasing with increasing nitrogen rate from N_0 [without] to N_1 (33.5), N_2 (67.0), and N_3 (100.5) kg N/ fed. Application nitrogen at the higher rate (100.5kg N/ fed.) produced the highest roots yield (34.98 tons/ fed.), while, the lowest one (19.70 tons/ fed.), resulted from control treatment (without nitrogen fertilizer). The increasing than control treatment (N_0) for N_1, N_2, N_3 rates were 24.18, 41.15 and 77.55 %, respectively. Such effect might have due to improved beet growth in term of more dry matter accumulation.

Also, the results in Table (2) showed that increasing potassium fertilizer rate from K_0 [without] to K_1 (16 kg K_2O/ fed.), K_2 (32 kg K_2O/ fed.), and K_3 (48 kg K_2O/ fed.) rates significantly increased roots yield by 15.65, 20.41 and 27.31 %, respectively as compared with the control treatment (K_0). The highest yield (29.39 tons/ fed.) resulting from potassium fertilizer at K_3 rate. Roots yield /fed. Significantly effected by the interaction between nitrogen and potassium fertilizers revealed that the combination of N_3 + K_3 (100.5 kg N/ fed. + 48 kg K_2O / fed.) had the highest roots yield (40.75 tons/fed.)

I-2- Top yield (tons/ fed.)

The data in Table (2) indicated that top yield (tons/ fed.) significantly increased as a results of increasing nitrogen fertilizer rates. Roots yields resulting from nitrogen fertilizer were 12.35, 17.24, 21.83 and 28.73 tons/ fed. at the rates of 33.5, 67 and 100.5 kg N/ fed., respectively . Relative percentages of increase in top yield to control treatment were 39.55, 76.73 and 132.62 % for N_1, N_2 and N_3 rates, respectively.

According to potassium fertilizer rates, increasing potassium fertilizer rate from K_0 (without fertilizer) to K_1, K_2 and K_3 significantly increased top yield. No significant difference was found between applied K_2 and K_3 rates in this respect. Fertilizing sugarbeet plants with $K_{0,}$ K_1, K_2 and K_3 rates produced 17.04, 19.18, 21.41, and 22.53 tons/ fed. of top yield, respectively. The increase percentage in top yield as compared with control treatment were 12.60, 25.61, and 32.27 for K_1, K_2 and K_3 rates, respectively. There were significant effects for the interaction between nitrogen and potassium fertilization rates on top yield/ fed. The highest top yield values (30.50 and 31.48 tons/ fed.) was obtained by planting beets with combination of N_3 + K_2 (100.5 Kg N/ fed. + 36 kg K_2O/ fed.) or N_3 + K_3 (100.5 kg N/ fed. + 48 kg K_2O/ fed.) Table (2).

Table (2). Effect of different nitrogen, potassium fertilizer rates and their interactions on yield characters of sugarbeet crop in combine analysis of 2014/15 and 2015/16 seasons.

Nitrogen rates (N)	Potassium (K) rates					Increase%
	K_0	K_1	K_2	K_3	Average	
Root yield (tons/fed.)						
N_0	17.57	20.77	20.15	20.32	19.70	
N_1	20.66	24.02	27.40	25.79	24.46	24.18
N_2	24.65	27.57	28.34	30.69	27.81	41.15
N_3	29.45	34.43	35.30	40.75	34.98	77.55
Average	23.08	26.69	27.79	29.39		
Increase%		15.65	20.41	27.31		
Top yield (tons/fed.)						
N_0	9.56	11.73	13.77	14.36	12.35	
N_1	13.94	15.30	19.92	19.80	17.24	39.55
N_2	18.83	22.13	21.86	24.50	21.83	76.73
N_3	25.82	27.58	30.05	31.48	28.73	132.62
Average	17.04	19.18	21.40	22.53		
Increase%		12.60	25.61	32.27		
Sugar yield (tons/fed.)						
N_0	2.01	2.42	2.52	2.57	2.38	
N_1	2.61	3.00	3.65	3.28	3.13	31.71
N_2	3.18	3.61	3.63	4.05	3.62	52.12
N_3	3.94	4.71	5.01	5.38	4.76	100.00
Average	2.94	3.44	3.70	3.82		
Increase%		17.08	26.18	30.08		

	Root yield	Top yield	Sugar yield
LSD $_{0.05}$ N	1.05	1.11	0.23
LSD $_{0.05}$ K	1.21	1.38	0.30
LSD $_{0.05}$ N×K	2.18	2.29	ns

In% = increase% than control treatment   ns=not significant

I-3- Sugar yield:

Significant difference was noticed in sugar yield among nitrogen fertilizer rates. The highest sugar yield (4.76 tons/ fed.) value was produce from the highest rate of nitrogen fertilizer of 100.5 kg N/fed. followed by 67 N/fed (3.62 tons/ fed.), 33.5 N/fed (3.13 tons/ fed.) and control treatment (2.38 tons/ fed.) rates.

Therefore, the nitrogen had the greatest direct effect on sugar yield value .The relative increases than control treatment were 31.71, 52.12 and 100% for 33.5, 67.0 and 100.5 kg N/ fed. rates, respectively as shown in Table (2). Comparing among potassium fertilizer rates, increasing rate of potassium fertilization enhanced sugar yield/ fed. The rates of K_2 (3.73 tons/ fed.) and K_3 (3.82 tons/ fed.) significantly increased sugar yield /fed. than both K_0 (2.14 tons/ fed.) and K_1 (3.44 tons/ fed.) rates, without significant differences between them. Relative increases than control treatment for K_1, K_2 and K_3 potassium rates were 17.08, 26.18 and 30.8 %, respectively. There was not significant effected for interaction between nitrogen and potassium rates on sugar yield.

The data in Table (2) showed that increasing nitrogen significantly increased roots yield, top yield, and sugar yield. The same results had been observed throughout different experiments which were obtained by Agami (2005); Maareg *et al.* (2005 a & b); Leilah *et al.*(2005); Ouda (2007); Osman (2011); Sarhan (2012); Shaban *et al.* (2014); Abdelaal and Tawfik (2015) and El–Deeb (2016). Also, Table (2) cleared that increasing nitrogen rate significantly increased yield characters i.e. roots, top and sugar yields. These results are in agree with those of Abido *et al.* (2015).

The data observed that roots and top yield significantly affected in the interaction between nitrogen and potassium fertilization rates. On the contrary, sugar yield/ fed. insignificantly affected by the interaction between nitrogen and potassium rates. These results are in agreement those of Osman (2005) and El-Shafai (2000).

II- Juice Quality:

The effects of nitrogen and potassium fertilizer treatments on sugarbeet juice quality i.e. total soluble solids (T.S.S%), sucrose and purity percentages were tabulated in Table (3)

II-1-Total soluble solids percentage (T.S.S%):

Significant difference was noticed for T.S.S % value among nitrogen rates. The highest T.S.S % value was resulted by adding higher nitrogen rate (100.5 kg N/ fed.) followed by 67 and 33.5kg N/ fed. rates, with an average of 21.37, 20.17, 19.84 and 18.5%, respectively. The relative increase than control treatment (without nitrogen fertilizer) were 7.25, 9.06, and 15.52% for N_1 (33.5), N_2 (67.0), and N_3 (100.5) kg N/ fed. respectively (Table, 3). Comparing among potassium rates, increasing potassium rate enhanced T.S.S %. The rate of K_2 (20.43) and K_3 (20.40) significantly increasing T.S.S % than both K_0 (19.36 %) and K_1 (19.67 %) rate, without significant difference between them. Relative increase than K_0 rate for K_1, K_2 and K_3 rates were 1.59, 5.53, and 5.38 %, respectively (Table 3).

II-2-Sucrose percentage:

The data in Table (3) showed that increasing nitrogen rates from N_0 (14.94%) to N_1 (15.87%), N_2 (16.16%) and N_3 (17.04%) increased sucrose% by 6.22, 8.21 and 14.08%, respectively. These differences were significant values. Also, the data showed that the highest sucrose % values were recorded by applying K_2 (16.36%) and K_3 (16.25%) potassium fertilizer rates, without significant differences between them. These two potassium rates significantly increased sucrose% than K_0 and K_1 rates (Table 3)

II-3- Purity percentage:

The tested different rates of nitrogen, potassium fertilizer and their interactions on purity% were no significant differences.

III- Impurity Parameters:

Data of the effects of nitrogen, potassium fertilizer rates and their interactions on sugarbeet impurity parameters (Na, K, α- amino nitrogen percentages, Extractable white sugar% (ZB%), Quality% (QZ %), Alkalinity Coefficient (AK) and loss sugar%) were recorded in (Tables 4 and 5).

Table (3).Effect of different nitrogen, potassium fertilizer rates and their interactions on TSS%, Sucrose% and purity% of sugarbeet crop in combine analysis of 2014/15 and 2015/16 seasons.

Nitrogen rates (N)	Potassium (K) Rates					Inc% or dec%
	K_0	K_1	K_2	K_3	Average	
			Total Soluble Solids %			
N_0	17.25	17.98	19.27	19.48	18.50	
N_1	19.45	19.50	20.33	20.07	19.84	7.25
N_2	19.97	20.30	20.02	20.40	20.17	9.06
N_3	20.78	20.90	22.12	21.67	21.37	15.52
Average	19.36	19.67	20.43	20.40		
Increase%		1.59	5.53	5.38		
			Sucrose%			
N_0	14.05	14.47	15.53	15.70	14.94	
N_1	15.70	15.57	16.18	16.02	15.87	6.22
N_2	15.93	16.33	16.01	16.39	16.16	8.21
N_3	16.75	16.79	17.73	16.90	17.04	14.08
Average	15.61	15.79	16.36	16.25		
Increase%		1.16	4.83	4.12		
			Purity%			
N_0	81.48	80.47	80.60	80.57	80.78	
N_1	80.73	79.85	79.61	79.83	80.00	-0.96
N_2	79.84	80.46	80.10	80.33	80.18	-0.74
N_3	80.61	80.30	80.17	78.03	79.78	-1.24
Average	80.67	80.27	80.12	79.69		
Decrease%		-0.49	-0.68	-1.21		

	Total Soluble Solids%	Sucrose%	Purity%
LSD $_{0.05}$ N	0.61	0.44	ns
LSD $_{0.05}$ K	0.52	0.41	ns
LSD $_{0.05}$ N×K	ns	ns	ns

Inc% (increase%) or dec% (decrease) than control treatment ns=not significant

III-1- Sodium (Na meq/100g)

The data in Table (4) observed that increase nitrogen rates from N_0 to N_1, N_2 and N_3 rates significantly increased Na% by 21.05, 41.65 and 79.06%, respectively. Also, there were positive correlation between potassium rates and Na%. The ascending sequences of tested potassium rates were as follows: K_0 (1.43 meq/100 g) < K_1 (1.60 meq/100 g) < K_2 (1.66 meq/100 g) < K_3 (1.83 meq/100 g). The last rate (the higher rate) of potassium increased Na % by 79.06% in compared with K_0 rate (without potassium fertilizer) or control treatment, as show in Table (4).

III-2- Potassium (Ka meq/100g)

The data in Table (4) also showed that increasing nitrogen fertilizer rates from N_0 to N_3 kg N/ fed. significantly increased potassium percentage from 6.66 to 11.67 (meq/100 g) in roots juice.

Table (4). Effect of different nitrogen, potassium fertilizer rates and their interaction on impurity parameters of sugarbeet crop in combine analysis of 2014/15 and 2015/16 seasons.

Nitrogen rates (N)	Potassium (K) Rates					Increase%
	K_0	K_1	K_2	K_3	Average	
			Na (meq/100 g)			
N_0	1.13	1.29	1.19	1.21	1.20	
N_1	1.27	1.49	1.51	1.55	1.46	21.05
N_2	1.51	1.56	1.74	2.01	1.70	41.65
N_3	1.83	2.04	2.18	2.57	2.16	79.06
Average	1.43	1.60	1.66	1.83		
Increase%		11.28	15.46	27.90		
			K (meq/100 g)			
N_0	6.09	7.13	6.68	6.73	6.66	
N_1	6.93	7.90	8.49	8.26	7.89	18.54
N_2	8.00	8.78	9.35	10.50	9.16	37.47
N_3	9.70	11.52	12.07	13.39	11.67	75.20
Average	7.68	8.83	9.15	9.72		
Increase%		14.97	19.08	26.57		
			A-amino N (meq/100 g)			
N_0	3.14	3.67	3.54	3.46	3.45	
N_1	3.27	3.58	4.52	3.83	3.80	10.01
N_2	3.82	4.34	4.69	5.00	4.46	29.31
N_3	4.56	5.89	5.83	6.12	5.60	62.17
Average	3.70	4.37	4.65	4.60		
Increase%		18.26	25.67	24.50		

	Na	**K**	**A-amino N**
LSD $_{0.05}$ N	0.212	1.172	0.248
LSD $_{0.05}$ K	0.075	0.511	0.114
LSD $_{0.05}$ NK	0.170	1.15	0.256

Increase% = increase% than control treatment

The relative increases in K% than control treatment (N_0) were 18.54, 37.47 and 75.20% for N_1, N_2 and N_3 rates, respectively. Potassium concentration in roots juice significantly increased with increasing potassium fertilizer rates. K% values could be arranged in the following descending order according to potassium rates: K_3 (9.72 meq/100 g), K_2 (9.15 meq/100 g), K_1 (8.83 meq/100 g) and K_0 (7.68 meq/100 g), without significant differences between applied K_1 and K_2 potassium rates. The increases in potassium% were 14.97, 19.08 and 26.57% than control treatment for K_1, K_2 and K_3, respectively.

III-3- Alpha – amino nitrogen (α- AN meq/100g)

Raising nitrogen fertilizer rate from N_0 (without nitrogen fertilizer) to N_1, N_2 and N_3 rates significantly increased α- AN in root juice from 3.45 to 3.80, 4.46 and 5.60 meq/100 g respectively. These increases than control treatment were 10.01, 29.31 and 62.17 % for N_1 , N_2 and N_3 rates , respectively (Table 4).

Regarding to the effects of potassium fertilizer rates, K_2 (4.65 meq/100 g) and K_3 (4.60 meq/100 g) rates significantly increased α- AN than K_1 (4.37 meq/100 g) and K_0 (3.70 meq/100 g). However, there was no significant difference between the first mentioned potassium rates and vice versa between the last ones as shown in (Table 4).

The results in (Table 5) illustrated that all tested impurity parameters not significantly affected by interaction between nitrogen and potassium rates. The results inducted that increasing nitrogen fertilizer rate significantly increased the impurity characters, these results are similar to those achieved by Osman *et al* (2010); Abd El- Kader (2011); Ferweez *et al* (2011) and Mekdad (2015). In contrast, Tawfik, Sahar (2000) found that the effect of nitrogen fertilizer rates from 30 to 120 kg N/fed. had insignificants effects on these juice impurities. Also the results observed that increasing potassium fertilization rate significantly increased Na, K, α- amino nitrogen in juice roots .The results are in agreement those obtained by Abo El-Ghait (2013) and Abdou (2014).

It could be concluded that 100.5 Kg N/ fed. accompanied with 48 Kg K_2O/ fed. gave the optimum and improving the yield and quality of sugarbeet grown in sandy soil.

III-4- Extractable white sugar% (ZB%)

Table (5) revealed effect of different nitrogen, potassium fertilizer rates and their interactions on Extractable white sugar% (ZB%), Quality% (QZ%), Alkalinity Coefficient (AK) and Loss Sugar % of sugarbeet crop.

The effect of N levels on ZB% was neglect, where the relative increases than N_0 was not more than 1.73%, therefore there were no significant differences among N levels. In regards to K levels, the highest effective level was K_1 (12.17%) followed by K_0 (11.86%) without significant differences.

Also, K_3 (11.61%) gave the higher ZB% than K_2 (11.55%) without significant differences. The relative increase than $K_1$was 2.61 % for K_2 and its relative decrease was 2.66 % and 2.17% at K_1 and K_3, respectively. The lowest effective K level was K_2. Thus, the effect of K levels gave varied responses without exact direction. In conclusion, only K levels had effects on ZB%.

III-5- Quality% (QZ %)

Both N and K levels harbored significantly effects on QZ% (Table 5). Increasing both N and K levels decreased QZ%. Consequently, the highest effective N and K levels were N_0 (80.55%) and K_0 (76.45%). On contrary, the lowest ones were N_3 (69.96%) and K_3 (71.51%). The relative decrease for previous levels than N_0 and K_0 were 13.14% and 6.46%, respectively. In regards to the interaction between N and K levels, the highest and the lowest values of QZ% were N_0K_0 (83.01%) and N_3K_3 (64.15%). The effect of N levels had more effects than K ones.

III-6- Alkalinity Coefficient (AK)

The efficacy of N and K levels on AK was presented in Table (5). The effects of N and K levels gave variant responses. The highest effective N and K levels were N_2 (2.43) and K_0 (2.39), respectively.

Table (5). Effect of different nitrogen, potassium fertilizer rates and their interactions on Extractable white sugar% (ZB%), Quality% (QZ%), Alkalinity Coefficient (AK) and Loss Sugar % of sugarbeet crop in combine analysis of 2014/15 and 2015/16 seasons.

Nitrogen rates (N)	Potassium (K) Rates					Inc% or dec%
	K_0	K_1	K_2	K_3	Average	
			ZB %			
N_0	11.96	11.98	11.64	11.60	11.80	
N_1	11.67	12.46	11.36	11.78	11.81	0.16
N_2	11.39	11.82	11.47	11.64	11.58	-1.84
N_3	12.43	12.43	11.73	11.41	12.00	1.73
Average	11.86	12.17	11.55	11.61		
Inc% or dec%		2.61	-2.66	-2.17		
			QZ %			
N_0	83.01	81.76	79.55	77.86	80.55	
N_1	76.33	77.25	71.94	72.98	74.62	-7.35
N_2	71.74	72.38	69.67	71.05	71.21	-11.59
N_3	74.73	72.88	68.07	64.15	69.96	-13.14
Average	76.45	76.07	72.31	71.51		
Inc% or dec%		-0.50	-5.42	-6.46		
			AK(meq/100 g)			
N_0	2.42	2.23	2.22	2.31	2.29	
N_1	2.37	2.39	2.25	2.32	2.33	1.73
N_2	2.47	2.44	2.36	2.46	2.43	5.99
N_3	2.27	2.40	2.36	2.44	2.37	3.23
Average	2.39	2.36	2.30	2.38		
Inc% or dec%		-0.87	-3.59	-0.21		
			Loss sugar%			
N_0	2.44	2.68	3.00	3.30	2.85	
N_1	3.62	3.65	4.44	4.37	4.02	40.88
N_2	4.49	4.53	4.99	4.72	4.68	64.21
N_3	4.21	4.64	5.47	6.41	5.18	81.69
Average	3.69	3.88	4.47	4.70		
Increase%		5.08	21.27	27.39		
	ZB%	**QZ%**	**AK**		**Loss sugar%**	
LSD $_{0.05}$ N	ns	2.613	ns		0.472	
LSD $_{0.05}$ K	0.402	1.296	ns		0.192	
LSD $_{0.05}$ N×K	ns	2.92	ns		0.432	

Inc% (increase%) or dec% (decrease) than control treatment ns=not significant

In addition, the lowest values for both previous factors were N_0 (2.29) and K_2 (2.30), respectively. Although these variations, there were no significant differences among both tested factors.

III-7- Loss Sugar %

Table (5) illustrated that the tested factors significantly effected on loss sugar%. N levels could be arranged in the following descending order according to Loss sugar%: N_3 (5.18%) > N2 (4.68%) > N1 (4.02%) > N0 (2.85%). The relative increase than N_0 for N_3, N_2 and N_1 levels were 81.69, 64.21 and 40.88%, respectively.

K levels indicated that the highest loss sugar% was recorded at K_3 (4.70%) followed by K_2 (4.47%), K_1 (3.88%) and the least one was K_0 (3.69%). However, the respective relative increases than K0 were 27.39, 21.27 and 5.08%.

The interaction between N and K levels was significant. The highest and lowest loss sugar% were observed at N_3K_3 (6.41%) and N_0K_0 (2.44%).

Generally, increasing both N and K levels enhanced loss sugar%. Moreover, the N levels had superior effects on loss sugar% than K levels.

In generall, the quality parameters, T.S.S%, sucrose%, purity%, ZB% and AK insignificantly affected by the interaction between nitrogen and potassium rates. The present results showed that increasing nitrogen or potassium fertilizer rates significantly increased T.S.S%, sucrose% and loss sugar%, as well as decreased QZ%. Similar results were reported by Ramadan and Nassar (2004); Ismail and Abo El-Ghait (2005); Maareg *et al.* (2005 a& b); Ouda, (2007), Osman *et al.* (2010); Sarhan (2012); Abdou (2013), and Mekdad (2015). There was not effect for nitrogen or potassium fertilizer on purity% and AK, these results are in line with the findings of Abo El-Ghait and Mohamed, (2005) and Abdelaal and Tawfik (2015).

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الملخص العربي

إستجابة بنجر السكر لمعاملات التسميد النتروجينى والبوتاسى فى الأرض الرملية

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أجريت تجربتان حقليتان خلال موسمى٢٠١٤/ ٢٠١٥ و ٢٠١٥/ ٢٠١٦ عند الكليو ٧١ طريق اسكندرية – القاهرة الصحراوى (منطقة غرب النوبارية) لدراسة تأثير أربعة معدلات من السماد النتروجينى" يوريا ٤٦% نتروجين (بدون إضافة ، ٣٣.٥ ، ٦٧ ، ١٠٠.٥ كجم نتروجين/ فدان) وأربعة معدلات من التسميد البوتاسى " سلفات البوتاسيم بو$_٢$أ ٤٨% "" (بدون إضافة ، ١٦ ، ٣٢ ، ٤٨ كجم بو$_٢$أ / فدان) والتداخل أو التفاعل بينهما على إنتاجية وجودة بنجر السكر صنف (ماجريبل) عديد الأجنة المنزرع فى الأرض الرملية بمنطقة غرب النوبارية – محافظة البحيرة. إستخدم فى هذة الدراسة تصميم القطع المنشقة مرة واحدة، ووضعت معدلات السماد النتروجينى فى القطع الرئيسية ووزعت معدلات السماد البوتاسى فى القطع الشقية عشوائيا،

وأوضحت النتائج الاتية

– يزداد محصول الجذور و محصول العرش ومحصول السكر زيادة جوهرية كنتيجة للزيادة فى المعدلات المضافه لكل من السماد النتروجينى والسماد البوتاسى، ووجد أن إضافة أعلى معدل من السماد النتروجينى (١٠٠.٥ كجم نتروجين / فدان) وأعلى معدل من السماد البوتاسى (٤٨ كجم بو$_٢$أ /فدان) حققا أعلى قيمة لمحصول الجذور (٣٤.٩٨ ، ٢٩.٣٩ طن / فدان) ومحصول العرش(٢٨.٧٣، ٢٢.٥٣ طن / فدان) و محصول السكر (٤.٧٦ ، ٣.٨٢ طن / فدان) على التوالى.

– كما وجد أن الزيادة فى السماد النتروجينى المضاف الى المعدل ١٠٠.٥ كجم ن / فدان والسماد البوتاسى الى المعدل ٣٢ كجم بو$_٢$أ / فدان حققا زيادة جوهرية فى كل من النسبة المئوية للمواد الصلبة الذائبة الكلية والنسبة المئوية للسكروز كعناصر جودة

– أما نسبة النقاوة وجد أنها لا تتأثر بإختلاف كمية السماد المضافة لكل من السماد النتروجينى أو البوتاسى .

– سجلت أعلى نسبة للمواد الصلبة الذائبة الكلية (٢١.٣٧ و ٢٠.٤٣ %) وأعلى نسبة للسكروز (١٦.٩٠ و ١٦.٣٦%) بإضافة ١٠٠.٥ كجم نتروجين ، ٣٢ كجم بو$_٢$أ / فدان) على التوالى .

– كذلك وجد أن الزيادة فى المعدلات المضافة لكل من السماد النتروجينى والسماد البوتاسى يزيد جوهريا نسبة الشوائب (الصوديوم، البوتاسيوم، الفا أمينو نتروجين، ونسبة السكر المفقود) فى عصير الجذور وخفض الجودة.

– ومن نتائج المعاملات المختلفة للتأثير المشترك للسمادين تحت الدراسة وجد أن إضافة ١٠٠.٥كجم نتروجين/ فدان + ٤٨ كجم بو٢أ/ فدان هى أفضل المعاملات السمادية تحت ظروف التجربة حيث حققت أعلى محصول للجذور وأعلى جودة لمحصول بنجر السكر الصنف ماجريبل عديد الأجنة.

Impact of Many Amendments and Their Mixtures on Soil Properties and Squash Production in Saline-sodic Soil

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ABSTRACT: A field experiment using squash crop (*Cucurbita pepo* L.) variety askandrani was carried out at the Experimental Farm, Faculty of Agriculture (Saba-Basha), Alexandria University, Egypt during 2014 growing season. The farm is located at Abees region 31˚ 10.102′ N and 29˚ 58.085′ E with altitude of (-5m) below sea level. The present research studied the effect of soil amendments such as animal manure, bagasse, sulphur and gypsum with different combinations on the physical and chemical properties of saline-sodic soil and also its effects on squash growth and fruit yield characteristics besides the nutrients content of leaves and fruits. Seventeen treatments of soil amendments were applied to soil and mixed thoroughly with the upper 30 cm layer. The squash was sowing at 13th October. Seeds were sown at 4-5 seeds in each hill with spacing of 0.25 m within each row and 0.6 spacing, and then thinned to one plant after 2 weeks from sowing. After emergence, the plots were irrigated by the furrow irrigation method. Harvesting was at 6, 11 and 27 December. Vegetative growth, yield and yield components and nutrients content of leaves and fruits were measured. Also, physical and chemical characteristics were determined. The obtained results revealed that all vegetative characters (leaf fresh and dry weights, leaf water content, gross plant weight and chlorophyll contents) were not affected by amendments treatments. The highest values were attained with animal manure (24 ton/ha) plus gypsum (4 ton/ha). The maximum squash fruit yield characters (fruit diameter, fruit length, fruit weight and fruit yield) were attained with animal manure plus gypsum treatment. The value of squash fruit yield was significantly increased with soil amendments treatments and the maximum value was attained with animal manure plus gypsum treatment (6954.0 kg/ha, it is accounted as 271.30% over the control treatment. All macro- and micro-nutrients content of leaves and fruits are significantly affected by application of soil amendments, especially animal manure plus gypsum treatment. The soil physical properties such as bulk density, mean weight diameter, geometric mean diameter, structure coefficient and geometric standard deviation are significantly improved by applications of soil amendments. The soil stability index (SI), Kelly's ratio (KR) and permeability index (PI) indicates an excess level of sodium and the soil qualified to alkali hazards. Thus soil has problem about the water permeability. All soil chemical properties including the nutrients availability were improved as a result of application of different soil amendments, especially animal manure plus gypsum. Also, soil available macro- and micro-nutrients were improved with application of soil amendments. It is clear that animal manure plus gypsum treatment is the best treatment for improvement of the sodic soil.

Keywords: salt-affected soil, sodic soil, organic amendments, natural amendments, gypsum, physical properties, squash plants

INTRODUCTION

Accumulation of excessive salts in irrigated soils can reduce crop yields, reduce the effectiveness of irrigation, destruction of soil structure, and affect other soil properties. Salt stress is one of the most serious limiting factors for crop growth and production in arid and semi-arid regions. In Egypt, many areas in Nile delta are mainly saline or saline-sodic soils with heavy texture. Meanwhile, the addition of organic matter in conjunction with gypsum has been found to reduce the adverse effect of soil properties associated with sodic soils (Wong *et al.*, 2009). Abou El-

Defan *et al.* (2005) studied the effect of farmyard manure, gypsum and their mixture on some soil characteristics irrigated with drainage water. They found that both EC and ESP values significantly decreased, especially with application of farmyard manure mixed with gypsum. El-Banna *et al.* (2004) found that treating the soil with gypsum+ FYM as well as with potassium fertilization insure a better environmental condition for wheat plants to grow healthy.

Levy and Mamedov (2002) showed that increasing organic matter contents in organic matter deficient sodic soils improved structural stability and improved permeability. Similarly, other waste products originating from treated wastewater in the form of solids or semi-solids have been identified as the potential ameliorants of sodic soils (Graber *et al*., 2006).

Gypsum is the most common chemical amendments applied for removal the salinity and sodicity from soils. It is low cost, available and easily handling (Wong *et al*., 2009; Abdel-Fattah, 2012). Several studies suggested that the application of gypsum to saline sodic and sodic soil can ameliorate the physical and chemical soil properties such as bulk density, hydraulic conductivity, water infiltration, soil pH, electrical conductivity, exchangeable sodium percentage and sodium adsorption ratio (Gharaibeh *et al*., 2009; Khan *et al*., 2010; Negim, 2016).

In recent time, various organic amendments such as farmyard manures and composts have been effectively used to improve salt affected soils (Feizi *et al*., 2010). Solid waste such as Press-mud (filter cake or filter mud) produced by the sugar mills industry as enrichment source of organic matter and other nutrients such as N, P, K, Ca, Mg, Fe, Zn, Cu and Mn and can be applied to soils for improving the physical, chemical and biological properties (Muhammad and Khattak, 2011; Negim, 2016; Jamil, 2008; Muhammad and Khattak, 2009). It also contains sulfur, which helps to acidify the soil. This acidification makes soluble calcium available and thus improves soil structure and increases the leaching of salts. In addition, press-mud is capable of improvement of soil texture, structure, organic matter contents, the water holding capacity and aeration of soil (Haq *et al*., 2001; Ghulam *et al*., 2010).

The unfortunate increase in land degradation due to salinity and sodicity requires special management practices. It appears that soil amendments applications to saline–sodic soils are necessary for improving soil physical and chemical properties. The aim of the present work was to explain the effect of soil amendments such as animal manure, bagasse, sulphur and gypsum on soil properties and squash production in saline-sodic soil.

MATERIALS AND METHODS

Experimental site and conditions

This study was conducted during the 2014 winter season at the Experimental Farm, Faculty of Agriculture (Saba-Basha), Alexandria University, Egypt. The farm is located at Abees region (31˚ 10.102′ N and 29˚ 58.085′ E with altitude of -5 m under sea level). This area is characterized by a semi-arid climate; the weather is hot and dry from May to August where temperatures ranged from 25-30 °C. On the other hand, the rainfall occurs in winter with an average of 186.2 mm per year. The average wind speed was 10.61 m/s and the average relative humidity was 69.5 % (Saeed *et al*., 2015).

Soil of the experimental site

Soil samples were collected from the experimental area from (0-10 cm), (10-20 cm) and (20-40 cm). Some physical and chemical properties of the field experiment soil are presented in Table (1). The soil properties were performed according to the methods outlined in Carter and Gregorich (2008). The soil of the experimental site is clayey texture with water table level of 1 m down the soil surface and the groundwater is moderately saline (2.5 dS/m), Saeed *et al*.(2015). Table (2) shows the chemical analysis of irrigation water used in the present study according to Ayers and Westcot (185), there is no restriction on the use of this water for irrigation.

Table (1).Some physical and chemical properties of the experimental site soil

Soil parameters	Unit	Soil depth (cm)		
		0-10	10-20	20-40
Particle size distribution				
Sand	%	29.7	29.7	32.2
Silt	%	15.0	17.5	15.0
Clay	%	55.3	52.8	52.8
Textural class	-	Clay	Clay	Clay
Soil bulk density	Mg/m^3	1.24	1.25	1.25
Soil moisture content at field capacity (θ_{fc})	m^3m^{-3}	0.351	0.362	0.369
Soil moisture content at permanent wilting point (θ_{wp})	m^3m^{-3}	0.092	0.093	0.094
Available water content	m^3m^{-3}	0.259	0.268	0.275
Organic matter content (%)	%	2.87	2.87	2.15
Total calcium carbonate	%	18.12	18.12	15.78
Electrical Conductivity (EC), (1:1, soil: water extract)	dS/m	6.98	6.29	5.94
pH (1:1, soil : water suspension)	-	8.05	8.15	8.25
Soluble Cations:				
Ca^{2+}	meq/l	2.38	1.69	1.42
Mg^{2+}	meq/l	7.85	6.05	4.50
Na^{+}	meq/l	58.15	54.13	52.13
K^{+}	meq/l	1.35	1.12	1.12
Soluble Anions:				
$CO^{=}_{3+}$ HCO^{-3}	meq/l	10.20	9.92	2.12
Cl^{-}	meq/l	44.00	44.39	41.00
$SO^{=}_{4}$	meq/l	14.03	7.70	12.54
SAR	-	25.71	27.51	30.30

Table (2). Chemical analysis of irrigation water used in the field experiment

Parameters	Value	Unit
pH	7.35	-
EC_{iw}	0.60	dSm^{-1}
Soluble Cations		
Ca^{+2}	1.89	$meql^{-1}$
Mg^{+2}	0.81	$meql^{-1}$
K^{+}	2.74	$meql^{-1}$
Na^{+}	0.46	$meql^{-1}$
Soluble Anions		
$CO^{=}_3 + HCO^{-}_3$	1.98	$meql^{-1}$
Cl^{-}	0.81	$meql^{-1}$
SO_4^{-2}	3.14	$meql^{-1}$
SSP	46.44	%
SAR	2.36	-
PS	2.38	$meql^{-1}$
RSC	-0.72	$meql^{-1}$

Squash cultivation

Squash (*Cucurbita pepo* L.) variety askandrani was selected for this study at 2014 winter season. Plant sowing date was at 13 October, 2014. Seeds were sown at 4-5 seeds in each hill with spacing of 0.25 m within each row. Thinning to one plant per hill was carried out after 15 days from sowing to obtain a final plant population of 26700 plants/ha. The experimental plot was 3.5 m length and 0.6 m spacing, each plot contains 3 rows. After emergence, the plots were irrigated by furrow irrigation method. Irrigation was terminated at 1 December 2014, and harvesting data was at 6, 11 and 27 December 2014. All agricultural field practices were done as usually recommended for squash cultivation (Ministry of Agriculture and Land Reclamation). Phosphorus fertilizer as calcium superphosphate (15.5% P_2O_5) was fully added to the soil during soil preparation at rate of 370 kg ha^{-1}. Ammonium Nitrate (33.5% N) at the rate of 168 kg ha^{-1} were applied at two equal doses, one after sowing and the second after 15 days later. Potassium Sulfate (48% K_2O) was added at the rate of 67 kg K_2O ha^{-1} in two equal doses, one after sowing and the second after 15 days later.

Amendments applications

Seventeen treatments of soil amendments were applied as shown in Table (3).The amendments were applied to the soil and mixed thoroughly with the upper 30 cm soil. The used organic amendments were subjected to some chemical analyses as shown in Table (4).

Table (3). Amendments and treatments used in the present study

Treatments	Rate of application
Control	Without any application
Animal manure	24 ton/ha
Bagasse	24 ton/ha
Wheat straw	24 ton/ha
Sulphur	720 kg/ha
Gypsum	4 ton/ha
Animal manure + Sulphur	24 ton/ha +720 kg/ha
Animal manure + Gypsum	24 ton/ha +4 ton/ha
Animal manure + Wheat straw	24 ton/ha + 24 ton/ha
Sulphur + Gypsum	720 kg/ha + 4 ton/ha
Wheat straw +Sulphur	24 ton/ha + 720 kg/ha
Wheat straw + Gypsum	24 ton/ha + 720 kg/ha
Bagasse + Sulphur	24 ton/ha + 720 kg/ha
Bagasse + Gypsum	24 ton/ha + 4 ton/ha
Organic acid +Sulphur	10 kg/ha + 720 kg/ha
Organic acid +Gypsum	10 kg/ha + 4 ton/ha
Bagasse +Sulphur + Gypsum	24 ton/ha + 720 kg/ha + 4 ton/kg

Table (4). Some chemical analyses of the tested organic amendments

Parameters	Animal manure	Bagasse	Wheat straw
pH (1:10)	8.9	7.9	7.5
EC (1:10), dS/m	12.6	4.5	9.6
OM (%)	47.41	46.45	44.28
Soluble Ions (mg/kg)			
N	130.0	90	70.0
P	40.0	20.0	24.0
K	305.0	210.0	80.0
Ca	35.0	41.5	37.4
Mg	31.4	25.7	20.5
Fe	32.4	28.0	7.9
Mn	27.6	20.9	15.4
Cu	17.1	5.8	2.3
Zn	2.2	6.5	5.4
Total elements (%)			
N	1.27	0.57	0.92
P	0.69	0.55	0.51
K	2.50	1.60	2.05

Studied characters

Vegetative growth characters

Three plants from the center row of each plot were taken at 55 days after sowing (DAS) at harvesting date. The following data were recorded:
Leaf fresh and dry weights per plant (g)
Leaf water content (%)
Gross plant weight (g)
Chlorophyll a, b and total contents (mg/g fresh weight) as determined by the method of Metzner *et.al.*(1965).

Yield and yield components: The following data were recorded:
Fruit length and diameter (cm), No. of fruits per plot, average fruit weight (g), fruit weight per plot (g) and gross fruit weight (ton/ha)

Nutrients content: The following data were recorded: Leaves and fruit nutrients content.

Soil physical characters: Soil samples were taken from each treatment after harvesting and the following data were recorded:
Soil bulk density (Mg/m^3) using soil core method (Carter and Gregorich (2008);
Mean weight diameter (mm) according to Van Bavel (1949) method;
Geometric mean diameter (mm) using the method of (Shirazi and Boersma, 1984);
Structure coefficient, structural stability index (SI) as described by Pieri (1992);
Permeability index (PI) as described by Doneen (1964); and
Kelley's ratio (KR) as described by (Kelley, 1951 and 1963).

Soil chemical characters: Soil pH, Electrical Conductivity (dS/m), soluble cations (meq/l), soluble anions (meq/l), total calcium carbonates (%), and organic matter (%) were determined according the methods outlined in Carter and Gregorich (2008).

Soil available nutrients: Soil available macro-nutrients (N, P and K) and soil available micro-nutrients (Fe, Mn, Cu and Zn) as follows:

Available nitrogen content (mg/kg): The soil sample was extracted by 2M KCl (1:20), available N was determined in soil extract by Nessler's method (Bermner and Mulvaney, 1982).

Available phosphorus content (mg/kg): Available phosphorus was extracted with 0.5 M $NaHCO_3$ solution adjusted to pH 8.5 according to Olsen *et al.* (1954). Available phosphorus was determined by ascorbic acid molybdenum blue method. Reading was recorded on spectrometer using 880 nm wave length (Jackson, 1973).

Available potassium content (mg/kg): The extraction was done by ammonium acetate (1N of pH 7.0) and potassium was determined by flame photometry according to (Jackson, 1973)

DTPA-extractable micronutrients: Ten grams of air dried soil sample was shaken with 20 ml of extracting solution (0.005 M DTPA + 0.01 M calcium chloride + 0.1 M TEA, pH 7.3) for two hours. The soil suspension was filtered using Watman No. 42 filter paper and the contents of Fe, Mn, Cu and Zn were measured by atomic absorption spectrophotometer (Lindsay and Norvell, 1978).

Plant chemical analysis: Leaves and fruit samples were taken at harvesting from each treatment and the N, P and K percentages were determined in the dry leaves and fruit. Their dry weights were determined following drying in a drying chamber to a constant weight at 75°C for 72 hour. After dryness, the plant samples were milled and stored for analysis as reported. However, 0.5g of the fruits and leaves powder was wet-digested with H_2SO_4–H_2O_2 mixture according (Lowther, 1980) and the following determinations were carried out in the digested solution: nitrogen (N), Phosphorous (P), potassium (K), iron (Fe), copper (Cu), manganese (Mn), and zinc (Zn) were determined according to Jackson (1973).

Nitrogen content: Total nitrogen was determined in digested plant material calorimetrically by Nessler`s method (Chapman and Pratt, 1961). Reading was achieved using wave length of 420 nm and N content was determined as percentage.

Phosphorus content: Total phosphorus was determined by the Vanadomolyate yellow method as given by Jackson (1973) and the intensity of color developed was read in spectrophotometer at wave length of 405nm.

Potassium content: Potassium was determined according to the method described by Jackson (1973) using Beckman Flame photometer.

Statistical analysis: The one-way analysis of variance (ANOVA) was carried out to determine the statistical significance of the treatment effects on the squash yield and soil characters using procedures outlined in Statistix (2003). The comparison between means was tested using least significant difference procedure at a significance level of 0.05 (Statistix, 2003).

RESULTS AND DISCUSSION

Vegetative growth

The leaf vegetative growth data of squash plants as affected by amendments application are presented in Table (5). The data reveal that all vegetative characters were not affected significantly by amendments application. The leaf fresh weight was reached the maximum value (5.78 g) with the treatment of animal manure plus gypsum, while the minimum value (2.77 g) was with sulphur plus gypsum treatment. The maximum value was 23.24% higher than the control treatment. The leaves dry weight has maximum value (0.92 g) with animal manure plus gypsum treatment, but the minimum value was attained with sulphur plus gypsum treatment. The maximum value was 19.48% higher than control treatment. Also, the maximum value of leaf water content (85.97%) was attained with organic acid plus sulphur treatment, while the lowest value (81.89%) was attained with sulphur treatment. Concerning the plant gross weight, the maximum value was 740.0 g with animal manure plus Sulphur treatment, while the minimum value (370.0 g) was attained with sulphur and gypsum treatment. The maximum value was 44.16% higher than the control treatment. Chlorophyll a and b contents were 0.683 and 0.530 mg/g fresh weight with animal manure plus gypsum treatment, respectively. The lowest values were 0.227 and 0.183 mg/g fresh weight attained with animal manure and bagasse plus sulphur treatments, respectively. The total chlorophyll content behaved the same trend.

As for the influence of organic fertilizers on vegetable production, Mohy El-Din (1997) mentioned that addition of organic waste significantly increased the fresh and dry weight of cucumber shoots during the autumn and spring seasons. Disadvantages of using manures include the hard and high cost of handling and distribution associated with the large amount of manure required obtaining sufficient quantities of nutrients for vegetables.

Fruit yield characters

Table (6) illustrates the squash fruit characters as affected by amendments treatments. All characters are significant at 1% probability level. Fruit diameter was reached the maximum value (3.6 cm) at animal manure plus gypsum treatment while the minimum value (1.4 cm) was attained at sulphur plus gypsum treatment. The maximum value was 4.00% higher than the control treatment. Also, the fruit length was reached the maximum value (17.0 cm) at wheat straw plus gypsum treatment, while the minimum value (9.1 cm) was attained at bagasse treatment. The maximum value was 49.10% higher than the control treatment. Concerning the average fruit weight, the highest value (199.5 g) was attained with animal manure plus gypsum treatment, while the lowest one (62.5 g) was attained with bagasse treatment. The maximum value was 52.20% higher than the control treatment. The fruit gross weight per plot has a maximum value (3650.0 g/plot) and was attained with animal manure plus gypsum treatment. The minimum value (425.5 g/plot) was attained with bagasse plus gypsum treatment. The maximum value was 271.20% higher than the control treatment.

Regarding the animal manure plus gypsum treatment, the obtained data showed that the early and total fruit yield of squash increased significantly up to 6954.0 kg/ha with animal manure plus gypsum accounted as 271.30% over the control treatment (Table 6). Using animal manure only or sulphur treatment led to an increase in the early and total yield (5701.4 and 4850.8 kg/ha) of squash as 204.42 and 159.00%, respectively comparing to the control treatment (Table 6).

Table (5). Vegetative growth of squash plants as affected by soil amendments application

Treatments	Leaf Fresh weight (g/plant)	Leaf Dry weight (g/plant)	Leaf water content (%)	Gross plant weight (g/plant)	Chlorophyll a content (mg/g FW)	Chlorophyll b content (mg/g FW)	Total chlorophyll content (mg/g FW)
Control	4.69	0.77	83.58	513.33	0.234	0.399	0.633
Animal manure	3.61	0.60	83.38	546.67	0.227	0.293	0.520
Bagasse	3.31	0.58	82.48	526.67	0.275	0.336	0.611
Wheat straw	3.71	0.64	82.75	660.00	0.602	0.318	0.920
Sulphur	4.03	0.73	81.89	428.33	0.595	0.321	0.916
Gypsum	4.67	0.73	84.37	530.00	0.443	0.471	0.914
Animal manure + Sulphur	4.52	0.71	84.29	540.00	0.344	0.257	0.601
Animal manure + Gypsum	5.78	0.88	84.78	740.00	0.683	0.530	1.213
Animal manure + Wheat straw	5.16	0.75	85.47	630.00	0.377	0.319	0.696
Sulphur + Gypsum	2.77	0.47	83.03	370.00	0.364	0.347	0.711
Wheat straw +Sulphur	3.56	0.64	82.02	456.67	0.568	0.375	0.943
Wheat straw + Gypsum	3.96	0.71	82.07	473.33	0.629	0.399	1.028
Bagasse + Sulphur	5.36	0.80	85.07	512.33	0.234	0.183	0.417
Bagasse + Gypsum	4.39	0.74	83.14	440.00	0.337	0.363	0.700
Organic acid +Sulphur	4.99	0.70	85.97	500.00	0.479	0.366	0.845
Organic acid +Gypsum	5.20	0.92	82.31	436.67	0.286	0.523	0.809
Bagasse +Sulphur + Gypsum	3.82	0.55	85.60	470.00	0.610	0.308	0.918
LSD (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Nutrients content

Leaf nutrients content: Leaf nutrients content of squash plants were significantly affected by amendments treatments as shown in Table (7). The macro-nutrients content (N, P, K, Ca and Mg) reached the maximum values, i.e. 5.94, 0.82, 3.90, 4.68 and 4.68%, respectively with animal manure plus gypsum. The lowest values (3.52, 0.48, 2.13, 2.51 and 2.00%, respectively) were attained with the other different treatments. The highest values were 68.75, 24.24, 7.44, 27.17 and 27.52%, respectively more than the control treatment. All nutrients content are significantly affected by application of amendments treatments.

The micro-nutrients content (Fe, Mn, Cu and Zn) reached the maximum values i.e. 384.8, 57.1, 94.1 and 70.7 mg/kg, respectively with animal manure plus gypsum treatment. The lowest values (244.4, 23.5, 65.9 and 22.5 mg/kg, respectively) were attained with the other different treatments. The highest values were about 13.12, 52.3, 13.1 and 72.20 mg/kg, respectively more than the control treatment. All micro-nutrients content are significantly affected by application of soil amendments.

In general, the growth of squash increased by application of animal manure. While the increase of N, P, and K % contents of squash leaves was due to the increase in soil organic matter, soil moisture and nutrient contents and availability in soil.

Fruit nutrients content: Fruit nutrients content of squash plants as affected by application of amendments are shown in Table (8). The contents of N, P, K, Ca and Mg reached the maximum values, i.e. 4.60, 0.98, 5.95, 3.68 and 4.86%, respectively with animal manure plus gypsum. The lowest values (2.41, 0.36, 4.10, 2.51 and 1.82%, respectively) were attained with the other different treatments. The highest values were 29.64, 63.33, 25.26, 22.26 and 14.35%, respectively more than the control treatment. All macro-nutrients content are significantly affected by application of soil amendments.

The micro-nutrients content (Fe, Mn, Cu and Zn) reached the maximum values, i.e. 279.5, 62.5, 51.2 and 41.4 mg/kg, respectively with animal manure plus sulphur treatment. The lowest values (128.6, 42.2, 32.0 and 18.7 mg/kg, respectively) were attained with the other different treatments. The highest values were 28.62, 12.61, 21.04 and 55.64%, respectively more than the control treatment. All micro-nutrients content are significantly affected by application of soil amendments except for copper content.

The application of manures to soil provides potential benefits including improving the fertility, structure, water holding capacity of soil, increasing soil organic matter and reducing the amount of synthetic fertilizer needed for crop production (Eghball, 2002; Phan *et al.*, 2002).

Manures are the main sources of nitrogen (N) supply in organic crop production. Nitrogen availability from applied manure includes the inorganic N (NO_3-N and NH_4-N) plus the amount of organic N mineralized following application. Nitrogen mineralization differs for different manure types since the inorganic/organic fraction and quality of organic N varies (Zaman *et al.*, 2004; Mikha and Rice, 2004). Raw manure is an excellent source for organic crop production. It supplies nutrients and organic matter and stimulating the biological processes in the soil that help to build up soil fertility. However, a number of cautions and restrictions still need more investigations, based on concerns about produce quality, food contamination, soil fertility imbalances, weed problems, and pollution hazards. Manure is an important source of plant nutrients Zaman *et al.* (2004), as it increases soil total N (Mikha and Rice, 2004) and improves the nutrient status of the soil (Eghball and Power, 1999) whom reported that 58% of beef manure N was available for plant uptake during the first 2 years after application.

Table (6). Squash fruit characteristics as affected by soil amendments application

Soil amendments	Average fruit diameter (cm)	Average fruit length (cm)	Average fruit weight (g)	Fruit weight (g)/plot	fruit yield (kg/ha)
Control	3.5	11.4	131.1	983.3	1872.9
Animal manure	3.2	11.8	144.6	2993.2	5701.4
Bagasse	2.9	9.1	68.0	1502.8	2862.5
Wheat straw	3.3	14.9	157.1	974.0	1855.3
Sulphur	3.3	14.3	140.7	2546.7	4850.8
Gypsum	2.6	9.8	119.0	2070.6	3944.0
Animal manure + Sulphur	3.4	12.0	128.0	934.4	1779.8
Animal manure + Gypsum	3.6	13.6	199.5	3650.9	6954.0
Animal manure + Wheat straw	3.3	11.4	176.3	1022.5	1947.7
Sulphur + Gypsum	1.4	13.6	110.9	1829.9	3485.4
Wheat straw +Sulphur	3.1	10.8	88.1	740.0	1409.6
Wheat straw + Gypsum	1.6	17.0	130.9	1636.3	3116.7
Bagasse + Sulphur	1.8	9.3	93.3	531.8	1013.0
Bagasse + Gypsum	3.3	9.9	92.5	425.5	810.5
Organic acid +Sulphur	1.8	11.5	162.7	2261.5	4307.7
Organic acid +Gypsum	2.6	11.9	125.5	2271.6	4326.8
Bagasse +Sulphur + Gypsum	2.3	12.8	135.9	2160.8	4115.8
LSD (0.05)	**1.4***	**3.5****	**25.7****	**1398.5****	**1.65****

Physical properties of soil

Table (9) showed that the soil bulk density ranged between 1.65 to 1.85 Mg/m^3 with average of 1.76 Mg/m^3. The lowest value was attained with animal manure plus gypsum treatment, while the highest value was attained with wheat straw treatment.

The low value was under the control treatment by 7.82%. The mean weight diameter (MWD) ranged between 0.663 and 0.752 mm with average value of 0.71 mm. The highest value was attained with animal manure plus gypsum treatment, while the lowest value was attained with gypsum treatment. The geometric mean diameter (GMD) has the highest value (0.575 mm) with animal manure plus gypsum, while the lowest value (0.475 mm) was attained with only animal manure treatment. The highest value was more than the control treatment by 6.09%. The structure coefficient (Cr) has the highest value (1.478) with animal manure plus gypsum, while the lowest value (1.072) was attained with gypsum treatment. The highest value was more than the control treatment by 11.55%. The geometric standard deviation (**δg**) reached the maximum value of 2.956 with animal manure and bagasse +sulphur+ gypsum treatments, while the lowest one (2.353) was attained with animal manure plus gypsum treatment. The lowest value was less than the control treatment by about 7.50%.

The structural stability index (SI) has highest value of 2.48 with bagasse plus sulphur treatment and lowest value with only bagasse treatment with average of 1.89. The structural stability index (SI) < 5% indicates a structurally degraded soil (Pieri, 1992). The highest value of Kelly's ratio (KR) is 2.86 was attained with animal manure plus gypsum treatment, while the lowest value was attained with wheat straw plus gypsum treatment with average of 2.01. The highest value was more than the control treatment by about 43.00%. The values of KR>1.0 indicates an excess level of sodium (Kelly, 1946). Thus, this soil is qualified to alkali hazards (Karanth, 1987). The permeability index (PI) was the highest value (102.51) with bagasse plus sulphur treatment, while the lowest one (76.98) was attained with sulphur plus gypsum treatment. The average value was 88.87. The values (PI) were more than 75 indicated that the soil has problem about the water permeability.

Table (7). Leaf nutrients content of squash plants as affected by soil amendments treatment

Soil amendments	Macro-nutrients content (%)					Micro-nutrients content (mg/kg)			
	N	P	K	Ca	Mg	Fe	Mn	Cu	Zn
Control	3.52	0.66	3.63	3.68	3.67	340.0	37.5	83.2	41.0
Animal manure	3.98	0.78	3.80	2.51	4.01	323.8	30.9	73.1	30.6
Bagasse	4.14	0.52	3.03	3.34	4.17	291.1	28.2	70.9	28.5
Wheat straw	4.90	0.72	3.20	3.18	2.77	380.2	29.5	80.3	34.0
Sulphur	4.38	0.48	3.40	2.84	4.34	301.7	48.5	83.2	38.2
Gypsum	3.81	0.64	2.63	3.68	2.00	351.7	54.2	70.7	64.8
Animal manure + Sulphur	5.12	0.71	3.47	4.01	3.37	374.5	24.4	65.9	22.5
Animal manure + Gypsum	5.94	0.82	3.90	4.68	4.68	285.2	57.1	94.1	68.2
Animal manure + Wheat straw	5.87	0.69	3.67	3.34	2.84	248.8	23.5	76.1	28.0
Sulphur + Gypsum	3.99	0.62	2.97	2.68	4.68	347.6	49.0	77.5	70.6
Wheat straw +Sulphur	4.70	0.63	2.13	3.68	4.68	244.4	40.3	84.6	38.5
Wheat straw + Gypsum	4.22	0.57	3.33	4.34	2.34	370.7	35.1	81.6	26.5
Bagasse + Sulphur	5.15	0.63	3.80	3.18	3.34	320.2	32.3	76.9	36.5
Bagasse + Gypsum	4.47	0.65	3.13	2.84	4.01	299.5	38.8	66.2	27.9
Organic acid +Sulphur	5.48	0.72	2.90	3.01	2.95	336.7	50.5	83.9	31.4
Organic acid +Gypsum	4.05	0.54	3.03	3.01	2.51	352.5	25.6	76.7	35.1
Bagasse +Sulphur + Gypsum	5.02	0.53	2.60	3.51	2.84	384.8	45.6	71.4	41.0
LSD (0.05)	**1.45***	**0.19***	**0.95****	**0.99****	**0.85***	**78.5***	**22.6****	**70.9****	**23.7****

Table (8). Fruit nutrients content of squash plants as affected by amendments application

Treatments	Macro-nutrients content (%)					Micro-nutrients content (mg/kg)			
	N	P	K	Ca	Mg	Fe	Mn	Cu	Zn
Control	3.54	0.60	4.75	3.01	4.25	217.3	55.5	42.3	26.6
Animal manure	3.60	0.71	4.73	2.67	2.83	147.8	55.2	43.3	35.0
Bagasse	2.41	0.39	4.27	2.68	2.58	279.0	54.0	42.3	27.8
Wheat straw	3.94	0.95	4.10	3.26	3.34	223.0	50.2	49.4	20.5
Sulphur	3.18	0.97	4.67	3.01	2.43	128.7	45.0	41.8	24.9
Gypsum	3.30	0.36	4.67	3.51	2.84	151.2	43.9	32.0	32.1
Animal manure + Sulphur	3.50	0.57	4.78	3.50	1.82	161.3	52.7	42.2	21.3
Animal manure + Gypsum	4.60	0.98	5.95	3.68	4.77	128.6	62.5	51.2	38.4
Animal manure + Wheat straw	3.76	0.44	5.40	2.54	3.93	191.5	56.3	37.6	33.4
Sulphur + Gypsum	4.45	0.59	5.60	2.51	2.73	213.8	49.3	45.5	41.4
Wheat straw +Sulphur	4.00	0.40	5.10	3.01	3.04	141.1	47.4	43.5	33.7
Wheat straw + Gypsum	3.89	0.59	4.60	3.26	2.84	152.4	50.7	42.8	21.0
Bagasse + Sulphur	4.25	0.48	5.00	2.76	2,43	175.7	60.0	45.8	29.0
Bagasse + Gypsum	3.53	0.57	5.54	3.50	1.82	161.1	52.6	42.4	21.3
Organic acid +Sulphur	3.83	0.67	5.55	3.26	4.86	212.1	45.3	43.0	22.2
Organic acid +Gypsum	3.78	0.79	5.37	3.18	4.05	213.1	45.0	48.1	34.3
Bagasse +Sulphur + Gypsum	3.29	0.63	4.27	2.68	4.46	218.4	42.2	42.6	18.7
LSD (0.05)	**NS**	**0.53***	**1.61****	**NS**	**1.68****	**89.6****	**35.0****	**NS**	**18.5****

Table (9). Some physical properties of soil treated with amendments

Treatments	BD Mg/m^3	MWD (mm)	GMD (mm)	Cr	δg	SI	KR	PI
Control	1.79	0.738	0.542	1.325	2.544	1.52	2.00	81.22
Animal manure	1.84	0.667	0.475	1.003	2.958	2.04	1.95	81.13
Bagasse	1.74	0.705	0.506	1.194	2.811	1.02	2.52	99.96
Wheat straw	1.85	0.677	0.498	1.115	2.729	2.04	1.76	87.46
Sulphur	1.70	0.718	0.536	1.345	2.523	1.70	2.85	97.65
Gypsum	1.73	0.663	0.490	1.072	2.723	1.89	2.31	85.28
Animal manure + Sulphur	1.71	0.721	0.524	1.227	2.668	2.40	1.84	86.69
Animal manure + Gypsum	1.65	0.752	0.575	1.478	2.956	2.28	2.86	88.89
Animal manure + Wheat straw	1.65	0.744	0.553	1.426	2.479	1.97	1.40	82.04
Sulphur + Gypsum	1.77	0.745	0.553	1.389	2.461	1.78	1.70	76.88
Wheat straw +Sulphur	1.83	0.714	0.521	1.245	2.651	1.76	1.88	90.17
Wheat straw + Gypsum	1.80	0.667	0.561	1.471	2.416	1.91	1.30	87.06
Bagasse + Sulphur	1.77	0.687	0.499	1.162	2.787	2.48	1.97	92.14
Bagasse + Gypsum	1.76	0.719	0.521	1.259	2.702	1.52	2.07	102.51
Organic acid +Sulphur	1.77	0.717	0.527	1.366	2.666	1.83	1.75	97.45
Organic acid +Gypsum	1.76	0.695	0.510	1.280	2.778	1.97	2.77	89.48
Bagasse +Sulphur + Gypsum	1.75	0.733	0.557	1.466	2.353	2.04	1.31	84.86
LSD (0.05)	**0.105****	**0.053***	**0.053***	**0.25***	**0.381****	**0.153***	**0.245***	**15.43****

Chemical properties of soil

Table (10) shows the effects of soil amendments application on some soil chemical properties. The soil pH ranged between 7.92 and 8.97 with an average of 8.46. Also, soil salinity (EC) was ranged between 2.12 and 5.53 dS/m with an average value of 3.64 dS/m. The soluble cations; Ca^{+2}, Mg^{+2}, Na^{+} and K^{+} ranged between 2.45 and 6.37; 3.04 and 6.27; 9.78 and 25.87 and 0.20 and 1.42 meq/l, respectively with average values of 3.90, 4.68, 17.29 and 0.59 meq/l, respectively. The soluble anions; HCO_3^{-}, Cl^{-} and $SO_4^{=}$ ranged between 6.13 and 8.58, 8.30 and 14.93 and 8.96 and 12.85 meq/l, respectively. The average values were 7.79, 12.35 and 10.26 meq/l, respectively. Calcium carbonate content ranged between 3.68 and 22.10% with an average of 13.93. Also, organic matter content ranged between 0.71 and 1.72% with an average value of 1.31%.

Soluble sodium percentage (SSP) of soil ranged between 54.02 and 71.16% with an average value of 62.42%. The lowest value was attained with animal manure plus gypsum treatment and was lower than the control treatment by about 24.079%. Also, sodium adsorption ratio (SAR) ranged between 6.12 and 14.77 with an average value of 9.28. The lowest value was attained with animal manure plus gypsum treatment. It is lower than the control treatment by 58.56%. The expected exchangeable sodium percentage (ESP) ranged between 7.79 and 17.02% with an average value of 11.48%. The lowest value was attained with animal manure plus gypsum treatment. It is lower than control treatment by about 54.82% (Table 11). From the obtained results it can be concluded that the animal manure plus gypsum treatment is the best treatment for improvement the saline-sodic soil.

Gypsum (Amezketa *et al.*, 2005) and organic matter (Wong et al., 2009) are some of the amendments which have been used. Gypsum is the most commonly used amendment for sodic soil reclamation and for reducing the harmful effects of high sodium irrigation water in agricultural areas (Amezketa *et al.*, 2005). Studies on the effect of gypsum application on saline-sodic soil reclamation have shown that the soil receiving gypsum at higher rate removes the greatest amount of Na^{+} from the soil columns and causes a substantial decrease in soil electrical conductivity (EC), sodium adsorption ratio and SAR (Hamza and Anderson, 2003).

Table (10). Some chemical properties of soil treated with soil amendments application

Treatments	pH	EC	Soluble cations (meq/l)				Soluble anions (meq/l)			$CaCO_3$	OM
		dS/m	Ca	Mg	Na	K	HCO_3	CL	SO_4	(%)	(%)
Control	8.94	3.67	5.36	7.30	23.44	0.59	10.80	14.60	11.27	20.00	1.05
Animal manure	8.33	2.95	3.22	6.64	18.87	0.78	8.13	11.86	12.00	21.71	1.42
Bagasse	8.42	2.85	3.69	4.22	19.88	0.66	8.01	13.40	10.15	10.52	0.71
Wheat straw	8.54	2.47	3.32	5.54	15.49	0.36	5.49	13.62	10.64	14.92	1.41
Sulphur	8.11	3.08	4.30	3.65	18.37	0.52	7.74	11.07	9.84	11.57	1.18
Gypsum	8.20	3.41	6.07	4.05	17.33	0.63	8.32	14.14	13.26	11.05	1.31
Animal manure + Sulphur	8.14	3.36	5.53	5.02	15.17	0.85	8.37	14.05	12.43	3.68	1.68
Animal manure + Gypsum	8.14	3.27	6.38	2.83	13.46	0.99	6.63	12.35	10.05	4.74	1.72
Animal manure + Wheat straw	8.64	2.45	3.48	6.38	21.89	0.72	7.43	12.28	11.02	11.58	1.37
Sulphur + Gypsum	8.51	2.71	3.88	5.54	16.71	0.94	7.70	14.07	10.33	9.47	1.23
Wheat straw +Sulphur	8.42	2.91	3.47	6.59	18.60	0.44	7.64	15.62	11.86	19.47	1.22
Wheat straw + Gypsum	8.27	2.45	4.20	6.00	13.85	0.44	6.21	15.25	11.26	22.10	1.32
Bagasse + Sulphur	8.40	2.80	3.77	5.65	18.34	0.28	6.91	12.86	11.14	16.32	1.58
Bagasse + Gypsum	8.54	2.86	3.08	6.09	18.90	0.51	6.60	16.87	10.80	18.14	1.06
Organic acid +Sulphur	8.30	2.60	3.08	6.17	16.15	0.60	7.12	15.67	12.97	11.58	1.27
Organic acid +Gypsum	8.00	3.27	5.25	3.06	17.11	1.27	6.96	12.24	8.00	15.78	1.37
Bagasse +Sulphur + Gypsum	8.24	2.24	4.44	5.07	12.66	0.26	5.99	10.74	15.36	14.21	1.41
LSD (0.05)	**0.44****	**1.09****	**1.37****	**1.78***	**7.16****	**0.30****	**0.42***	**2.1009****	**1.23****	**6.09****	**0.30****

Table (11). Sodium hazard of soil treated with soil amendments application

Treatments	ESP (%)	SAR	SSP (%)	RSE %	RSSE %
Control	17.02	14.77	71.16	-	-
Animal manure	12.79	11.08	60.75	24.85	14.63
Bagasse	12.37	10.43	69.91	27.32	1.76
Wheat straw	15.38	11.24	61.84	9.64	13.10
Sulphur	14.28	12.22	68.19	16.10	4.17
Gypsum	11.28	8.47	62.54	33.73	12.11
Animal manure + Sulphur	13.35	9.55	60.79	21.56	14.57
Animal manure + Gypsum	7.69	6.12	54.02	54.82	24.09
Animal manure + Wheat straw	13.28	10.03	56.23	21.97	20.98
Sulphur + Gypsum	8.08	6.50	55.31	52.53	22.27
Wheat straw +Sulphur	10.67	8.96	63.85	37.31	10.27
Wheat straw + Gypsum	10.07	7.55	62.76	40.83	11.80
Bagasse + Sulphur	10.33	8.68	65.44	39.31	8.04
Bagasse + Gypsum	9.11	7.65	66.20	46.47	6.97
Organic acid +Sulphur	8.98	9.85	62.10	47.24	12.73
Organic acid +Gypsum	12.24	7.85	60.63	28.08	14.80
Bagasse +Sulphur + Gypsum	8.20	6.85	59.46	51.82	16.44
LSD (0.05)	**4.39****	**3.87****	**11.65***	**17.32***	**8.23***

Removal sodium efficiency (RSE) in percentage of Na-removed from soils at the end of the experiment was calculated as follows:

$$RSE = \frac{\left(ESP_i\text{-}ESP_f\right)}{ESP_i} \times 100$$

Where:

ESP_i : exchangeable sodium percentage before the soil amendments application, and

ESP_f : exchangeable sodium percentage after the soil amendments application at the end and after plant harvest.

The removal sodium efficiency (RSE) or percentage of Na-removed from the soils at the end of the experiment in used soils was significantly reduced after the application of the amendments (Table 11). RSE of animal manure plus gypsum revealed the highest value (54.82%) among the treatments followed by 51.82 and 47.24% for Bagasse +Sulphur + Gypsum and Organic acid +Sulphur treatments, respectively. Also, the removal of soluble sodium efficiency (RSSE%) was calculated by the same equation using SSP instead of ESP. The value of RSSE for animal manure plus gypsum revealed the highest value (24.09%) among the treatments followed by 22.27 and 20.98 for Sulphur + Gypsum and animal manure plus wheat straw treatments, respectively.

The obtained results confirmed that animal manure plus gypsum treatment was the best method for reclamation the salt-affected soil.

Available nutrients in soil

Table (12) showed that the soil available nutrients were significantly affected by application of soil amendments. The values of available N, P and K ranged between 122.1 and 324.4; 9.2 and 71.4 and 162.5 and 250.0 mg/kg, respectively with an average value of 269.9, 39.1 and 202.9 mg/kg, respectively. The higher values were attained with animal manure plus gypsum treatment. These values are higher than the control treatment by 165.62, 296.97 and 11.11%, respectively. Also, the content of available Fe, Mn, Cu and Zn ranged between 4.1 and 11.3; 8.2 and 18.4; 4.2 and 4.9 and 0.4 and 1.2 mg/kg, respectively with an average values of 7.9, 13.8, 4.6 and 0.8 mg/kg, respectively. The higher values were attained with animal manure plus gypsum treatment. These values are higher than the control treatment by 76.56, 77.22, 13.95 and 82.35%, respectively. It is clear that all soil amendments increased the soil available nutrients.

Although the use of chemical amendments, like gypsum, successfully improved the chemical properties of these soil, but fails to restore nutritional and biological properties of reclaimed soils. As a cost-effective and environmentally acceptable strategy, saline-sodic soil can also be reclaimed through organic bio-amelioration (Gill *et al*., 2009). The incorporation of organic amendments to sodic soil enhances microbial activity that transforms the organic materials into long chain aliphatic compounds capable of binding and stabilizing soil aggregates. Bio-amelioration method has great advantage over chemical amendments such as: (1) improvement of soil hydraulic conductivity, (2) increases the plant nutrients availability in amended soil, (3) environmental services through soil carbon sequestration. It is concluded that bio-amelioration approach for sodic land reclamation would not only improve the soil fertility, but also make able the reclaimed sodic soil for agriculture that can fulfil the food requirements of growing population. Also, Gypsum application successfully reduces exchangeable sodium percentage (ESP) of sodic soils, but fails to improve the physical and biological properties of the soil (Tejada *et al*., 2006).

Recently, organic bio-amelioration approach has proved to be an efficient, low cost and environmentally acceptable strategy to ameliorate sodic and saline-sodic soils. Input of organic matter conditioner such as mulch, manures, compost and recyclable organic waste/residues have been investigated for their effectiveness in sodic soils amelioration. It has been demonstrated that the application of organic matter to sodic soils can accelerate Na+ leaching, decrease the exchangeable sodium percentage and increase infiltration rate and aggregate stability of amended soils (Jalali and Ranjbar, 2009).

Numerous studies showed the benefits of organic amendments in improving physical, chemical and biological properties of soil. Although, these parameters can be changed slowly and several years are necessary to obtain significant differences, biological and biochemical parameters are more sensitive and can provide earlier measurements of changes produced by soil management (Melero *et al*., 2007; Courtney and Mullen, 2008; Chitravadivu *et al*., 2009).

Soil organic matter encourages granulation, increases cation exchange capacity (CEC) and is responsible for up to 90% adsorbing power of the soils. Cations such as Ca^{2+}, Mg^{2+} and K^{+} are produced during its decomposition (Brady and Weil, 2005). **O**rganic amendments decreased soil sodicity and increased exchangeable Ca2+ and Mg^{2+} (Anand, 1992).

Table (12). Available nutrients content in soil as affected by soil amendments application

	Available macro-nutrients (mg/kg)			Available micro-nutrients (mg/kg)			
	N	**P**	**K**	**Fe**	**Mn**	**Cu**	**Zn**
Control	122.13	20.50	225.00	6.4	10.1	4.3	0.7
Animal manure	307.27	40.13	168.75	5.8	17.9	4.5	0.4
Bagasse	219.90	39.88	225.00	11.0	14.6	4.3	0.7
Wheat straw	307.30	50.38	212.50	9.1	12.1	4.6	0.7
Sulphur	323.13	17.25	162.50	8.1	14.6	4.7	0.7
Gypsum	252.27	9.16	200.00	6.3	11.5	4.4	0.8
Animal manure + Sulphur	280.53	57.38	193.89	8.6	12.7	4.2	1.0
Animal manure + Gypsum	324.40	81.38	250.00	11.3	18.4	4.9	1.2
Animal manure + Wheat straw	306.30	45.13	250.00	6.3	14.1	4.8	1.00
Sulphur + Gypsum	200.27	16.25	175.00	4.6	10.2	4.5	0.8
Wheat straw +Sulphur	280.50	52.88	218.75	8.8	13.4	4.7	0.8
Wheat straw + Gypsum	283.9	43.25	206.25	7.9	8.3	4.8	0.7
Bagasse + Sulphur	215.63	33.38	193.75	10.4	18.3	4.8	0.8
Bagasse + Gypsum	255.30	25.75	193.75	6.2	10.6	4.4	0.4
Organic acid +Sulphur	267.27	57.00	218.75	9.4	15.1	4.2	0.8
Organic acid +Gypsum	323.53	48.60	187.50	4.1	14.8	4.6	1.2
Bagasse +Sulphur + Gypsum	303.53	36.50	168.75	10.0	17.6	4.8	1.0
LSD (0.05)	**52.15****	**30.22****	**28.05****	**2.9****	**6.1****	**0.2****	**0.2****

Finding of previous study showed that incorporation of organic bio-ameliorants improve the growth and yield of major crops (*Triticum aestivum* L. and *Oryza sativa* L.) under the sodic condition (Yaduvanshi and Sharma, 2008; Choudhary *et al*., 2011). The incorporation of organic bio-ameliorants into sodic soils significantly increased the root growth and yield of wheat (*Triticum aestivum* L.) crop, due to continuing supply of readily-available nutrients, due to mineralizing organic matter (Gill *et al*., 2009). In addition, there would be polysaccharides and mycelial exudates released from the mineralization of organic matter seem to play an important role in plant growth promotion (Srinivasan *et al.*, 2011).

The most effective procedures for saline-sodic soils reclamation are based on the removal of exchangeable and soluble sodium out of the soil profile. A method of saline or saline-sodic soils reclamation using a combination of organic manure and gypsum was evaluated and proved to be the best soil amendment for reducing soil pH, soil salinity, and soil sodicity. As shown in the present study, the sodium removal efficiency was the highest with treating the soil with animal manure plus gypsum. Consequently, squash yield was the highest at the same treatment.

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الملخص العربي

تأثير عديد من المحسنات وتوليفاتها على خصائص التربة وإنتاج الكوسة فى تربة ملحية- صودية

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أجريت تجربة حقلية على الكوسة صنف اسكندراني فى المزرعة التجريبية – كلية الزراعة سابا باشا – جامعة الاسكندرية بمنطقة ابيس ١٠ خلال الموسم الشتوى ٢٠١٤ لدراسة تأثير إضافة عدد من محسنات التربة مثل السماد الحيواني– مصاصة القصب – الحبس – الكبريت – الحامض العضوي وخليط منها على الخواص الفيزيائية والكيميائية للتربة المتأثرة بالاملاح وأيضا على النمو وخصائص المحصول والمحتوى من العناصر الغذائية فى اوراق وثمار الكوسة. تم زراعة الكوسة فى أكتوبر ٢٠١٤ بزراعة البذور فى جور على ابعاد ٠.٢٥ متر داخل الخط ومسافة ٠,٦ متر بين الخطوط بطول ٣,٠ متر. بعد اكتمال النمو تم الرى بطريقة الخطوط حتى الحصاد فى ديسمبر ٢٠١٤. جميع المعاملات تم تطبيقها كما هو موصى به. أضيفت محسنات التربة (١٧ معاملة) بخلطها مع التربة السطحية لعمق ٣٠سم قبل الزراعة. تم تسجيل النمو الخضرى– المحصول ومكوناته– محتوى الاوراق والثمار من العناصر الغذائية كما تم تسجيل خصائص التربة الفيزيائية والكيميائية. أشارت النتائج الى ان خصائص النمو الخضرى (الوزن الاخضر والوزن الجاف للأوراق – المحتوى المائى للأوراق – وزن النبات الكلى – محتوى الاوراق من الكلوروفيل) لم تتأثر معنويا نتيجة إضافة المحسنات ولكن أعلى قيم تم الحصول عليها مع معاملة السماد الحيوانى (٢٤ طن/هكتار) + الجبس (٤ طن/هكتار). أعلى قيم لخصائص محصول الكوسة (قطر الثمرة – طول الثمرة – وزن الثمرة – المحصول الكلى للثمار) تم الحصول عليها من معاملة السماد الحيواني+الجبس. محصول ثمار الكوسة زاد معنويا مع إضافة محسنات التربة ووصل الى اعلى قيمة ٦٩٥٤ كجم/هكتار مع معاملة السماد الحيواني+ الجبس بما يعادل ٢٧١,٣ % مقارنة بمعاملة الكنترول. تأثر محتوى العناصر الغذائية الكبرى والصغرى فى الاوراق والثمار تأثرت معنويا باضافة محسنات التربة خاصة معاملة السماد الحيوانى+الجبس. كما تأثرت معنويا الخواص الفيزيائية للتربة مثل الكثافة الظاهرية– متوسط القطر الموزون – متوسط القطر الهندسي – معامل البناء باضافة محسنات التربة المختلفة. وقد أظهر معامل ثبات البناء – نسبة كيلي ودليل النفاذية التأثير العالى من الصوديوم فى التربة وبالتالى فان التربة تصبح مهيأة لاضرار الصوديوم ولهذا فالتربة بها مشاكل تتعلق بنفاذية المياه. كما تحسنت خواص التربة الكيميائية والتى تشمل محتوى التربة من العناصر الغذائية الميسرة كنتيجة لاضافة محسنات التربة خاصة السماد الحيوانى + الجبس . من النتائج التى تم الحصول عليها يمكن ان نقرر ان السماد الحيوانى + الجبس هى أفضل المعاملات لتحسين خواص التربة الملحية – الصودية وكذلك نمو ومحصول الكوسة.

Phytoremediation of The Air Pollution Using some Plants in Three Different Locations of Alexandria City

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ABSTRACT: The present study was carried-out at the Horticulture Research Institute, Agriculture Research Center (A.R.C.). Alexandria, Egypt during the spring and autumn seasons of 2015. The aim was to investigate the effect of phytoremediation of air pollution using some plants (*Nerium oleander and Pittsporum Tobira*) in three locations in the Alexandria city**.** We applied these work in three different sites in Alexandria city which namely, (1) El-Ebrahimeya, (2) El- Dekhela and (3) Antoniadis garden (Control). The results showed that the concentrations of lead, cadmium and zinc elements were the highest in the Dekhela region soil compared with other areas . Lead element was a higher concentration at the sector 30-60cm compared with the sector 0-30cm. Analyzing the leachates of polluted leaves, stem and roots, it has been detected that in both species studied, the concentrations of lead, cadmium ans zinc was the highest in Dekhela compared with those obtained in Antoniades garden region.

Key word: Phytoremediation – Pollution – Lead - Cadmium – Zinc - *Nerium oleander* - *Pittsporum tobira* - Alexandria city.

INTRODUCTION

Alexandria is the second capital of Egypt, it was the old capital, located on the Mediterranean coast. Alexandria city, one of the most culturally diverse and civilized cities, where many different historical periods throughout the ages have seen, where there are many ancient and modern monuments, became an open museum featuring Greek, Roman, Coptic and Islamic. The population of Alexandria city is about 4,123,869 people according to 2006 census (World Population Prospects) serving commercial, industrial and agricultural activities. Therefore, the issue of pollution is one of the important issues that threatened the throne of the tourist city, especially air pollution standpoint (Ghattas,1992). In Alexandria, some industrial areas started to contribute to the problem of air pollution due to the rapid growth of industrialization, besides the lack of planning for site allocation of industries. Therefore, there were a considerable numbers of studies on industrial air pollution and its effects on the environment in Alexandria. For instance, for the cement industry, many researchers tackled the problem of pollution monitoring, control, health effects and other factors caused by this industry (Abd El-Kader *et al.*,1979). Amer (1999) studied air pollution and planning of housing location in Alexandria.

Lead is widely distributed naturally, but the greatest risks normally arise from emissions to the environment associated with human use of the metal and its derivatives. Fumes and dust come from smelting of lead, manufacture of insecticides, paint, powdery glazes and storage batteries, and from gasoline containing lead additives. Sewage sludge may contain very high levels of lead and its use as a fertilizer may contaminate soils. High levels may occur in urban air as a result of the high traffic density and associated emission of lead from gasoline additives (Harrison and Laxen, 1981). Madany and Salim (1992), found that the concentration of lead in street and house dust were 697.2, and 360 $\mu g/m^3$; respectively. It was suggested that the motor vehicles are the major source of these metals in dust samples.Jaffe *et al.*(1992) measured lead concentration in urban and rural area. Urban concentrations were higher than rural concentration, Ghattas (1992). He found that the lead concentration in air of Alexandria, Cairo was averaged 0.259 $\mu g/m^3$.

Cadmium is a normal constituent of soil and water at low concentrations. It is usually mined and extracted from zinc ores, especially zinc sulphide. Industrially, cadmium is used as an antifriction agent, and in alloys. In the environment, cadmium is dangerous because many plants and some animals absorb it efficiently and accumulate it within their tissues. Shalaby (1997) found that cadmium concentraion in air samples in urban area and rural area was 0.028, and 0.002$\mu g/m^3$; respectively. Ghattas (1992) measured cadmium concentration in ambient environment at Alexandria, near Horreya avenue and found that Cd concentration was 0.0053 $\mu g/m^3$.

Major uses of zinc are in the production of noncorrosive alloys, brass and in galvanizing steel and iron products. Zinc undergoes oxidation as surface coating, thus protecting the underlying metal from degradation. Zinc oxides are used in rubber and as a white pigment. Zinc is utilized therapeutically in human medicine in the treatment of zinc deficiency. The carbonates, which are organic zinc compounds, are used as pesticides (Friberg *et al.*, 2002).Also they found that about 21-38 x 10^3 metric tons of zinc per year is fallout. Shalaby (1997) found that zinc concentration in air samples in urban and rural area was of 0.5, 0.44, and 0.11$\mu g/m^3$; respectively.

This study aims to see experimentally the effect of using two kinds of plants; *Nerium oleander and Pittsporum tobira* on reducing the air pollution level in three locations in Alexanderia city; El-Ebrahimeya, El-Dekhela and Antoniadis garden. Three highly dangerous heavy metals were detected through the study; Lead, Cadmium and Zinc.

MATERIAL AND METHODS

The present study was carried-out at the Horticulture Research Institute, Agriculture Research Center (A.R.C.) Alexandria, Egypt during the spring season (March-April) and the autumn season (October-November), 2015. The aim was to investigate the effect of phytoremediation of air pollution using one year old unpinched plants of (*Nerium oleander and Pittsporum tobira*) of about 50 cm height. 24 plants of each shrub were planted in three locations in Alexandria city **.**We applied these work in three different sites in Alexandria city namely:

1- El-Ebrahimeya square which considered as a densely populated region and logged of a lot vechicles.
2- El- Dekhela region which is considered as an industrial region.
3- Antoniadis garden (Smouha) which is considered as a control region(less polluted).

1. Sampling:

1.1. Sampling of Total Suspended Particulate (TSP), Particulate Matter Less Than 10 micrometer (PM_{10}) , Lead, Cadmium and Zinc:

Samples were collected inside the working environment during the melting process and carried out using portable dust sampler type L-2SF.MK3 from Rotheroe and Michell. The sampler has a regulated air flow rate of 50 - 110 liter per minute. The inlet manifold of volume sampler was two meters height from the ground surface. Samples were collected on Whatman GF/A fiberglass filter of 7 cm diameter with a 99% - >99.99% collection efficiency for 0.035 - 1 µm particles (Kathren, 1984).

1.2. Digestion Method:

For measuring lead, cadmium and zinc concentrations, the filter paper was placed in desiccators for 48 hrs prior and after the sampling. The analytical balance (Meter) of 0.1 mg sensitivity was used. Digestion method was carried out following the method of Thompson and Walsh (1983) and WMO (1993) for airborne samples.

2. Monitoring instruments

2.1. TSP, PM_{10} and $PM_{2.5}$(Particulate matter Less Than 2.5 micrometer)

With increased awareness of environmental pollution from fine particulate in the workplace and increasing enforcement of Control of Substances Hazardous to Health (COSHH) and environmental legislation, the demand for more area and perimeter monitoring on a short to medium term basis is on the increase. This need for real-time particulate information is a requirement in general industry, when looking at Total Suspended Particulate (TSP), and at inhalable and respirable dust levels as a health issue.

CASELLA CEL has introduced the Dust Detective Static Air Sampling (SAS) enclosure for exactly this application. This accessory provides a simple solution to short to medium term fixed area monitoring with the micro dust pro and Apex sampling pumps and is designed specifically for use in indoor applications, but some short term outdoor perimeter samples can be undertaken with the unit (Ashraf, 2013).

The key component to this accessory is the sampling inlet which utilizes Polyurethane foam (PUF) size-selective filter techniques. The foam filter specifications and dimensions determine the desired aerosol size selection characteristics and eliminate particle sizes greater than PM_{10}, $PM_{2.5}$ or Respirable (4 mm) as appropriate. The larger particles become trapped and collect within the foam matrix, whilst all particles below these “cut-off points” pass through the PUF filters and enter the measurement chamber, where the real time mass concentration is established (Ashraf, 2013).

After passing through the Micro dust pro, particulate matter is deposited on a 25 or 37mm filter which may be used for gravimetric or chemical analysis.

2.1.1.Starting a Sample Run

The following procedure was applied:

1. The protective dust cap was removed and the sample was fit inlet tube/head to the case.
2. The PUF filter foam (s) was inserted and in line sample filter.
3. The Micro dust pro was switched and Apex pump on.was confirmed zero using the in-line filter connected to the sample inlet.
4. The Apex flow was checked that rate was set to 3.5L/min.
5. The unit was located in required location.Pump and Microdust data logger was started according to their respective user manuals.

2.1.2 GPS

Global Positioning System (GPS) device was used to determine the measurement locations on Alexandria map.

2.1.3 Digital Camera

Digital camera has been used to document measurements and monitoring the nature of the surrounding environment.

2.2 Data Sources

2.2.1 Metrological Data

Several websites were used to get recent weather data in measurement sites such as Weather Underground (http://www.wunderground.com/)and the Iowa Environmental Mesonet (IEM) (http://mesonet.agron.iastate.edu/).

2.2.2 Calculation Methode for TSP (Total Suspended Particulate) and PM_{10} (Particulate Matter Less Than 10 Micrometer).

The level of Total suspended particulate(TSP) and the level of respiratory particles(PM_{10}) at the three selected locations was calculated as showen :{(Average of TSP before- Average of TSP after new filter)/ AQL}*100, and the same equation for PM_{10} :{(Average of PM_{10} before- Average of PM_{10} after new filter)/ AQL}*100,the AQL(Air Quality Limit) for air pollutant according to law 4/94 which modified to law 9 for 2009 (Egyptian Environment Affairs Agency,1994).

2.3. Sample preparation:

We washed the collected samples (leaves, stems and roots of the two shrubs) with distilled water to clean dust and deposited substance we recorded the fresh weight for every collected sample, after that all samples were dried on papers then oven dried at 70Cº for 48 hours to constant mass, after putting them in paper bags. After washing the samples we kept the leachates water obtained from the washed samples in jars to determine heavy metals as it's content described by Haswel (1991).

The samples of water of all plant part leachates of both shrubs (*Nerium oleander* and *Pittsporum tobira*) were washed with it which were put in jars (18 jars) and were given a code for doing chemical analysis as determination of heavy metals especially (Cd, Zn and Pb) by using the Atomic Absorpation Spectrometer.

2.4. Soil analysis:

Soil samples of shrubs understudy were taken at random from surface 0-30 cm and at depth 30-60 cm, dried in the oven for determination of heavy metals (Cd, Zn and Pb), these samples were digested as follows:

- A sample of soil was dried very well and was siftted with sieve it's scale 2mm.
- A weight was taken from the soil about 0.5g.
- 4ml of Nitric acid was put for the sample (HNO_3).
- 1ml of Prochloric was put for the sample ($HCLO_4$).
- The solution was headted at 105º for 2-3 hour until appear white fumes then the temperature was raised to 185º until the solution became dry.
- The residue was left to be cool then 2 ml of hydrcloric acid (HCL) was added then was heated on 60ºfor one hour.
- The mixture was cooled and 8ml of distill water was added then was left for 4 hour after that was nominated and was continued to 50 ml of distill water to be ready to take the reading from the apparatuse.
- After that the digested sample of soil was taken for doing chemical analysis as determination of heavy metals especially (Cd- Zn and Pb) determination using Atomic Absorpation Spectrometer according to Isaac and Kerber (1971).

Correlation relationships were statisticaly analysed by Gomez and Gomez (1984), in order to detect the relationships among the three pollutants (Pb, Zn and Cd) each of TSP (Total Suspended Particulate) and PM_{10} (Particulate Matter Less Than 10 micrometer).

RESULTS AND DISCUSSION

1. Heavy metals (lead, cadmium and zinc) content in soil

Data presented in Table (1) showed that, in season 2015, for the *Nerium* and *Pittsporum* plants,it was found that the concentration of lead element was the highest in the Dekhela region soil compared with other areas, while lead element was manifested in higher concentration in the layer of 30-60 cm compared with the layer of 0-30 cm. The lowest amount was accumulated in Antoniadis garden in the same depth. Also, it has been found that the concentration of cadmium element was the highest in the Dekhela region compared with the other areas, while cadmium element was found in higher concentration in the layer of 30-60 cm compared with the layer of 0-30 cm. The lowest concentration was accumulated in Antoniadis garden in the same depths. In addition, the concentration of zinc element was the highest in the Dekhela region compared with other areas, while zinc element was obtained of a higher concentration in the layer of 30-60 cm compared with that of the layer of 0-30 cm. The lowest amount was accumulated in Antoniadis garden in the samples taken from the same depth. Some limited differences among the three pollutants with respect to their concentration in spring and autumn. It is believed that these differences might due to the traffic density.

Table (1). Heavy metals (lead, cadmium and zinc) content in the soil planted with *Nerium and Pittsporum* in the different locations.

Treatments			Lead (mg/kg)		Cadmium (mg/kg)		Zinc (mg/kg)	
			Spring	Autumn	Spring	Autumn	Spring	Autumn
Nerium oleander	Antoniadis (Control)	D1	2.820	2.745	0.015	0.010	1.220	3.875
		D2	4.815	4.675	0.023	0.026	2.705	6.230
	Dekhela	D1	39.600	22.470	0.077	0.185	7.485	9.725
		D2	46.295	34.900	0.152	0.237	9.070	15.885
	Ebrahimeya	D1	8.605	8.235	0.023	0.018	4.520	5.380
		D2	9.985	10.945	0.066	0.039	5.530	9.010
Pittsporum tobira	Antoniadis (Control)	D1	1.645	3.000	0.014	0.019	1.070	3.150
		D2	2.100	5.120	0.025	0.030	2.050	5.580
	Dekhela	D1	27.150	19.585	0.165	0.259	5.625	8.880
		D2	31.455	24.830	0.320	0.398	8.185	10.750
	Ebrahimeya	D1	4.020	7.945	0.021	0.011	3.935	5.170
		D2	5.940	9.895	0.040	0.025	5.130	6.620

D1: soil sample at depth of 0-30 cm.
D2: soil sample at depth of 30-60 cm.

2. Heavy metals (lead, cadmium and zinc) content in water

Data presented in Table (2) displayed the level of lead in leachates samples resulted from washing leaves, stems and roots of the two shrubs (*Nerium oleander* and *Pittsporum tobira*) in the spring and autumn seasons of 2015. It was found that high concentration of lead in leaves growing at region of Dekhela compared for concentration the low in Antoniadis garden. With respect to the leachates level of lead in stems, high level was found in Dekhela region, relative to that obtained from Antoniadis garden. The leachate of roots for the both shrubs (*Nerium oleander* and *pittsporum tobira*) showed that high concentration of lead was found in Dekhela region vs. the lowest concentration was found in Antoniadis.

With respect to level of cadmium in the leachate leaves, stems and roots of both two shrubs (*Nerium oleander and Pittsporum tobira*) in the spring and autumn season of 2015, the highest concentration of cadmium was detected in leaves of the shrubs growing at Dekhela region, while concentration was found in those growing at Antoniadis garden. The level of lead in leachate of stem showed also the high level of cadmium in Dekhela region, while the lowest level was found in Antoniadis garden. The leachate of roots of both shrubs (*Nerium oleander and Pittsporum tobira*) displayed the highest concentration of cadmium in roots of shrubs growing at Dekhela region as it compared with those indicated at Antoniadis garden.

As for the zinc concentration, it was found that the level of zinc in leachates of leaves, stems and roots of (*Nerium oleander and Pittsporum tobira*) shrubs in the spring and autumn season of 2015,the highest zinc level was obtained in leaves of the shrubs growing at region of Dekhela, compared with that obtained at Antoniadis garden. The level of zinc in the leachates of stems showed also that the highest level of zinc was found in stems of shrubs growing at Dekhela region, while the lowest level was found in those of shrubs growing at Antoniadis garden.The leachates of roots of both shrubs (*Nerium oleander and Pittsporum tobira*) showed that highest concentration of zinc at Dekhela region compared to those at Antoniadis garden. Some limited differences among the three pollutants with respect to their concentration in spring and autumn. It is believed that these differences might due to the traffic density.

Table (2). Heavy metal content in leachates of plant parts (mg/l).

Plant	Location	Leaves						Stem						Root					
		Lead content (mg/l)		Cadmium content (mg/l)		Zinc content (mg/l)		Lead content (mg/l)		Cadmium content (mg/l)		Zinc content (mg/l)		Lead content (mg/l)		Cadmium content (mg/l)		Zinc content (mg/l)	
		Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn
N. oleander	**Anto. (Control)**	0.083	0.101	0.0980	0.001	4.8096	0.4403	1.740	0.141	0.0067	0.0006	5.491	0.334	0.071	0.091	0.0065	0.0003	4.539	0.324
	Dekhela	0.416	0.237	0.2904	0.0046	14.089	0.783	4.495	0.304	0.0139	0.0046	17.130	0.884	0.581	0.162	0.0130	0.0050	8.058	0.703
	Ebrahimeya	0.115	0.155	0.1272	0.0033	13.303	0.6506	3.640	0.155	0.0074	0.0030	7.937	0.429	0.123	0.132	0.0083	0.0033	7.724	0.499
P.tobira	**Anto. (Control)**	0.038	0.091	0.0367	0.0003	3.963	0.195	1.185	0.059	0.0067	0.0002	2.914	0.042	0.098	0.068	0.0057	0.0003	4.745	0.119
	Dekhela	0.514	0.139	0.1893	0.0006	11.100	0.458	3.517	0.155	0.0143	0.0006	11.968	0.262	0.765	0.183	0.0114	0.0006	11.26	0.368
	Ebrahimeya	0.460	0.110	0.1607	0.0003	8.304	0.334	2.412	0.076	0.0100	0.0003	6.961	0.212	0.383	0.122	0.0083	0.0003	6.518	0.266

3. Heavy metals (lead, cadmium and zinc) content (mg/kg) in the filter paper.

Data presented in Table (3) exhibited the results of analyzed filter paper during the spring and autum season of 2015.The results showed that the level of lead in air was high in Dekhela location, but was low in Antoniadis. The level of cadmium was high in Dekhela,as it compared with that of Antoniadis location. The level of zinc in air in Dekhela location was high, it was low in Antoniadis. Some limited differences among the three pollutants with respect to their concentrations in spring and autumn. It is believed that these differences might due to the traffic density.

Table (3). Heavy metal content in filter paper (mg/kg).

Location	Lead content in filter paper (mg/kg)		Cadmium content in filter paper (mg/kg)		Zinc content in filter paper (mg/kg)	
	Spring	Autumn	Spring	Autumn	Spring	Autumn
filter (Control)	2.53	2.66	0.19	0.22	23.82	24.06
Anto.(control)	3.03	3.00	0.20	0.22	32.52	33.17
Dkhela	10.175	13.00	0.61	0.95	45.91	32.64
El-abrahimyia	6.02	6.75	0.29	0.34	36.96	35.20

4. Correlation relationships of Total Suspended particulate (TSP) and Particulate Matter Less Than 10 Micrometer (PM_{10}).

The results showed that the dust fall per 37 days is more than the dust fall per one days in Dekhela region ,while the lowest amount of dusts were found in Antoniadis region as shown in (Table 4 and 5). Which summarize the data of concentration of TSP and PM_{10} in cubic meter which shows that the concentration of TSP and PM_{10} in Dekhela region is more than the concentration of TSP and PM_{10} in Antoniadis region.

4.1. Correlation relationships in *Nerium oleander* plant during 37 days:

Data presented in Table (4) showed significant correlation between Pb and Cd which mean that the source of these pollutant heavy metal is the same which was traffic agent, while incase of medium correlation between Pb and both TSP and PM_{10}these mean that TSP and PM_{10} is a kind of dusts that contains lead. In the other side, there are high correlation between Cd and Zn.

Table (4). Correlation coefficient between the three pollutants (Pb, Zn and Cd) ,TSP(Total suspended particules) and PM_{10}(Particulate Matter Less Than 10 Micrometer) in *Nerium oleander* plant.

	Pb	Cd	Zn	TSP	PM_{10}
Pb	1.00000**	0.604**	0.584*	0.598**	0.598**
Cd	0.604**	1.00000**	0.953**	-0.209$^{n.s}$	-0.2095$^{n.s}$
Zn	0.584*	0.953**	1.00000**	-0.210$^{n.s}$	-0.210$^{n.s}$
TSP	0.598*	-0.209$^{n.s}$	-0.210$^{n.s}$	1.00000**	1.00000**
PM_{10}	0.598*	-0.2095$^{n.s}$	-0.210$^{n.s}$	1.00000**	1.00000**

** Highly significant at 0.01 probability level. * Significant at 0.05 probability level. n.s:not significant

4.2. Correlation relationships in *Pittsporum tobira* plant during 37 days :

Data presented in Table (4) showed a high correlation between Pb and Cd and medium correlation between Pb and Zn. On the other side there is high correlation between Cd and Zn. This means that the source of heavy metal is the same,i.e., traffic agent.

Table (5). Correlation coefficient between the three pollutants (Pb, Zn and Cd) ,TSP(Total suspended particules) and PM_{10}(Particulate Matter Less Than 10 Micrometer) in *Pittsporum tobira* plant.

	Pb	Cd	Zn	TSP	PM_{10}
Pb	1.00000**	0.8285**	0.640**	0.1176*	0.1172*
Cd	0.8285**	1.00000**	0.822**	$-0.197^{n.s}$	$-0.198^{n.s}$
Zn	0.640**	0.8225**	1.00000**	$-0.191^{n.s}$	$-0.191^{n.s}$
TSP	0.1175*	$-0.1978^{n.s}$	$-0.1912^{n.s}$	1.00000**	1.00000**
PM_{10}	0.1174*	$-0.198^{n.s}$	$-0.191^{n.s}$	1.00000**	1.0000**

** Highly significant at 0.01 probability level. * Significant at 0.05 probability level. n.s:not significant

DISCUSSION

According to the results of this study, it was found that the levels of lead, cadmium and zinc in the three location under study were found to be different from one location to another. Both shrubs succeeded to absorb and accumulate heavy metals, but *Nerium oleander* proved to be better.

It was found that the different phytoremediation technologies available to decontaminate soil polluted by heavy metals. With deep root systems and high biomass yields, phytoremediation by trees have huge economic and ecological value, offers a cost-effective and environmental-friendly alternative technology to conventional remediation methods such as soil digging and pumpand-treat systems.Although phytoremediation methods appear to be effective for a wide range of heavy metals, the biological processes behind tree effectiveness are largely unknown. Some important processes that require further investigation are: (a) interaction between tree root system and microbe, (b) chelation mechanisms for heavy metals and (c) biotechnologies suitable for tree phytoremediation (Greger,1999).

Concentrations of metals measured in soils demonstrate that TSP, PM10, lead, cadmium and Zinc values differed greatly according to the agricultural site, plant species, and metal type. The difference as due to locations might be related to soil nutrient management, soil properties, and accumulation of metals, which depends on variety and age of plants, metal levels, and duration of effect (Vassilev and Yordanov 1997). Transfer of metals from soils to plants is dependend on three factors; the total amount of potentially available elements (quantity factor), the activity as well as the ionic ratios of elements in the soil solution (intensity factor), and the rate of element transfer from solid to liquid phases and to plant roots (reaction kinetics) (Greger, 1999). In conclusion, using shrubs as *Nerium oleander and Pittsporum tobira*, polluted air and soil can be remediated, notably at public streets and nearby the source of pollutant agent such as industries.

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الملخص العربى

استخدام بعض النباتات في معالجة تلوث الهواء في ثلاث مناطق مختلفة في الاسكندرية

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قسم بحوث نباتات الزينة – معهد بحوث البساتين – مركز البحوث الزراعية[٤]

أجريت هذه الدراسة في معهد بحوث البساتين،مركز البحوث الزراعية (A.R.C). الإسكندرية، مصر خلال فصلي الربيع والخريف عام2015 . وكان الهدف هو دراسة تأثير استخدام شجيرات الدفلة و البتسبورم فى معالجة تلوث الهواء في ثلاثة مواقع في مدينة الإسكندرية هي: (١) الإبراهيمية (٢) الدخيلة (٣) حديقة أنطونيادس (مقارنة).

أظهرت النتائج أن اعلى تركيزات من عناصر الرصاص والكادميوم والزنك كانت في تربة منطقة الدخيلة مقارنة مع باقي المناطق تحت الدراسة و كانت التركيزات العالية للعناصر في قطاع التربة عند عمق ٣٠– ٦٠ cm مقارنة مع تلك عند عمق ٠–٣٠ cm . وقد أظهرت البيانات أن مستوى الرصاص والكادميوم والزنك في ماء غسيل الأوراق و السيقان والجذور فى الشجيرات (موضع الدراسة) كانت عالية فى منطقة الدخيلة بينما كانت أقل فى مستوياتها فى منطقة حديقة أنطونيادس. وأظهرت الدراسة ايضا وجود اختلافات عشوائية في قياسات الربيع والخريف تعود الى الكثافة المرورية.

Effect of Molybdenum, Phosphorus and Sulfur on Yield and Elements Content in Leaves of Wheat Grown in Saline Soil

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ABSTRACT: The objective of this work was to investigate the effect of molybdenum, phosphorus and sulfur on the growth and elements content in wheat (*Triticum aestivum L*) grown under saline soil conditions. To achieve this work, a field experiment was conducted at the experimental research station of Faculty of Agriculture, Saba Basha, Alexandria University. Four rates of molybdenum (0, 50, 100, and 200 g Mo /fed.), four phosphorus rates (0, 7.5, 15 and 22.5 kg P/fed.) and four sulphur rates (0, 50, 100 and 200 kg S/fed) were applied in a split split plot design with three replicates. Molybdenum, phosphorus and sulphur significantly improved grain yield of wheat. The highest grain yield (1.91 ton/ fed) was obtained with application of 200 kg S/ fed, 22.5 kg P/fed and 100 g Mo/fed rates. The contents of N, P, K, and S in wheat leaves were also increased due to phosphorus and sulphur application rates, but Mo concentration in the leaves was depressed due to sulphur application and increased with phosphorus and molybdenum applications.
Key words: salinity, sulphur, phosphorus, molybdenum, wheat

INTRODUCTION

Wheat (*Triticum aestivum* L) is the main food crop in Egypt. Because of the great gap between the consumption and production, Egypt imports above five million tons of wheat grains (USDA, 2013). Salinity is the major abiotic stress that reduces plant growth and crop productivity worldwide (Tiwari *et al.,* 2010). Salinity has inhibitory effect on wheat phonological aspects such as leaf number, leaf rate expansion and total dry matter yield (El-hendawy *et al*., 2005).

Sulphur is one of the essential nutrients for plant growth (Ali *et al*., 2008). It is a building block of protein and a key ingredient in the formation of chlorophyll (Jamal *et al.,* 2009). The grain protein in wheat being low when S is deficient, the vegetative symptoms of S deficiency are stunting, yellowing of the whole plant and severe yellowing of the younger leaves when S deficiency is persistent (Wurst *et al.,* 2010). Sulfur deficient plants have also less resistance under stress conditions (Doberman and Fairhurst, 2000). Its fertilization is a feasible technique to suppress the uptake of excess Na and Cl because of the antagonistic relationship (Zhang *et at*., 1999).

Phosphorus is the second most important macronutrient next to nitrogen in limiting crop growth, this nutrient is involved in an array of process in plants such as photosynthesis, energy generation (ATP) , nucleic acid biosynthesis and as an integral component of several plant structures such as phospholipids (Vance *et al*., 2003). It is suggested that proper P fertilization under saline condition would be useful to increase yield of some plant species by minimizing the adverse effect of salinity (Aslam and Qureshi, 1998).

Molybdenum is essential for most organisms and occurs in more than 60 enzymes catalyzing diverse oxidation-reduction reactions in plant metabolism (Zimmer and Mendel, 1999). Because of its involvement in the nitrate assimilation, nitrogen fixation process, and transport of nitrogen compounds in plants, molybdenum plays a crucial role in nitrogen metabolism in plants (Li *et al*., 2013). Wu *et al*. (2014) indicated that Mo application significantly enhanced chlorophyll, dry matter, and grain yield in wheat. Availability of Mo to plants is influenced by soil parameters like pH, organic matter, and clay content. (Behera *et al*., 2011).

The present study was undertaken to investigate the effect of sulphur, phosphorus and molybdenum on the growth and elements contents in leaves of wheat grown in saline soil.

MATRIAL AND METHODS

A field experiment was conducted at the Experimental Research Station, Faculty of agriculture, Saba Basha, Alexandria University during the season of 2014/2015 (18 /11/2014). Wheat cultivar (Triticum aestivum, L), Giza 89 was used in this study as a test crop. Treatments were arranged using the split split plot design with three replicates. The experimental plot area was 2 x 3 meters and the experiment included 64 treatments. The main plot contained sulphur (0, 50, 100 and 200 kg/fed) which added before planting.

The sub plots contained phosphorus (0, 7.5, 15 and 22.5 kg P/fed) which added also before planting as calcium superphosphate fertilizer 15.5% P_2O_5. The sub sub plots contained molybdenum (0, 50, 100 and 200 g Mo/fad) which added after planting and before expulsion of spikes as ammonium molybdate.

The recommended dose of nitrogen (73.6 kg N/fad) was applied as urea fertilizer (46% N) after planting to the soil. The wheat grain yield was recorded at the time of harvesting (30/4/2015) and samples of plant leaves were collected at stage of expulsion of spikes.

Table (1). Some physical and chemical properties of the experimental soil

Soil properties	Results
Particle size distribution	
Clay %	43.40
Silt %	42.30
Sand %	14.30
Soil texture	Clay loam soil
Chemical properties:	
pH (1:2.5)	8.32
EC (1:1water extract), dS/m	3.65
Organic matter %	0.60
1) Soluble cations (1: 1) (meq/L):	
Ca^{++}	8.60
Mg^{++}	6.50
Na^{++}	18.88
K^{+}	1.70
Soluble anions (1: 1) (meq/L):	
HCO_3^{-}	7.60
Cl^{-}	23.20
SO_4^{--}	7.42
SAR	6.87
Available nutrients(mg/kg soil) :	
Available N	150
Available P	12.5
Available K	275
Available Mo	0.35
Available S	44.9

The plant samples (leaves) were washed by tap water then by distilled water and oven dried at 65℃ for 48 hours and grinded using a stainless steel mill. Ground plant samples powder divided into two portions, the first portion was wet digested with H_2SO_4- H_2O_2 digest (Lowther, 1980) for measuring potassium by flame photometer (Jackson, 1973), nitrogen, phosphorus by spectrophotometry (Jackson, 1973) and molybdenum using thiocyanate and thioglycollic acid (Mir *et al.*, 2012) The second portion was digested with HNO_3-H_2O_2 (Zheljazkov and Nielson, 1996) to determine sulphur as described by Jackson (1973).The main physical and chemical properties of the experimental soil are presented in Table (1) and the soil was saline in nature. The analysis of soil was carried out according to the methods outlined by Black (1965), The obtained results were statistically analyzed according to the analysis of variance technique and the multiple regression equations were calculated using costat software (CoHort softwere 1995).

RESULTS AND DISCUSSION

Grain yield

Data in Table (2) showed that the grain yield (ton/fed) was significantly affected by S, P and Mo application rates. Table (3) revealed that increasing S rates from 0 to 200 kg/fed significantly and progressively increased the grain yield as compared with the control treatment. The highest grain yield (1.82 ton fed) was obtained with the application of 200 kg S/fed which is 14.5 % higher than the control treatment. Similar results have been reported by El-Badawy *et al*. (2011). This is most probably due to healthy soil environment for plant growth (Ali *et al*., 2012). The main action of S is minimizing the soil pH and this will minimize the possibility of NH_3 loss by volatilization or the accumulation of nitrite and consequently the gaseous loss of N due to its presence (Nasseem and Nasrallah, 1981).Table (3) showed that grain yield of wheat increased gradually as the application of P increased. It is increased by 1.17, 1.75 and 1.34% for rated of 7.5, 15 and 22.5 kg P/fed, respectively, relative to the control treatment. The positive effect of P most probably due to modification of root architecture, development of large root system, longer root hairs and thinner roots and improved the ability of plant to produce higher dry matter yield (Balemi and Negisho, 2012; Haling *et al*., 2013 and Paez-Garcia *et al*., 2015). Addition of P not only helped for overcoming P deficiently but also improved the restricted root growth under saline condition (Feigin, 1985).

Table (2). Wheat yield (ton/fed) as affected by sulphur, phosphorus, and molybdenum application rates

Treatments		**Molybdenum, g/fed**			
Sulphur kg/fed	**Phosphorus kg/fed**	**0**	**50**	**100**	**200**
0	0	1.57	1.58	1.61	1.59
	7.5	1.57	1.59	1.61	1.59
	15.0	1.57	1.59	1.62	1.60
	22.5	1.57	1.59	1.62	1.60
50	0	1.69	1.71	1.73	1.70
	7.5	1.70	1.71	1.74	1.71
	15.0	1.69	1.71	1.74	1.71
	22.5	1.70	1.71	1.74	1.72
100	0	1.75	1.76	1.78	1.75
	7.5	1.75	1.76	1.79	1.76
	15.0	1.75	1.77	1.79	1.77
	22.5	1.75	1.76	1.79	1.76
200	0	1.81	1.82	1.84	1.80
	7.5	1.81	1.83	1.85	1.82
	15.0	1.81	1.83	1.85	1.82
	22.5	1.81	1.83	1.91	1.81
LSD (0.05)					
Sulphur		0.005			
Phosphorus		0.004			
Molybdenum		0.004			
sulphur* phosphorus		0.007			
sulphur* molybdenum		0.008			
phosphorus * molybdenum		0.009			
Sulphur* phosphorus* molybdenum		0.017			

Application of molybdenum (Table 3) produced higher values of grain yield (2.35, 3.35 and 1.2%) at 50,100 and 200 g Mo/fed rates, respectively, as compared with control. The highest value of grain yield (1.84 ton/fed) was obtained at 100 g Mo/fed rate. Molybdenum occurs in several enzymes catalyzing diverse oxidation – reduction reaction in plants (Mengel and Kirkby, 2001). Because of its involvement in the nitrate assimilation, nitrogen fixation process, and transport of nitrogen compounds in wheat plants, molybdenum plays a crucial role in nitrogen metabolism in plants (Li *et al*., 2013). The effect of molybdenum on increasing plant yield is often related to increasing the ability of the plant to utilize nitrogen (Biscaro *et al*, 2011).

Table (3). The grain yield of wheat plants as affected by sulphur, phosphorus and molybdenum application rates

Treatments	Yield Ton / fed
Sulphur rate, kg / fed	
0	1.59
50	1.72
100	1.78
200	1.82
LSD $_{0.05}$	0.005
Phosphorus rate, kg/fed	
0	1.71
7.5	1.73
15.0	1.74
22.5	1.75
LSD $_{0.05}$	0.004
Molybdenum rate, g/fed	
0	1.70
50	1.74
100	1.76
200	1.73
LSD $_{0.05}$	0.004

Table 4 indicated a significant interaction effect between sulphur and phosphorus rates on grain yield. The highest value of grain yield was obtained with applying 200 kg S/fed and 22.5 kg P/fed rates. The synergistic effect of P and S may be due to utilization of high quantities of nutrients through the development of root system which resulted in better growth and grain yield. Similar results were reported by Yadav (2011) for wheat. Also, the interaction between sulphur and molybdenum had significant effect on grain yield of wheat. The highest yield was obtained at 200 kg S/fed with 100 g Mo/fed rates (Table 5). Application of S fertilizer is a feasible technique to suppress the uptake of Na and Cl due to the antagonistic relationship. Thus its application is useful to improve soil conditions for healthy crop growth (Zhang *et al*., 1999). The interaction effect between phosphorus and molybdenum on grain yield of wheat was significant and the highest value of grain yield was obtained with 22.5 kg P/fed and 100 g Mo /fed rates (Table 6). According to Modi (2002), both Mo and P increased seed protein content and seed yield in wheat. The second order interaction between sulphur, phosphorus and molybdenum rates had significant effect on grain yield of wheat. The highest value of grain yield of wheat was obtained with 200 kg S/fed and 22.5 kg P/fed and 100 g Mo/fed application rates.

Table (4). The interaction between sulphur and phosphorus application rates on wheat grain yield

Sulphur kg/fed	Phosphorus kg/fed	Grain Yield Ton/fed
0	0	1.58
	7.5	1.71
	15.0	1.76
	22.5	1.82
50	0	1.58
	7.5	1.72
	15.0	1.78
	22.5	1.84
100	0	1.59
	7.5	1.72
	15.0	1.79
	22.5	1.85
200	0	1.59
	7.5	1.73
	15.0	1.79
	22.5	1.87
LSD $_{0.05}$		0.029

Table (5). The interaction between sulphur and molybdenum application rates on wheat grain yield

Sulphur kg/fed	Molybdenum g/fed	Grain Yield Ton/fed
0	0	1.56
	50	1.58
	100	1.61
	200	1.59
50	0	1.70
	50	1.72
	100	1.74
	200	1.72
100	0	1.76
	50	1.78
	100	1.80
	200	1.77
200	0	1.83
	50	1.84
	100	1.88
	200	1.83
LSD $_{0.05}$		0.008

Table (6). The interaction between phosphorus and molybdenum application rates on wheat grain yield

Phosphorus kg/fed	Molybdenum g/fed	Grain Yield Ton/fed
0	0	1.70
	50	1.72
	100	1.74
	200	1.71
7.5	0	1.72
	50	1.73
	100	1.76
	200	1.73
15.0	0	1.72
	50	1.73
	100	1.76
	200	1.73
22.5	0	1.72
	50	1.74
	100	1.77
	200	1.74
$LSD_{0.05}$		0.009

Considering the three variables (S, P and Mo), the grain yield (Y) was regressed against sulphur rate (X_1), phosphorus rate (X_2) and molybdenum rate (X_3). The regression equation for this relationship was:

$$\mathbf{Y = 1.61 + 1.1\times10^{-3}X_1 + 4.7\times10^{-4}X_2 + 6.6\times10^{-5}X_3}$$

$$\mathbf{R^2 = 0.854 \qquad P < 0.01}$$

The comparison of slopes of each variable in the equation (1.1×10^{-3}: 4.7×10^{-4}: 6.6×10^{-5}) gives a quantitative estimate for the efficiency of one variable to the other. Thus the efficiency of sulphur, phosphorus and molybdenum levels would be equal to (1:0.42:0.06). The comparison of the b values of S, P and Mo indicated that efficiency of S for increasing grain yields was the higher followed by the efficiency of the other two.

Elements content in leaves

Table (7) showed that increasing sulphur rates from 0 to 200 kg S/fed progressively and significantly increased N, P, K and S concentrations but decreased Mo concentration in wheat plant leaves. The main effect of sulphur (Table 8) showed increaseed nitrogen by about 1.15, 3.04 and 5.19% and phosphorus increased by about 1.09, 8.33 and 18.75%, respectively over the control (without sulphur) with the application of 50, 100 and 200 kg S/fed, respectively. The corresponding relative values for potassium and sulphur concentrations were 10.64, 14.48, 21.48 and 9.17, 36.69, 49.54 % respectively. On the other hand, the relative decrease in molybdenum concentration was 13.6, 24.82 and 31.20% with application of 50, 100 and 200 kg S /fed, respectively as compared with the control treatment. The addition of sulphur decreased the concentration of Mo, showing the antagonistic relationship.

The biochemical oxidation of S produces H_2SO_4 which acts for relatively lower decrease of soil pH. This improves soil conditions for more favorable plants growth due to increasing the availability of plant nutrients (Motior *et al.*, 2011). Xie *et al.* (2004) found that the sulphur fertilizer application increased N, P, K concentrations in plant and the requirements for sulphur are closely linked to nitrogen availability. Similar results were also reported by Kumar *et al.* (2012) for rice and wheat. On the other hand, plants take up molybdenum as the molybdate ion (MoO_4^{-2}) which causes antagonism with high levels of sulfate ions (Schulte and Kelling, 1992).

Table (8) showed increases relative values of 261.1, 694.4 and 983.3% for P; 1.87, 4.56 and 7.40 % for K; 3.84, 5.38 and 8.46 % for S, 1.63, 2.78 and 3.27 % for N; 11.29, 15.61 and 19.60 % for Mo with the application of 0, 7.5, 15 and 22.5 kg P/fed, respectively as compared with the control treatment. The highest values of N, P, K, S and Mo concentration were obtained with application of 22.5 kg P/fed. Haling *et al*. (2013) stated that increasing P levels significantly increased macronutrients and micronutrients in two common bean varieties. Similar results were observed by Sharma *et al*. (2012) who reported that increasing levels of phosphorus increased the uptake of N, P, and K in wheat plants. Barshad (1951) reported that a complex phosphomolybdate anion, more readily absorbed and translocated than the MoO_4^{-2} alone, the synergistic effects exist between Mo and P application, so that formation of anionic complexes between P and Mo (which are more likely to be absorbed by plant roots) could be accounted for such effects. Also, high availability of P and Mo ions can be due to ligand exchange mechanism (Zakikhani *et al.,* 2014). Similar results were reported by Modi (2002) in wheat.

Table (8) showed that only Mo concentration in leaves of wheat plants was significantly affected by molybdenum application. The main effect of molybdenum rates showed increasing in Mo concentrations in leaves of wheat plants as compared with control treatment. The highest values of Mo were obtained at 200 g Mo/fed rate. According to the obtained results, Mo has no significant effect on P content in wheat leaves under the experimental conditions. This effect may be due to the presence of available S (Modi, 2002). In contrast, other researcher reported that application of Mo decreased P in mustard due to hindering P enzyme activity such as phosphatase (Chatterjee *et al.*, 1985). Table (9) showed that the highest concentration values of N, P, K and S were obtained at 200 kg S/fed and 22.5 kg P/fed application rates. Also, the highest Mo concentration was obtained without sulphur and 15 kg P/fed application rates. The lowest Mo concentration was obtained with 200 kg S/fed and 22.5 kg P/fed application rates (Table 9). Yadav, (2011) discussed the synergistic effect of phosphorus and sulphur on N, P and S concentration of cluster beam. The interaction effect between sulphur and molybdenum application rates on Mo concentrations showed that the highest molybdenum concentration was obtained without sulphur and 200 g Mo/fed and the lowest value of Mo was obtained at 200 kg S/fed without Mo application (Table 10).

The interaction effect between phosphorus and molybdenum rates showed that the highest value of molybdenum concentration was obtained with 22.5 P/fed and 200 g Mo/fed rates, while the lowest value was obtained without phosphorus and molybdenum applications (Table 11). The second order interaction between sulphur, phosphorus and molybdenum rates on molybdenum concentration (Table 7) showed that the highest value of molybdenum concentration was obtained without sulphur, 22.5 kg P/fed and 200 g Mo/fed rates, while the lowest value was obtained with 200 kg S/fed, 7.5 P/fed and without molybdenum application.

Table (7). Effect of sulphur, phosphorus and molybdenum application rates on elements contents in wheat leaves

Treatments			N	P	K	S	Mo
Sulphur kg/fed	Phosphorus kg/fed	Mo g/fed	g/kg, (d.m.)				mg/kg (d.m.)
0	0	0	12.05	0.16	19.33	1.04	0.70
		50	11.95	0.16	19.29	1.04	12.10
		100	11.91	0.16	19.57	1.04	4.10
		200	12.05	0.16	19.06	1.04	7.90
	7.5	0	12.07	0.60	18.93	1.03	0.77
		50	12.03	0.63	19.53	1.03	2.30
		100	12.10	0.59	18.99	1.03	4.43
		200	12.08	0.60	18.97	1.03	8.23
	15.0	0	12.23	1.26	19.27	1.13	0.89
		50	12.23	1.25	19.26	1.13	2.49
		100	12.22	1.25	19.24	1.13	4.66
		200	12.21	1.21	19.23	1.13	8.87
	22.5	0	12.31	1.79	19.42	1.15	0.92
		50	12.31	1.83	19.42	1.16	2.73
		100	12.31	1.92	19.43	1.26	5.07
		200	12.33	1.87	19.47	1.16	9.07
50	0	0	12.11	0.17	20.55	1.14	0.50
		50	12.13	0.17	20.67	1.14	1.77
		100	12.11	0.17	20.72	1.15	3.60
		200	12.09	0.17	20.59	1.14	7.10
	7.5	0	12.20	0.58	21.03	1.13	0.60
		50	12.20	0.63	21.07	1.13	2.00
		100	12.26	0.62	21.19	1.14	3.92
		200	12.27	0.60	21.07	1.13	7.13
	15.0	0	12.41	1.32	21.63	1.24	0.63
		50	12.40	1.25	21.72	1.24	1.99
		100	12.37	1.25	21.57	1.24	4.07
		200	12.42	1.25	21.69	1.24	7.20
	22.5	0	12.42	1.82	21.96	1.27	0.79
		50	12.44	1.83	22.00	1.27	2.11
		100	12.43	1.86	21.84	1.27	4.43
		200	12.45	1.89	21.94	1.28	8.33

Table (7). Continue.

Treatments			N	P	K	S	Mo mg/kg (d.m.)
Sulphur kg/fad	Phosphorus kg/fad	Mo g/fad	g/kg,(d.m.)				
100	0	0	12.27	0.18	21.04	1.38	0.40
		50	12.27	0.19	20.94	1.38	1.48
		100	12.28	0.19	20.99	1.39	2.90
		200	12.30	0.18	21.06	1.37	6.40
	7.5	0	12.57	0.65	21.95	1.60	0.45
		50	12.57	0.69	21.82	1.59	1.72
		100	12.54	0.66	21.84	1.59	3.63
		200	12.58	0.63	22.01	1.58	6.63
	15.0	0	12.65	1.32	22.40	1.49	0.46
		50	12.67	1.38	22.48	1.49	1.73
		100	12.66	1.32	22.49	1.50	3.83
		200	12.68	1.30	22.53	1.50	6.90
	22.5	0	12.57	2.03	22.78	1.53	0.55
		50	12.59	2.03	22.88	1.53	1.79
		100	12.60	2.03	23.00	1.53	3.49
		200	12.61	2.01	22.92	1.53	6.74
200	0	0	12.40	0.21	22.28	1.67	20.3
		50	12.38	0.20	22.28	1.67	1.35
		100	12.38	0.22	22.27	1.67	2.70
		200	12.40	0.19	22.19	1.67	4.86
	7.5	0	12.78	0.72	22.59	1.66	0.34
		50	12.77	0.76	22.74	1.65	1.56
		100	12.75	0.72	22.61	1.65	3.55
		200	12.80	0.72	22.73	1.66	6.47
	15.0	0	12.91	1.55	23.69	1.58	0.42
		50	12.89	1.51	23.65	1.59	1.68
		100	12.88	1.55	23.49	1.59	3.49
		200	12.95	1.53	23.70	1.59	6.44
	22.5	0	13.06	2.14	25.12	1.63	0.47
		50	13.08	2.10	25.07	1.62	1.63
		100	13.10	2.06	25.13	1.63	3.20
		200	13.09	2.08	25.15	1.63	6.38
LSD (0.05)							
Sulphur			0.09	0.04	0.24	0.011	0.09
Phosphorus			0.08	0.03	0.19	0.010	0.07
Molybdenum			NS	NS	NS	NS	0.09
sulphur* phosphorus			0.15	0.06	0.36	0.02	0.14
sulphur* molybdenum			NS	NS	NS	NS	0.18
phosphorus*molybdenum			NS	NS	NS	NS	0.19
Sulphur*phosphorus* molybdenum			NS	NS	NS	NS	0.37

Table (8). The main effects of sulphur, phosphorus and molybdenum application rates on elements contents in wheat leaves

Treatments	N	P	K	S	Mo
	g/kg, (d.m)				mg/kg,(d.m)
Sulphur rate, kg / fed					
0		0.96	19.27	1.09	4.07
50	12.29	0.97	21.32	1.19	3.51
100	12.52	1.04	22.06	1.49	3.06
200	12.78	1.14	23.41	1.63	2.80
LSD $_{0.05}$	0.09	0.04	0.24	0.01	0.09
Phosphorus rate, kg/fed					
0	12.20	0.18	20.80	1.30	3.01
7.5	12.40	0.65	21.19	1.35	3.35
15.0	12.54	1.43	21.75	1.37	3.48
22.5	12.60	1.95	22.34	1.41	3.60
LSD $_{0.05}$	0.08	0.03	0.19	0.010	0.07
Molybdenum rate, g/fed					
0	12.43	1.03	21.49	1.35	0.57
50	12.43	1.03	21.55	1.35	1.90
100	12.43	1.03	21.52	1.36	3.81
200	12.45	1.02	21.51	1.35	7.16
LSD $_{0.05}$	NS	NS	NS	NS	0.09

Table (9). The interaction between sulphur and phosphorus application rates on elements contents in wheat leaves

Sulphur, kg/fed	Phosphorus, Kg/fed	N	P	K	S	Mo
		g/kg,(d.m)				mg/kg,(d.m)
0	0	11.98	0.16	19.31	1.03	3.70
	7.5	12.06	0.6	19.11	1.04	3.93
	15.0	12.22	1.24	19.24	1.12	4.22
	22.5	12.31	1.85	12.43	1.18	4.44
50	0	12.11	0.16	20.63	1.13	3.24
	7.5	12.23	0.6	21.08	1.14	3.41
	15.0	12.39	1.26	21.65	1.24	3.47
	22.5	12.43	1.85	21.93	1.27	3.91
100	0	12.27	0.18	21.01	1.38	2.79
	7.5	12.56	0.65	21.91	1.49	3.10
	15.0	12.66	1.32	22.47	1.53	3.23
	22.5	12.59	2.02	22.89	1.59	3.14
200	0	12.39	0.2	22.25	1.59	2.30
	7.5	12.77	0.72	22.66	1.63	2.97
	15.0	12.91	1.5	23.63	1.65	3.00
	22.5	13.08	2.09	25.11	1.67	2.92
LSD $_{0.05}$		0.15	0.06	0.36	0.02	0.14

Table (10). The interaction between sulphur and molybdenum application rates on molybdenum concentration in leaves of wheat leaves

Sulphur, kg/fed	Molybdenum, g/fed	Mo, mg/kg d.m.
0	0	0.81
	50	2.40
	100	4.56
	200	8.51
50	0	0.63
	50	1.96
	100	4.00
	200	7.44
100	0	0.46
	50	1.68
	100	3.46
	200	6.66
200	0	0.38
	50	1.55
	100	3.23
	200	6.03
LSD $_{0.05}$		0.18

Table (11). The interaction between phosphorus and molybdenum application rates on molybdenum concentration in leaves of wheat leaves

Phosphorus, kg/fed	Molybdenum, g/fed	Mo, mg/kg d.m.
0	0	0.47
	50	1.67
	100	3.32
	200	6.56
7.5	0	0.53
	50	1.89
	100	3.88
	200	7.11
15.0	0	0.60
	50	1.97
	100	4.01
	200	7.35
22.5	0	0.68
	50	2.06
	100	4.04
	200	7.63
LSD $_{0.05}$		0.19

The results showed highly significant positive correlation (0.01 probability) between grain yield and the content of nitrogen (r = 0.756), phosphorus (r =0.837), potassium (r =0.855), sulphur (0.837) and molybdenum (r = 0.755). This indicates that the presence of significantly higher potassium contents is due to sulphur application (Table 8) which helps plants to attain more potassium to avoid sodium uptake. This has been considered an added advantage to alleviate salinity apart from enhancing soil fertility and physical properties. The obtained results indicate that application of sulphur combats salinity by enhanced uptake of potassium.

CONCLUSIONS

Salinity is a major abiotic stress factor affecting plant growth and productivity worldwide. Plants develop several mechanisms to induce tolerance to overcome salinity effects. Of the several possible mechanisms to reduce the effect of salinity stress is management of mineral nutrients status of plant can be the efficient defense system. Sulphur, phosphorus and molybdenum applications caused increase in yield and N, P, K, S and Mo in wheat. Sulphur at 200 kg/fed, 22.5 kg P/fed and 100 g Mo/fed rates were efficient as compared to other treatments for grain yield of wheat under the saline soil condition. The application of sulphur helped in the utilization of added phosphorus, but appeared to depress molybdenum utilization showing and antagonistic relationship and when phosphorus was applied, however, the antagonistic effect of sulphur was overcome. Also, the application of phosphorus helped in the utilization of added and native soil sulphur.

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الملخص العربى

تأثير الموليبدنيم والفوسفور والكبريت على المحصول ومحتوى العناصر فى أوراق القمح النامى فى الارض الملحيه

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أقيمت تجربة حقلية بمحطة التجارب الزراعية بكلية الزراعة سابا باشا جامعة الاسكندرية لاختبار تأثير الموليبدنم والفسفور والكبريت على المحصول ومحتوى العناصر فى الاوراق للقمح النامى فى أرض متأثرة بالأملاح. وقد استخدمت اربعة مستويات الكبريت وهى (٠ ، ٥٠ ،١٠٠، ٢٠٠ كجم كبريت/ فدان) واربعة مستويات من الفسفور وهى (٠ ، ٧.٥ ،١٥، ٢٢.٥ كجم فسفور/ فدان) واربعة مستويات من الموليبدنم وهى (٠، ٥٠، ١٠٠، ٢٠٠ جم موليبدنم/ فدان) فى تصميم القطع المنشقة مرتين وبثلاث مكررات وقد اوضحت النتائج ان استخدام الكبريت والفسفور والموليبدنم أدى الى زيادة معنوية فى محصول الحبوب لنبات القمح حيث كانت اعلى القيم (١.٩١ طن/فدان) عند مستوى ٢٠٠ كجم كبريت/ فدان و ٢٢.٥ كجم فسفور/فدان و ١٠٠ جم موليبدنم/فدان. وقد زاد محتوي أوراق القمح من النيتروجين والفسفور والبوتاسيوم والكبريت عند استخدام التسميد بالكبريت والفسفور.بينما قل محتوى اوراق نبات القمح من الموليبدنم عند استخدام مستويات مختلفه من الكبريت ولكن زاد محتوى اوراق القمح من الموليبدنم عند استخدام الفسفور.

In vitro Mutagenesis of Oriental Lily, cv. Blanco

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ABSTRACT: This study was carried out in the Tissue Culture Laboratory, Department of Flowers , Ornamental Plants and Landscape Gardens , Faculty of Agriculture , El-Shatby Alexandria University, Egypt during the period from 2012 to 2015 to establish an efficient and reliable protocol for *in vitro* propagation of Blanco oriantal *Lilium*. Bulb scales of *Lilium* bulbs were used through this study. The bulb scales were planted on Murashig and Skooge media (MS), using different combinations of naphthalene acetic acid (NAA) at 0, 1 and 2 mg/l and benzyl adenine (BA) at 0, 1, 2 and 3 mg / l for shoot regeneration .While the media used for rooting was amendmented with different (NAA) at 0, 1 and 2 mg/l and indol butyric acid (IBA) at 0, 1, 2 and 3 mg/l. Regenerated rooted plants were then treated by colchicines or glufosinate ammonium at 1, 2, 3 and 4 ppm for each respectively . The best medium for shoot regeneration was contained contained concentrations, of BA at 3 mg / l and NAA at 2 mg/l and, while the best rooting medium was NAA at 2mg/l and IBA at 2mg/l. Colchicine at 4ppm was the best concentration for multiplication induction of chromosomes, while Glufosinate ammonium at 2 and 3 ppm gave the highest genetic variation.

Key words: *In vitro* culture - *Lilium* oriental Blanco - bulb scale – initiating – rooting – micro propagation – Colchicine- Glufosinate ammonium-RABD.

INRTODUCTION

The genus *Lilium* is one of about 220 genera belonging to the *Liliaceae* and comprises about 85 species, including many beautiful ornamental species. Each cell of *Lilium* has 24 chromosomes (Darlington and Ammal, 1945). Numerous cultivars belong to the genus *Lilium* are of ornamental value as cut flowers (De- Jong, 1974), having been derived from interspecific hybridization. Lilies are economically important mainly because of their large and attractive flowers. *Lilium* species are monocotyledons and bulb scales plants which are commercially important because of their attractive beautiful flowers. They are vegetatively propagated by bulbs and the bulb scales can be grown into larger bulbs after breaking dormancy by cold treatment (Nhut *et al.,* 2006b).

Lilium propagation can be performed by the regeneration of the scale bulblets that are formed adventitiously at the bottom of the detached lily scales during storage at 25℃ in vermiculite, moist peat or in soil (De Klerk *et al.,* 1992). Lilies and other important bulbous crops, being monocotyledons, are relatively more difficult to manipulate in *in vitro* culture than dicotyledons since dormancy, a factor which is still not very well understood, affects the micropropagation of bulbous crop species (Kim *et al*., 1994).

Lilium micropropagation by bulb scales as an alternative to the conventional methods for vegetative propagation is becoming important owing to certain advantages such as increasing multiplication rates and the attention of plant material free of viruses and other pathogens (Nhut *et al*., 2006a).

Micropropagation (or *in vitro* propagation) is the most common term used for clonal, true-to-type propagation of plants by a variety of tissue, cell and organ culture methods , it implies the aseptic culture of small sections (i.e., explants) of tissues and organs, in closed vessels with defined culture media and under controlled environmental conditions, micropropagation, in addition to genetic engineering, is at present the most commercially efficient and practically-oriented plant biotechnology, resulting in rapid generation of a large number of clonal plants of many plant species, which are in many cases also virus- or other pathogen-free, it is now the technical link in the generation of transgenic plants and somatically-bred plants through tissue culture (Loberant and Altman, 2010).

Colchicine is a natural alkaloid with an antimitotic activity, obtained from the plant *Colchicum autumnale* L.plant (Emsweller, 1988; Van Tuyl *et al.*, 1990). When colchicine is present in a cell that is undergoing mitotic division, the chromosomes split at all points except the centromere, causing duplication in the number of chromosomes per cell. The main action of the colchicine is to prevent the formation of a spindle so the anaphase movement of the chromosomes does not take place and the cell fails to divide, when the daughter chromosomes finally divide, they are all included in one cell and the chromosome number is doubled to be effective, colchicine must be present in the cell when the chromosomes divide. Colchicine is very harmful to humans and in some cases shows undesirable mutagentic activity on plants, colchicine is effective in doubling the chromosome number, inhibits mitosis activity and is used for doubling the chromosome number in lilies (Van Tuyl *et al.*, 1990).

Glufosinate ammonium is a broad spectrum herbicide used for the control of many weed species, as well as a desiccant for certain crops. Its primary mode of action is through the inhibition of glutamine synthetases (Lea and Ridley,1989), which leads to a build-up of ammonium in the cell (Wendler *et al.,* 1990) and disruptions in photorespiratory pathways, inhibiting photosynthesis (Lacuesta *et al.*, 1992; Merkel *et al.,* 2004). Translocation of glufosinate ammonium after absorption is highly variable (and species dependent) and is often limited by its fast action at the sites of contact resulting in rapid phytotoxicity (necrosis), though small rates of transportation, through phloem, to roots and floral parts have been reported (Pline *et al.,*1999 and Skora *et al.*, 2000). The half-life of glufosinate in bare topsoil is fairly short (approximately 1 week); however small amounts can still be detected in spring water run-off following snow melt (Siimes *et al.*, 2006). The main action of phosphinothricin is an glutamine synthetase inhibitor that binds to the glutamate site. Glufosinate-treated plants die due to a buildup of ammonia and corresponding decrease in pH in the thylakoid lumen, leading to the uncoupling of photophosphorylation. The uncoupling of photophosphorylation causes the production of reactive oxygen species, lipid peroxidation and membrane destruction (Carpenter and Boutin , 2010).

The main aim of this study was to establish a protocol for micro propagation of *Lilium* using different concentrations of auxins and cytokinins, as well as studying the effect of different doses of chemical mutagens on *in vitro* generated plants of *Lilium* cv. Blanco. The possibility of the emergence of genetic mutations and variations on the plant is also addressed.

MATERIALS AND METHODS

The present investigation was carried out at the Tissue Culture Laboratory in the Flowers, Ornamental Plants and landscape Gardens Department, Faculty of Agriculture, El-shatby, Alexandria University, during the period from 2012 to 2015.

The experiment consisted of two stages, the first stage was the micropropagation of *Lilium* cv.Blanco, and the second stage was the induction of mutations using two chemical mutagen colchicine and glufosinate ammonium.

Plant material and explants sterilization:

Bulbs were imported from Holland by a commercial nursery, bulb scales were washed under running tap water for 20 min, then dipped in Clorox bleach 5% for 20 min then in mercuric chloride 0.1 % for one min then in ethanol 75% for one min then washed three times with sterile distilled water. The bulb scales were aseptically placed in jars containing 20 ml of culture media, each jar containing one bulb scale.

Preparation and sterilization of culture media:

The pH of all media used was adjusted at 5.8 $\pm$ 0.1 using 1.0 M of HCl and /or 1.0 M of NaOH, agar was added after adjusting the pH, then, **(**Murashige and Skooge,1962) MS medium contained in addition to the prescribed salts and vitamins, 30g/l sucrose and 7g/l agar were autoclaved at 121°C for 20 minutes under (15psi) 1.05 kg/cm^2 pressure, medium was left to cool and stored at 25$\pm$ 2 °C for one week before being used in order to exclude contaminated jars. All equipments were steam-sterilized for 30 min at 121°C (15psi) .Glass jar of 9cm height x 5cm diameter with their poly propylene caps, were used during multiplication, establishment and rooting stages.

(A) *In vitro* propagation:

1-Shoot regeneration

To determine the appropriate micropropagation condition or media for *Lilium,* the initiation stage was conducted as follows: bulb scales were cultured on (Murashige and Skooge, 1962) MS basal supplemented with different concentrations of BA (0, 1, 2 and 3 mg/l) combined with different concentrations of NAA (0,1and 2 mg/l) .One scale bulb was cultured in each jar in culture room under controlled conditions (25 $\pm$ 2 °C, 16/8 light/dark cycle) And within one month.

2-Rooting stage

After two weeks of shoot regeneration, when shoot, reached 5cm height, shoots were transferred to MS rooting medium containing NAA at 0,1 and 2mg/l, IBA at 0, 1, 2 and 3mg/l and every treatment contained 5 replicates.
The following morphological characters were measured:
- Percentage of successful bulb scales %.

- Number of shoot per bulb scale.
- Shoots length (cm).
- Fresh weight of regenerated shoot (g).
- The time for roots induction (day).
- Number of roots per regenerated shoot .
- Root length after three months (cm).

Statistical analysis

The obtained data were statistically analyzed as Completely Randomized Design (CRD) in a factorial design (Steel and Torrie, 1980). Comparisons among means were made using the least significant differences test (L.S.D). Data were analyzed using SAS institute program multiple comparisons method (Tukey, 1994).

i.Shoot regeneration

Number of treatments = 4 concentration of BA X 3 concentration of NAA = 12 treatment.
Number of replicates = 5 replicates.
Total number of jar = 12 treatment X 5 replicates = 60 jars / experiment.

ii. Rooting

Number of treatments = 4 concentration of IBA X 3 concentration of NAA = 12 treatment.
Number of replicates = 5 replicates.
Total number of jar = 12 treatment X 5 replicates = 60 jars / experiment.

(B) The use of chemical mutagens:

1-The use of colchicine

Rooted plantlets coming from the *in vitro* culture of the best BA and NAA treatments were used and were treated with colchicine at concentrations of 1, 2, 3 and 4 mg/l through soaking the plantlets for a period of two hours at 23°C then washing under running water three times. The root tips were excised and placed in carnoy's solution (750ml/l absolute ethyl alcohol: 250ml/l glacial acetic acid) for 24 hours at 4°C then ethyl alcohol 70% in the refrigerator while screening **,** the white tip of the roots were cut to 1-2 mm and were put on a glass slide and placed them few drops of acetocarmine were added to each slide , mashed with a steel needle (Asakavičiūt *et al.*, 2008). The prepared glass slide was then covered. The chromosome number was tested under light microscope of 40 X magnification.

2- The use of glufosinate ammonium

glufosinate ammonium was applied through bacterial filters and after sterilizing the media before solidifying at temperature about 50°C and were added at the following concentrations of 1,2,3 and 4 mg/l , the rooted regeneration shoots were then transferred on glufosinate ammonium media, placed in the growth chamber for two weeks.

DNA extraction and purification for the RAPD analysis

Total DNA was extracted from plants using gene jet plant genomic DNA purification mini kit K0791 Thermo Scientific, 100 mg of young leaves taken from each plant &thoroughly were washed with water then ethylene and then milled under liquid nitrogen. The DNA was extracted using plant tissue purification kit according to many factures in struction. DNA extracted was tested using gel electrophoresis at 1.2 % agarose gel . The DNA was stored at -20°C for further work (Cato and Richardson, 1996).

Seven primers of 17 nucleotides each, except for OPD-05 primer 10 nucleotides (Table1) were used for RAPD analysis for the 10 tissue culture treatments of *Lilium* cv. Blanco. Each PCR amplification was performed twice for each primer to ensure their reproducibility in a total volume of 27 µl containing 12 µl Master mix (Thermo Scientific) [(dream taq TM red PCR master mix (DNA polymerase + optimized red buffer + Mg Cl_2 and dNTPs.) + 3 µl the purified DNA + 3 µl primer + 9 µl water] . For the RAPD analysis ,the PCR amplification was performed with initial denaturation at 94 °C for1 min, followed by 30-35 cycles of denaturation at 94°C for1 min, annealing at 50 °C for 1 min according to different primer used and extension at 72°C for 1 min. The final extension at 72 °C for 5 min. period of extension was1.48 h (Dzialuk *et al.*, 2011).

The PCR amplified products were subjected to electrophoresis in a 1.5% agarose gel containing Ethidiumbromide (at 4 µl) in (1X) TBE buffer for 40 min using cleaver submarine electrophoresis unit .Gene ruler 100pb plus DNA ladder from (Thermo Scientific) as was used to identify the DNA amplified band size (Brody and Kern , 2004).
The cluster analysis and polymorphic tree were done by PyELph software system for gel image analysis and phylogenetics version 2.6.5 (Pavel and Vasile , 2012) .

Table(1). ISSR primers used in finger print – PCR reaction

No. of primer	Primer name	Sequence 5' to3'
P1	823	TCTCTCTCTCTCTCTCC
P2	810	GAGAGAGAGAGAGGAT
P3	826	ACACACACACACACACC
P4	828	TGTGTGTGTGTGTGTGA
P5	818	CACACACACACACACAG
P6	808	AGAGAGAGAGAGAGAGC
P7	OPD-05	GCGGACTGA

RESULTS AND DISCUSSION

A-*In vitro* propagation
1-Shoot regeneration

Data presented in Table (2) and photo (1) showed that the best result for the percentage of successful bulb scales was found when NAA was used at 2mg /l (87.3%) or when BA was applied at 2 mg/l and 3 mg/l (83.3%). The best result for shoot length was recorded when NAA was used at 2 mg/l (4.76 cm) or when BA was used at 1mg/l (4.76 cm).

The best result for the number of regenerated shoots per bulb scale was detected when NAA was used at 2 mg/l (4.9 shoots) or when BA was applied at 2mg/l (5.66 shoot). While the best result for fresh weight was recorded when NAA was applied at 1mg/l (1.55g) or when BA was used at 2 mg/l (1.68g).

Table (2). Effects of BA and NAA on shoot regeneration from bulb scales of *Lilium* cv. Blanco cultured on MS media.

concentration		Percentage of successful bulb scales (%)	Shoot length (cm)	Number of regenerated shoots per bulb scale	Fresh weight (g)
NAA(mg/l)	**0**	70c	3.55b	3.60b	1.23a
	1	77.5b	2.25c	3.95ab	1.55a
	2	87.3a	4.76a	4.90a	1.51a
L.S.D (0.05)		**1.019**	**0.810**	**0.974**	**0.421**
BA (mg/l)	**0**	70c	2.75b	3.33b	1.08b
	1	76b	4.76a	3.86b	1.52ab
	2	83.3a	2.74b	5.66a	1.68a
	3	83.3a	3.83a	3.73b	1.45ab
L.S.D (0.05)		**1.300**	**1.029**	**0.570**	**0.5361**

Columns with the same letter(s) are not significantly different from each other at 5% level of probability.

Data in Table (3) regarding the interaction between BA and NAA showed that the best result of percentage of successful bulb scales was found when NAA was used at 1 mg/l combined with BA at 2mg/l (100%). The best result for shoot length was detected when NAA at 2mg/l and BA at 1mg/l (5.16 cm) were applied.

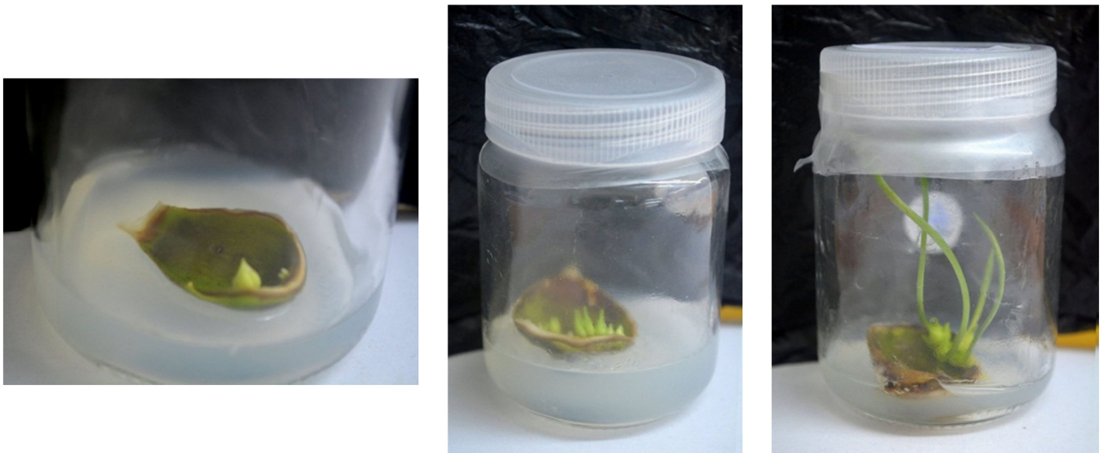
The best result for the number of regenerated shoots per bulb scale was detected when NAA at 2mg/l and BA at 3mg/l (2.722 shoot) were used. While the best result for fresh weight was recorded when NAA at 2 mg/l combined with BA at 2mg/l (6.666g).

Our study is in consistent with Han *et al*. (2004) who showed that the bulb scales of *Lilium longiflorum* cultured on MS medium with BA induced shoots, after 6 weeks, the frequency of shoot formation was very high (more than 92.3%) on the media and the medium supplemented with 2.2 mg/l BA was the most effective in inducing shoots from bulb scales. These results are in agreement with El-Naggar *et al*. (2012) where the bulb scales of *Lilium* 'Prato' cultured on (MS) basal medium supplemented with BA at 2 mg/l gave the highest number of shoots while low concentrations of the interaction between BA and NAA increased the number of shoots, while low concentrations of BA and NAA gave the best result for shoot height .On the other hand, BA at 1 mg/l gave the highest fresh weight while low concentrations of the interaction between BA and NAA increased the fresh weight. The fresh weight of regenerated shoots increased by increasing the BA concentration up to 1.0 mg/l; then declined after that in bulb scales explants, cytokinins are generally known to promote the formation of buds in many excised and *in vitro* tissue cultured organs (Nitsch *et al*., 1967). At large amounts of cytokinins, the activity of these cytokinins become ineffective due to natural inhibitors or biological factors that reduce the activity of cytokinins (Bonner and Varner, 1976). Among cytokinins, BA has been extensively used in *Lilium* species due to its pronounced effect on the adventitious shoot formation (Takayama and Misawa, 1982 and Maesato *et al*., 1994).

Table (3). Effects of interaction between BA and NAA on shoot regeneration from bulb scales of *Lilium* Blanco in culture on MS media.

Treatments		Percentage of successful bulb scales (%)	Shoot length (cm)	Number of regenerated shoots per bulb scale	Fresh weight (g)
NAA (mg/l)	**BA (mg/l)**				
0	**0**	60	3.850	1.071	4.000
	1	80	4.583	1.001	3.666
	2	60	2.955	1.719	5.200
	3	80	4.333	0.899	4.500
1	**0**	60	4.000	1.222	4.000
	1	70	2.500	1.373	3.000
	2	100	2.333	2.026	6.166
	3	80	3.083	1.656	4.833
2	**0**	60	2.250	1.099	4.000
	1	80	5.166	2.075	4.500
	2	90	2.183	1.776	6.666
	3	90	4.083	2.772	4.166
L.S.D		**0.577**	**2.876**	**1.335**	**0.548**

L.S.D at 0.05 level of probability.



1 month **2 months** **3 months**

Photo (1). Shoot proliferation from bulb scales after callus formation through 3 monthes.

2-Rooting stage

Data presented in Table (4) and photo (2) showed that the best result for the time for root induction was found when NAA at 2mg/l (9.7 day) was used. While the best result for the number of roots per regenerated shoot was recorded when NAA at 0 and 2mg/l were used (6.3 and 5.7 roots/shoot, respectively) or if IBA was applied at 3mg/l (8.4 roots). But the best result for root length was detected when NAA at 1mg/l (3.05 cm) or IBA at 3mg/l (2.86 cm) were used .

Table (4). Effects of IBA and NAA on the rooting from regenerated shoots of *Lilium* Blanco cultured on MS media.

Concentration	The time for roots induction (day)	Number of roots per regenerated shoot	Root length after 3month(cm)
NAA(mg/l)			
0	24.75a	6.3a	2. 5ab
1	10.9b	4.2b	3.05a
2	9.7b	5.7a	2.15 b
L.S.D (0.05)	**1.78**	**1.362**	**0.584**
IBA (mg/l)			
0	11c	3.2c	2.26a
1	17.46	5.6b	2.80a
2	12.13c	4.3bc	2.4a
3	19.93a	8.4a	2.86a
L.S.D(0.05)	**2.273**	**1.73**	**0.742**

Columns with the same letter(s) are not significantly different from each other at 5% level of probability.

Regard to the interaction between NAA and IBA data in Table (5) showed that the best result for the time of root induction was found when NAA was applied at 1 mg/l and IBA at 1mg (6.4 days) .The best result for number of roots per regenerated shoot was detected when NAA at 2 mg/l and IBA at 1mg/l (9.6 roots) were used . While the best result for root length was recorder when NAA at 1mg/l and IBA at 3 mg/l (3.6 cm) were applied.

Table (5). Effects of interaction between IBA and NAA on the rooting from regenerated shoot of *Lilium* cv. Blanco in culture on MS media.

Treatments NAA (mg/l)	Treatments IBA (mg/l)	The time for roots induction(day)	Number of roots per regenerated shoot	Root length after 3manth (cm)
0	**0**	13.2	5	2.2
	1	32.2	4.2	2.8
	2	20.4	7.4	2.6
	3	33.2	8.6	2.6
1	**0**	8.8	2.4	2.4
	1	6.4	3.2	3.4
	2	7.6	3.0	2.8
	3	16.2	8.2	3.6
2	**0**	11.0	2.2	2.2
	1	13.8	9.6	2.2
	2	8.4	2.6	1.8
	3	10.4	8.4	2.4
L.S.D		**1.046**	**0.796**	**0.341**

L.S.D at 0.05 level of probability.

These results are in agreement with the findings of Takayama and Misawa (1982) who found that *Lilium auratum* Lindl. and *L. speciosum* Thunb derived from bulb scales, all appeared to differentiate organs and the high NAA concentrations induced roots .Higher NAA concentrations stimulated rooting and sprouting .

Our study is in agreement with Hashem *et al*. (2006) who produced *in vitro* shoots of *L. longiflorum* and they found that the significantly highest number of roots was achieved with IBA at 5 mg/l, the highest root number in the case of NAA was significantly lower than the IBA, and was induced at 0.50 mg/l, the significantly longest root was obtained with IBA at 10 mg/l, the longest roots with NAA at 0.25 mg/l were shorter than those obtained with IBA. Auxin promotes adventitious root development in both intact and excised stems, for induction of rooting each bulblet was separated and cultured on MS (half-strength and full-strength) supplemented with different concentrations of NAA,the best rooting of 100 % was obtained on MS (full-strength) medium fortified with NAA at 1.0 mg/l ,these results are in concurrence with the observations made by Maesato *et al.* (1991) in *Lilium japonicum*. Using more than auxin led to increase the number of roots (Moore ,1979).

Photo (2). Root formation after transfer of regenerated shoots to rooting medium at 3mg/l IBA and 1mg/l NAA in *Lilium* cv.Blanco.

B- The use of chemical mutagens

1-The use of colchicine

The plantlets having the best shoot and root induction (at 2mg/l NAA and 2mg/l IBA) produced from *in vitro* culture were selected for colchicine treatment .The best concentration of colchicine which caused doubling in the number of chromosomes where active at 4ppm (photo.3). Asakavičiūt *et al*. (2008) mentioned that treating bulb scales of *Lilium* with 0.1, 0.5 and 1mg/l colchicine solution and 0.05, 0.1 and 0.5 mg/l oryzalin solution caused the chromosome count of the varieties to be changed. This is due to the main action of the colchicine to prevent the formation of a spindle so the anaphase movement of the chromosomes does not take place and the cell fails to divide, when the daughter chromosomes finally divide, they are all included in one cell and the chromosome number is doubled. (Van Tuyl *et al*., 1990).

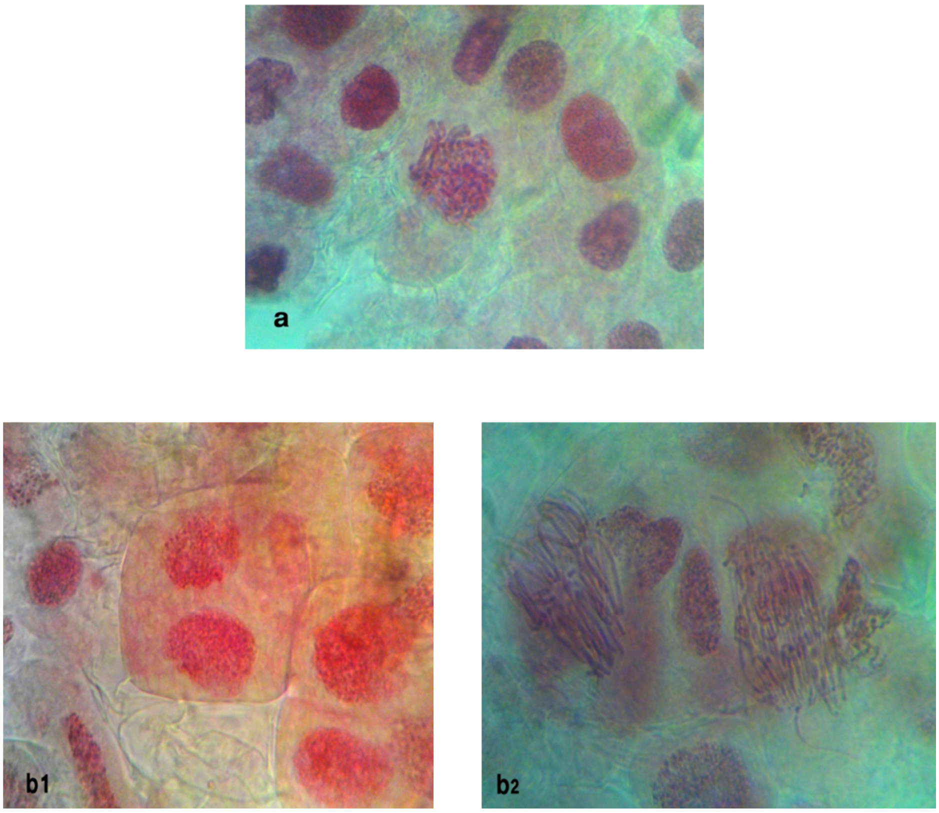


Photo (3). Section in root tip show the duplication of the member of chromosomes also the abscane of the middle lamella at 4 mg/l in root tip cells in *Lilium* cv. Blanco b1and b2' with the control' a'.

2-The use of glufosinate ammonium

PCR was used to detect the variations between the 5 concentrations of glufosinate ammonium and to detect any variation between the used treatments and control (photo 6).

RAPD is a multiplex marker system that conventionally uses single primer PCR to amplify random DNA fragments (Kumar *et al.,* 2009). The fragment sizes of DNA produced were from 200 to 1400 bps. The number and size of DNA fragments produced from the RAPD profiles varied among different glufosinate ammonium treatments.

A number of unique bands of DNA fragments were found between control or wild type and 1ppm glufosinate ammonium where two bands were missing in 1mg/l treatment (photo 5). Also two extra bands were found when using glufosinate ammonium at 3mg/l, also two missing bands can be distinguished at 4 mg/l treatment. This difference may be due to the amount of genetic variation that exists between the glufosinate ammonium treatment and the control or wild plant.

The polymorphic tree (Fig.1) showed that there are two main clusters the first cluster includes treatments of control(0 mg/l) and 1mg/l glufosinate with a slight difference between them also 4 mg/l appears to be related to the first cluster with difference with both the control(0 mg/l) and the 1mg/l , the second cluster included the 3 mg/l and 2 mg/l glufosinate with a small variation between them (Table 6 and photo 6).

These results showed that glufosinate ammonium with moderate concentrations 2 and 3 mg/l gave the best results and gave the highest variation followed by 1 and 4 mg/l.

Low concentration of glufosinate ammonium 1mg/l has the least effect and there were a very slight varieties between it and the control (0 mg/l). This result agree with **Avila-Garcia *et al.* (2012)** who reported that the glufosinate concentrations (µM) required to reduce the glutamine synthetase (GS) enzyme activity by 50% in *Lilium perenne* L. ssp. *multiflorum*. Al-Khatib *et al.* (2003) and Carpenter and Boutin (2010) whose appeared that low-dose rates was observed to have no effect on vegetative growth or reproduction.

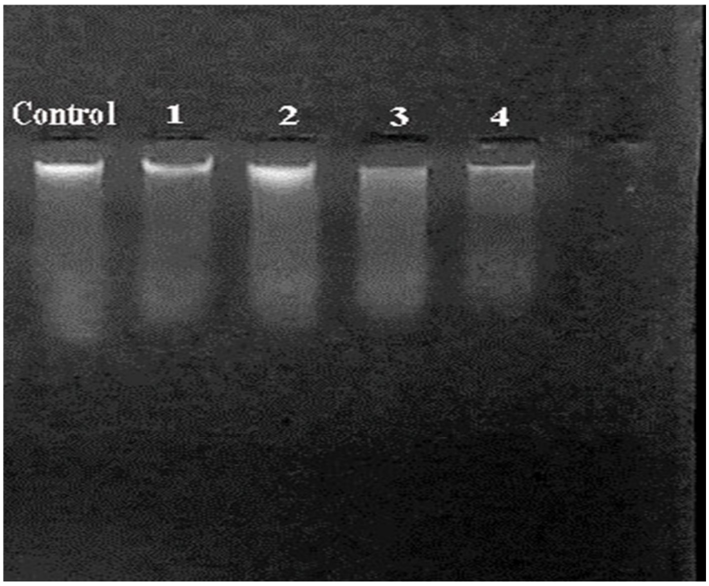
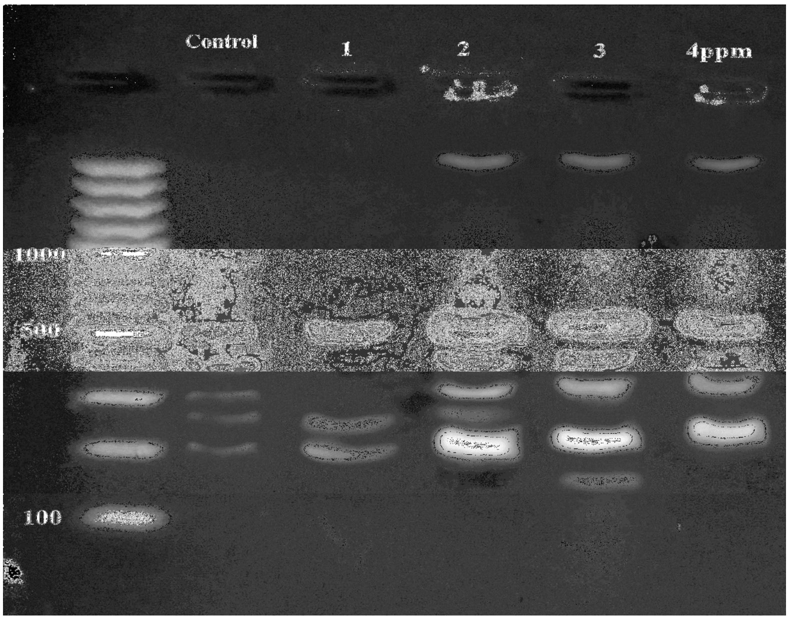


photo (4). Gel electrophoresis of the DNA extracted from leaf samples of the five treatments of glufosinate amonium on the resulting plantlet in *Lilium* cv. Blanco by *in vitro*. propagation at 0,1,2,3and 4 mg/l,respectively.

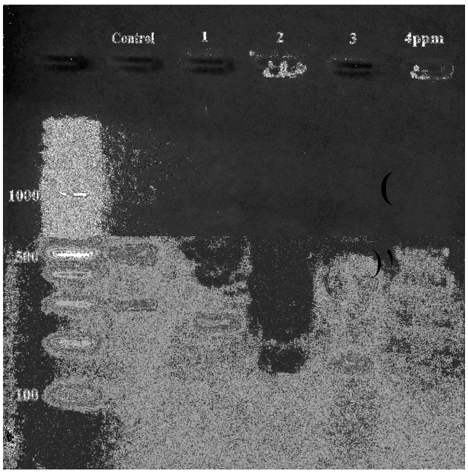


photo(5). Gel electrophoresis of PCR reaction showing bands amplified between 200 and 1400 bp with different five concentrations (0,1,2,3and 4mg/l, respectively) of glufosinate ammonium on the resulting plantlet in *Lilium* cv. Blanco by *in vitro* propagation.

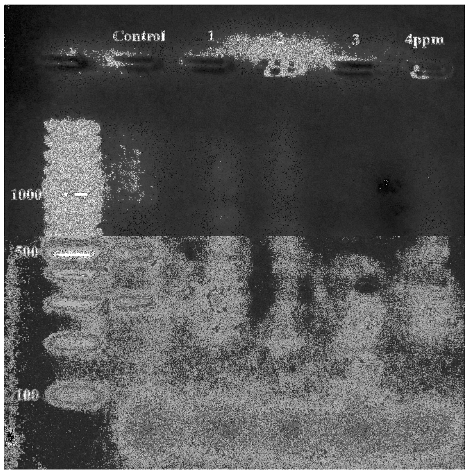
Table (6). Number of bands, number of polymorphic bands and polymorphism % detected by different primers for the finger print for different concentrations of glufosinate ammonium for *Lilium* cv.Blanco.

Number of bands (fragments)					
treatment / Primer	**0 mg/l**	**1mg/l**	**2mg/l**	**3mg/l**	**4mg/l**
Primer1 (823)	2	1	0	1	0
Primer2 (810)	2	0	0	0	0
Primer3 (826)	2	0	3	3	3
Primer4 (828)	0	0	1	1	3
Primer5 (818)	0	0	2	1	0
Primer6 (808)	2	1	3	2	0
Primer7 (OPD-05)	0	2	0	2	2
Total number of band	8	4	9	10	8
Number of polymorphic band	**5**	**3**	**6**	**6**	**4**

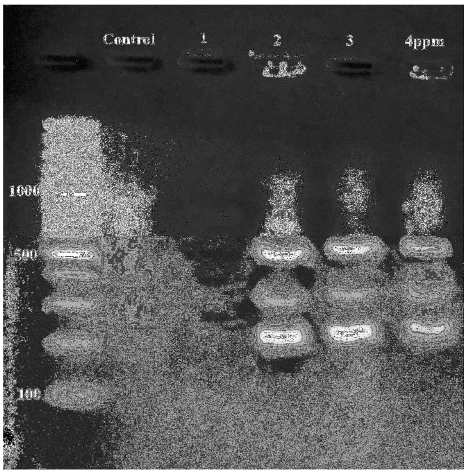
(a)


Control
1
2
3
4ppm
1000
500
100

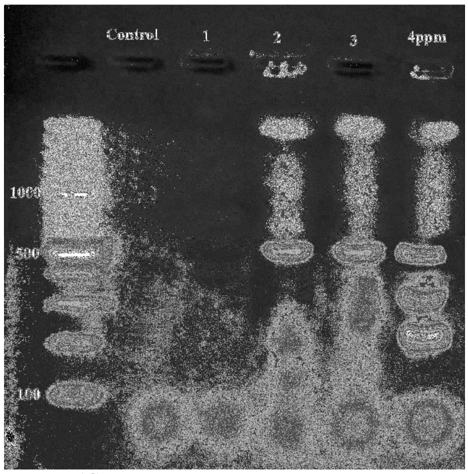
(b)


Control
1
2
3
4ppm
1000
500
100

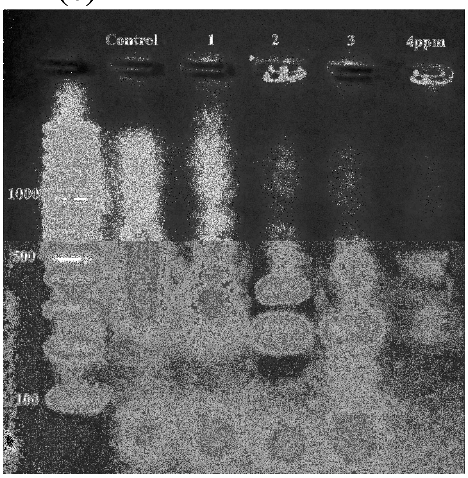
(c)


Control
1
2
3
4ppm
1000
500
100

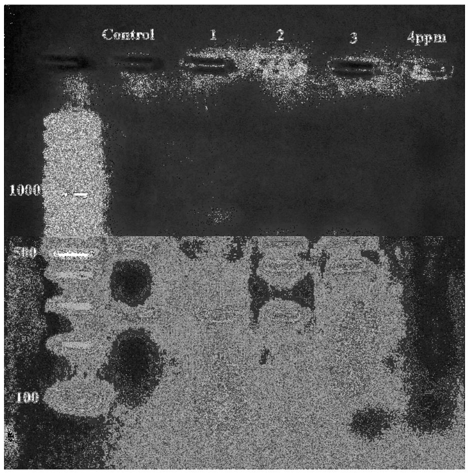
(d)


Control
1
2
3
4ppm
1000
500
100

(e)


Control
1
2
3
4ppm
1000
500
100

(f)


Control
1
2
3
4ppm
1000
500
100

(g)

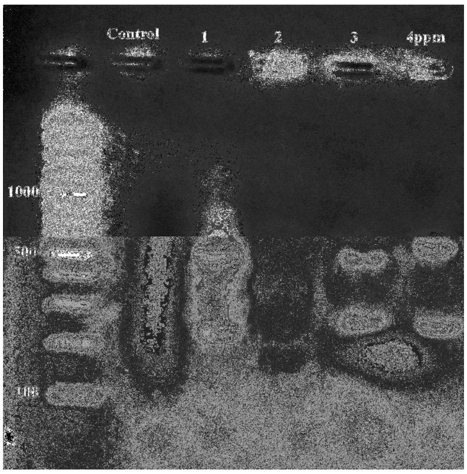


Photo (6). Gel electrophoresis of finger print-PCR reaction of the seven of primers a,823;b, 810; c,826;d, 828;e, 818;f, 808 and g, OPD-05 respectively on *Lilium* cv.Blanco .Lanes from 1 to5 indicates treatments of glufosinate ammonium at 0, 1, 2, 3, 4 mg/l respectively.

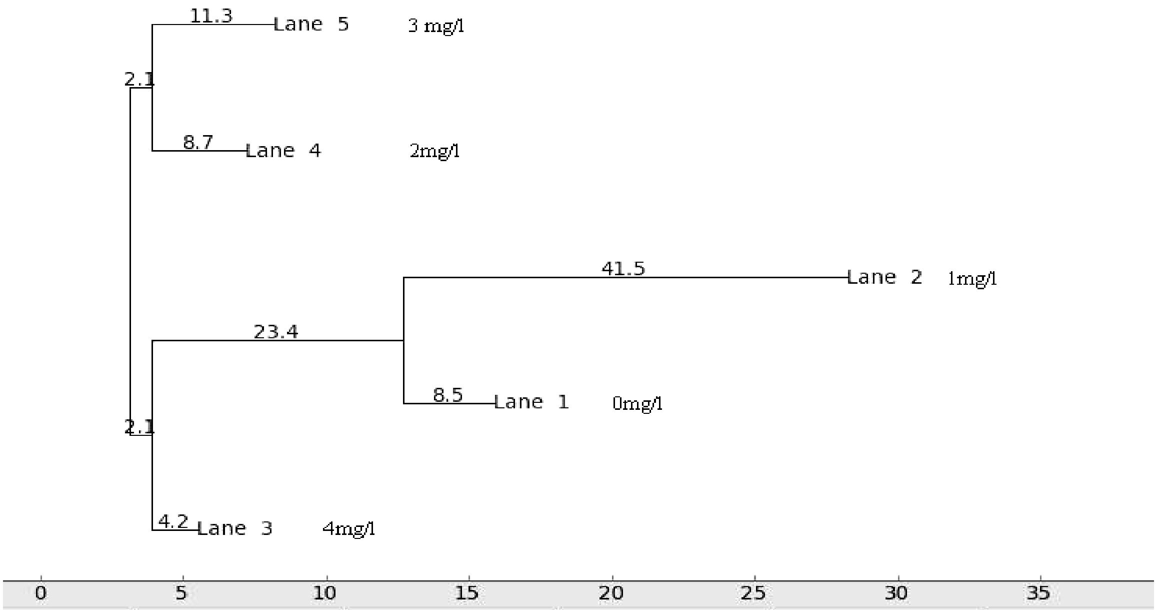


Figure (1). The phylogenetic tree of the five concentrations from glufosinate ammonium lanes 1- 5 represents.lane1,0 mg/l; lane2, 1mg/l ;lane3,2mg/l ;lane4,3 mg/l; lane 5, 4 mg/l on the resulting plantlet in *Lilium* cv. Blanco.

CONCLUSION

The bulb scales of *Lilium* cv.Blanco planted on MS gave the best results for successful bulb scales at 3mg/l BA and 1mg/l NAA and shoots regeneration increased with increasing concentration of BA and the best results through the interaction between BA and NAA while roots showed the best results with increasing IBA and reducing NAA**,**the best concentration of colchicine which caused doubling in the number of chromosomes was 4 mg/l , while glufosinate ammonium at 2 and 3 mg/l gave the highest genetic variations.

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الملخص العربى

إحداث الطفرات فى نبات الليليم صنف أورينتال بلانكو تحت الظروف المعمليه

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** قسم الزهور ونباتات الزينة وتنسيق الحدائق– كلية زراعة الشاطبى– جامعة الأسكندرية

أجريت هذة الدراسة فى معمل زراعة الأنسجة– قسم الزهور ونباتات الزينة وتنسيق الحدائق – كلية زراعة – الشاطبى – جامعة الأسكندرية خلال الفترة مابين ٢٠١٢–٢٠١٥ لتطويروإيجاد بروتوكول فعال للإكثار المعملى الدقيق لنباتات الليليم (أورينتال بلانكو). ولقد تم إستخدام الأوراق الحرشفية من أبصال الليليم التى تم أستيرادها من أحد المشاتل هولندا(النبات الأم) خلال الدراسة المعمليه لأستحثاث أكثار(تضاعف) المجاميع الخضرية. تم زراعة المنفصل النباتى(الأوراق الحرشفية) على بيئة MS مضاف إليها توليفات مختلفة من الأوكسين (NAA) ٠ – ١ – ٢ مجم/لتر والسيتوكينين(BA) ٠ – ١– ٢– ٣ مجم/لتر لأستطالتها وكذلك تجذيرها على بيئات تحتوى على نوعين من الأوكسينات بتركيزات مختلفه (NAA) ٠ – ١– ٢ مجم/لتر و(IBA) ٠ –١– ٢– ٣ مجم/لتر بالأضافه لأختيار أفضل النباتات المكونة للجذور ومعاملتها بالكولشسين كمطفر كيماوى وذلك بالتركيزات التالية١ – ٢– ٣

– ٤ مجم/لتر وذلك بنقع الجذور لمدة ساعتين . وكانت أفضل بيئة زراعة المحتوية على BA عند ٣مجم/لتر و NAAعند ٢ مجم/لتر وعند نقل هذة المجاميع الخضرية النامية معمليا على تركيزات من NAA ٢مجم/لتر ، IBA ٢ مجم/لتر أعطت أفضل وأكبر عدد من الجذور وأفضل جرعة كولشيسين أحدثت تضاعف لعدد الكرموسومات هى ٤ جزء فى المليون وبالتالى حدوث تضاعف. واختيرت أفضل النباتات المكونة للجذور وتم معاملتها بأضافة الجليفوسينات أمونيوم الى بيئة MS بالتركيزات الاتية١-٢-٣-٤مجم/ لتروكان تركيز٢ و ٣مجم/لتر أفضل تركيزات أحدثت أختلافات وراثية.

Response of Some New Hybrids of Maize to Mineral and Organic Fertilization in Reclaimed Soil

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ABSTRACT: Two field experiments were conducted at North of El Tahrir, El- Behira, Egypt, during 2015 and 2016 seasons, to study the effect of mineral fertilization and organic manure on three maize hybrids. Split plot design with three replications was used, where the main plots contain combination of mineral fertilization (M) + organic manure (OM) i.e., (100 % M,75% M+ 25% OM, 50% M +50% OM, 75% M +25%OM and 100% OM), meanwhile the three maize hybrids (SC.2031, SC.2030 and TWC1100) were allocated in the sub plots. Plot size was 10.50 m^2 (3 m x 3.5 m) having 5 ridges of 3 m in length and 0.7 m in width. The obtained results revealed that combined application of 75% mineral + 25% organic manure) affected significantly increase in plant height (cm), ear length, number grains/row, number of grains/ear, 100 - grain weight, grain, straw, and biological yield (kg/fed.), and harvest index %. The maize hybrid SC. 2031 recorded the highest means values of above mentioned characters. Fertilizing maize hybrid SC2031 by 75 % mineral + 25% organic manure gave the highest grain yield and its components under this study.

Key words: maize; yield; mineral; organic; fertilization; manure; yield; its components

INTRODUCTION

Maize (*Zea mays* L.) is one of the most widely grown cereals in the world. Also, it is important summer grain crops in Egypt. There is wide gap between consumption and local production. This gap could be narrowed through use the high yielding hybrids as well as use optimum organic and mineral fertilization.

Organic farming is an excellent soil amendment which gave a balance of nutrients, while contributing valuable organic material to the soil. Soil microorganisms improved water holding capacity, soil structure for pH buffering and the organic complexing of nutrients, making them available for plant uptake. It is well documented that the incorporation of organic manure into the soil is increasingly important because it improves soil fertility and increased crop yield (Singh, 2001).

Significant increase in plant height, dry matter, yields and NPK contents with the application of nitrogen fertilizers. Maize growth, dry matter, yields and NPK contents improved significantly when treated compost were added, but it was still below the fertilizer treatments. On comparative basis, maize response was better with FYM (Memon *et al.,* 2012). Maize yield and its components such as number of cobs/plant, cob length, number of grains/cob, and 100- grain weight were maximum when plots were fertilized at 100 kg/ha., as urea + poultry manure at rate 12.98 t/ha. (Nasim *et al.,* 2012). Application of nitrogen at the rate of 120 kg N/ha applied as 50% urea + 50% FYM can appreciably enhance the growth and yield indices of maize crop. Bilal *et al*. (2016) concluded that integrated fertilization of nitrogen sources as 50% FYM and 50% urea at the rate of 120 kg N/ha resulted in higher yield and yield related traits of maize crop and is therefore recommended for achieving higher yield and yield attributes of maize crop.

The soil with organic manure continually applied had lower bulk density and higher porosity values, porous and buffering capacities (Edmeades, 2003).Proper application of organic and inorganic fertilizers can increase the activities of soil microorganisms and enzymes and soil available nutrient contents (He and Li, 2004; Saha *et al*., 2008).

100 grain weight, yield and yield components and N, P and K of maize plants were increased significantly by increasing the level of nitrogen up to 140 kg N/fed (Siam *et al*., 2008) Nitrogen levels had significant effects on yield and yield components in maize hybrids (Sharifi and Taghizadeh, 2009).The level of nitrogen fertilization differentiated the chlorophyll content expressed in SPAD units (Szulc and Hubert, 2010). 100 grain weight, grain yield and straw yield increased with increasing the rate of N fertilizer up to 120 kg N/ha. Treatment of 120 kg N/fed in four doses as 40, 20, 20 and 20 % added after 14, 28, 48, and 56 days after sowing (DAS), recorded higher values of 100 grain weight, straw and grain yield of maize (El-Agrodi *et al*., 2011).

N and P levels significantly increased the studied parameters of corn plants as compared with control. The highest values were obtained by using 120 kg N+ 35 kg P_2 O_5/ fed., followed by 80 kg N+ 25 kg P_2 O_5/ fed., and 40 kg N+15 kg P_2 O_5/fed (Ibrahim and Hala, 2007).

The Single Cross 3084 significantly surpassed other hybrids in number of grains/ear, ear weight, grain weight/ear and grain yield/fed. It was noticed that the maximum values of plant and 100-grain weight, ear weight, grain yield/fed were obtained by application of 120 kg N/fed as a mineral form. Whereas, no significant difference was noticed between 90 kg N min.+30 kg N org./fed and 120 kg N min/fed on most characters studied in both seasons **(**El-Gizawy and Salem, 2010).

The objective of this investigation was to study the impact of organic manure for new maize hybrids as sown reclaimed soil on yield and its components and their interaction.

MATERIALS AND METHODS

Two field experiments were carried out to study the effect of mineral fertilization and organic manure on yield, yield components of three maize hybrids and their interaction. Field experiments were conducted at North of El Tahrir, El-Beheara Governorate, Egypt, during the two successive seasons 2015 and 2016.

A split plot with three replications was used whereas main plots were combination of mineral fertilization (M) and organic manure (OM) namely; 100% mineral fertilization (120 kg N/fed, 24 kg P_2O_5/fed and 24 kg K_2O/fed.), 75% mineral (90 kg N/fed,18 kg P_2O_5/fed and 18 K_2O kg K_2O /fed) + 25% organic manure (2.5 ton/fed), 50% mineral (60 kg N/fed, 12 kg P/fed and 12 kg K_2O/fed)

+ 50% organic manure (5 ton/fed.), 25% mineral (30 kg N/fed, 6 kg P/fed. and 6 kg K_2O /fed.) + 75% organic manure (7.5 ton/fed) and 100% organic manure (10 ton/fed) while the three maize hybrids namely; Single cross 2031 (S.C. 2031), single cross 2030 (SC. 2030) and three way cross (TWC.1100) were distributed in subplot. Plot size was 10.50 m^2 (3 m x 3.5 m) having 5 ridges of 3 m in length and 0.7 m in width. Two grains were hand planted in each hill. Plant spacing 25 spacing 25 cm between plants.

Some physical and chemical characteristics of the studied soil before sowing are presented in Table (1) which were determined according to Klute (1986).

Mineral fertilization consists of nitrogen as in form of ammonium nitrate (NH_4NO_3 33.5 %), phosphorus as calcium super phosphate (15.5 % P_2O_5) and potassium as potassium sulphate (48 % K_2O).

Organic manure (cow manure) at the one rate was added (10 tons/fed) at the soil preparation before planting in both seasons analysis of organic manure is presented in Table (2).

Table (1). Some physical and chemical properties of the experimental soil sites during 2015 and 2016 seasons

Soil parameter		
	Season	
	2014	**2015**
Particle size distribution %		
Sand	58.40	57.10
Silt	11.00	١١.٨
Clay	30.60	31.10
Textural class	Sandy loam	Sandy loam
Chemical properties:		
pH (1:1) (soil: water suspension)	7.92	8.00
EC (1:1) (soil: water extract), dS/m	3.70	3.80
Soluble cations (1:2) (meq/l)		
K^+	0.46	0.48
Ca^{++}	2.60	2.50
Mg^{++}	3.50	3.40
Na^{++}	12.10	12.50
Soluble anions (1:2) (meq/l)		
HCO^-_3	6.00	6.60
CL	8.00	8.20
SO^-_4	4.40	4.00
Calcium carbonate, %	21.25	19.85
Total nitrogen, %	0.75	0.85
Available P (mg/kg)	4.42	4.55
Organic matter, %	1.47	1.45

Table (2).Composition of organic manure (cow manure)

Determination	Cow manure	Unit
Moisture	13.70	%
Organic matter (%)	62.93	%
Total N	1.20	%
Total P	1.40	%
Total K	1.10	%
pH (1:5)	8.35	-
EC (1:5)	1.40	dS/m
C:N	30.4:1	-

Planting dates were on 25th May in 2015 and 2016 cropping seasons, respectively.

Phosphorus fertilizer was applied before planting. Field was hand thinned before the first irrigation to one plant/hill. The experimental units were hand hoed twice for controlling weeds before the first and second irrigations. N fertilizer was applied in two equal doses, the first dose was before the first irrigation and the second one was before the second irrigation during cropping seasons. Potassium sulphate (48 % K_2O) was added before the first irrigation.

All other agricultural treatments for maize plants were done as recommended by the Egyptian Ministry of Agriculture. Preceding crop was wheat in both seasons.

Plant height and yield traits were determined at harvest time after 120 days from planting, three medium ridges (36 plants), which were taken from each sub plot in which grain yield was determined on the basis of 15.5 % moisture and the following data were recorded: Plant height (cm), ear length (cm), number of grains /row, number of grains /ear, 100 - grain weight (g), grain yield, straw yield, biological yield (kg/fed), and harvest index (%).

Data were subjected to analysis of variance according to Gomez and Gomez (1984). All statistical analysis was performed using analysis of variance technique by means of CoStat computer software package (CoStat, Ver. 6.311., 2005). The least significant differences (LSD at 0.05) used to compare the treatment means.

RESULTS AND DISCUSSION

Data in Table (3) revealed the effect of combination of mineral and organic fertilization and their interaction on plant height (cm), ear length (cm) and number of grains/row for the three maize hybrids during 2015 and 2016 seasons.

With regard to the effect of mineral fertilization and organic manure affected significantly in plant height, ear length and number of grains/row of the maize in both seasons, whereas application of 75 % mineral fertilization and

25% organic manure recorded the highest mean values for these traits followed by application of 100% mineral fertilization, respectively, during two seasons (Table 3). He and Li (2004) indicated that combined application of organic and inorganic fertilizers can increase the activities of soil and available nutrient content which increased growth and yield attributes of plants. Also, Kandil (2004) revealed that using organic fertilizer caused significant increases in plant height, ear length and number of kernels/row of maize.

Also, Table (3) revealed that there was significant difference among the three maize hybrids on plant attributes namely; plant height, ear length number of grains/row in both growing seasons. Where, the SC. 2031 achieved the tallest plant height, ear length and the highest mean value of number of grains/row. Variations in grain number might be due to differences in genetic potential of maize hybrids. On the other side there was no significant difference among the three maize hybrids in the first season. These results are in harmony with Kandil (2013) who indicated that there was significant difference among maize hybrids in plant height (cm), ear length (cm) and number grains/row.

The data in Table (3) indicated that there was significant interaction between the combination of mineral + organic manure on plant height (cm), ear length (cm) and number of grains/row. Whereas the highest mean values for plant height, ear length and number of grains/row were obtained from SC. 2031 when fertilization 75% mineral + 25% organic manure in seasons 2015 and 2016.Meanwhile the lowest one recorded with TWC 1100 + 100% organic manure during two seasons. On the other hand there is no significant interaction between two factors on ear length in the first season.

Table (3). Average of plant attributes for three maize hybrids as affected by mineral fertilization (M), organic manure (OM) and their interaction during 2015 and 2016 seasons

Attributes	Fertilizer treatments (F)	Season 2015							Season 2016						
		Maize hybrid (H)			Average (F)	LSD at 0.05			Maize hybrid (H)			Average (C)	LSD at 0.05		
		SC. 2031	SC. 2030	TWC 1100		F	H	F x H	SC. 2031	SC. 2030	TWC 1100		F	H	FxH
Plant height (cm)	100 % Mineral	346.7	326.7	283.2	318.9a	11.4	6.8	15.4	336.3	328.7	316.0	327.0a	11.9	7.0	15.6
	75 % M +25% OM	346.7	326.7	298.3	323.9a				339.0	330.0	314.0	327.7a			
	50 M + 50 OM	336.7	326.7	303.3	322.2a				324.7	315.7	300.3	313.6b			
	25 M + 75 OM	286.7	299.3	303.7	296.6b				309.7	310.0	311.7	310.5b			
	100% OM	305.3	321.0	283.3	303.2b				317.3	310.0	278.0	301.8b			
Average (H)		324.4a	320.1a	294.4b					325.4a	318.9a	304.0b				
Ear length (cm)	100 % Mineral	23.4	25.2	23.4	24.0a	1.3	1.1	ns	22.5	24.6	23.5	23.5b	0.10	0.16	0.22
	75 % M +25% OM	25.0	25.4	23.3	24.6a				24.5	24.9	23.4	24.3a			
	50 M + 50 OM	22.2	22.2	21.7	22.0b				22.1	21.0	22.0	21.7c			
	25 M + 75 OM	21.0	18.9	16.8	18.9c				19.7	21.0	18.1	19.6d			
	100% OM	19.3	18.3	17.8	18.5c				20.1	19.0	18.0	19.0e			
Average (H)		22.2a	22.0a	20.6b					21.8b	22.1a	21.0c				
Number of grains/row	100 % Mineral	49.3	49.3	53.3	50.6a	2.3	ns	3.9	52.0	49.0	49.7	50.2a	0.46	0.42	3.9
	75 % M +25% OM	52.0	48.7	47.3	49.3ab				53.7	50.3	48.0	50.7a			
	50 M + 50 OM	47.7	51.0	46.0	48.2b				46.0	45.7	50.7	47.5b			
	25 M + 75 OM	43.3	40.0	46.7	43.3c				44.0	41.0	42.0	42.3c			
	100% OM	41.3	42.7	40.7	41.6c				44.0	40.7	40.0	41.6d			
Average (H)		46.7	46.3	46.8					47.9a	45.3c	46.1b				

- Mean values in the same column/row marked with the same letters are not significantly different at 0.05 level of probability.
- ns.: not significant difference at 0.05 level of probability according to LSD.

Table (4) showed the effect of mineral and organic fertilization and their interaction on number of grains/ear, 100- grain weight (g) and grain yield (kg/fed.) for the three maize hybrids in 2015 and 2016 seasons.

With regard to the effect of mineral fertilization and organic manure, it is significantly affected number of grains/ear, 100- grain weight and grain yield (kg/fed.) of maize in both seasons, whereas 75 % mineral and 25% organic manure recorded the highest mean values for number of grains/ear (in the second season only), 100- grain weight and grain yield in two seasons (Table 4).In this respect Kandil (2004) revealed that using organic fertilizer caused significant increases in yield and its components of maize. These findings agreed with Siam *et al.* (2008), Szulc and Hubert (2010), Memon *et al*. (2012), and Bilal *et al*. (2016).

Table (4) reported that there was significant difference among the three hybrids on number of grains/ear, 100- grain weight and grain yield (kg/fed.) in both cropping seasons. Where, the SC. 2031 gave the highest number of grain/ear and grain yield in two seasons. While the highest value of 100- grain weight recorded with TWC1100 in both season. While Sc.203 recorded the lowest one in 2015 and 2016. Variations in grain number might be due to differences in genetic potential of maize hybrids. These findings are in agreement with El-Gizawy and Salem (2010), Ahmed (2011), and Kandil (2013) who indicated that there was significant difference among maize hybrids in 100- grain weight, grain yield and number grains/ear.

The interaction between the combination of mineral + organic manure on number of grains/ear, 100- grain weight and grain yield (kg/fed.) were significant (Table 4). Whereas the highest values for number of grains/ear in both season, and grain yield (kg/fed.) in the first season only were obtained from SC. 2031 when fertilization 75% mineral + 25% organic manure in seasons 2015 and 2016.on the other wiseTWC1100 + 75% mineral + 25% organic recorded the heaviest 100+ grain weight in two seasons. Meanwhile the lowest one recorded with TWC 1100 + 100% organic manure during two seasons. On the other hand there is no significant interaction between two factors on grain yield/fed in the second season.

Table (4). Average of plant attributes for maize hybrids as affected by mineral fertilization (M),organic manure (OM) and their interaction during 2015 and 2016 seasons

Attributes	Fertilizer treatments (F)	Season 2015							Season 2016						
		Maize hybrid (H)			Average (F)	LSD at 0.05			Maize hybrid (H)			Average (F)	LSD at 0.05		
		SC. 2031	SC. 2030	TWC 1100		F	H	F x H	SC. 2031	SC. 2030	TWC 1100		F	H	F x H
Number of grains/ear	100 % Mineral	690.7	592.0	746.7	676.5a	32.3	23.7	52.9	728.0	588.0	695.3	670.4a	6.1	5.4	12.2
	75 % M +25% OM	728.0	584.0	662.7	658.2ab				751.3	604.0	672.0	675.8a			
	50 M + 50 OM	667.3	612.0	6.44.0	639.7b				644.0	548.0	709.3	633.8b			
	25 M + 75 OM	606.7	480.0	653.3	580.0c				616.0	492.0	588.0	565.3c			
	100% OM	578.7	512.0	569.3	553.3c				616.0	488.0	560.0	554.7d			
Average (H)		654.3a	556.0b	658.0a					671.1a	544.0c	644.9b				
100 grain weight (g)	100 % Mineral	42.6	42.4	45.2	43.4b	0.14	0.15	0.34	43.4	43.5	45.5	44.1b	0.17	0.16	0.37
	75 % M +25% OM	44.2	44.7	47.1	45.3a				46.0	44.7	47.7	46.1a			
	50 M + 50 OM	41.8	41.7	47.1	43.5c				40.2	41.9	41.2	41.1c			
	25 M + 75 OM	41.1	40.8	39.2	40.4d				38.9	40.4	38.9	39.4e			
	100% OM	40.0	39.8	38.7	39.5e				42.2	39.2	39.2	40.2d			
Average (H)		41.9b	41.9b	43.5a					42.1 a	41.9b	42.5a				
Grain yield (kg/fed)	100 % Mineral	2751.9	2915.6	2694.5	2787.3b	17.4	17.1	38.9	2785.5	2840.3	2712.3	2779.4b	151.3	112.7	ns
	75 % M +25% OM	3095.1	3094.1	2725.1	2971.4a				2850.5	3056.8	3020.5	2975.9a			
	50 M + 50 OM	2438.5	2598.5	2243.5	2426.8c				2827.2	2700.5	2617.2	2715.0b			
	25 M + 75 OM	2338.5	2078.5	2173.1	2196.7d				2640.5	2487.2	2153.8	2427.2c			
	100% OM	2285.1	2040.1	1758.5	2027.9e				2377.2	2470.5	2313.8	2387.2c			
Average (H)		2581.8a	2545.4b	2318.9c					2696.2a	2711.1a	2563.5b				

- Mean values in the same column/row marked with the same letters are not significantly different at 0.05 level of probability.
- ns: not significant difference at 0.05 level of probability according to LSD.

Data in Table (5) reported that the effect of mineral fertilization and organic manure and their interaction was significant on straw yield, biological yield (kg/fed.) and harvest index (HI %) of three maize hybrids in 2015 and 2016 seasons.

The effect of mineral fertilization and organic manure significantly affected the straw yield, biological yield (kg/fed.) and harvest index (HI %) in both seasons, whereas application of 75 % mineral fertilization and 25% organic manure recorded the highest mean values for straw and biological yields while 100% mineral fertilization gave the highest value of HI% in two seasons (Table 5). These findings agreed with Kandil (2004), Siam *et al.* (2008), Szulc and Hubert (2010), El-Agrodi *et al.* (2011), Nasim *et al*. (2012) and Bilal *et al*. (2016).who showed that yield and its components of maize increased by application of organic fertilizer.

The results in Table (5) stated that the three maize hybrids had significant difference in straw yield, biological yield (kg/fed.) and harvest index (HI %) in both growing seasons. Whereas, the hybrid SC. 2031 recorded the heaviest straw yield, and biological yield (kg/fed.) in both seasons. Meanwhile the highest HI % was given with Sc.2030 in the first season, only. Variations in grain number might be due to differences in genetic potential of maize hybrids. On the other side there was no significant difference among the three maize hybrids in the first season. The obtained results are in confirmed with Kandil (2013) who indicated that there was significant difference among maize hybrids in straw and biological yields as well as HI%.

The findings in Table (5) revealed the significant interaction between the combination of mineral + organic manure on straw yield, biological yield (kg/fed.) and harvest index (HI %). Whereas the highest mean values for straw yield in the second season, were obtained from SC. 2031 when fertilization 25% mineral + 75% organic manure. On the other hand the highest value of biological yield (kg/fed.) and harvest index (HI %) were given with Sc. 2031 + 75% M +25% Om in the first season, only. Meanwhile the lightest straw yield recorded with Sc.203 + 1% OM in the first season, TWC 1100 + 100% organic manure in 2016 season. However the lowest biological yield/fed was obtained with fertilizing Sc.2030 by 100 % organic manure in the first season only. On the other hand there is no significant interaction between two factors on straw yield in the first season, on biological yield/fed in the second season, and on HI % in the first and second seasons.

Table (5). Average of plant attributes for maize hybrids as affected by mineral (M), organic manure (OM) fertilization and their interaction during 2015 and 2016 seasons

Attribute	Fertilizer (F)	Season 2014/2015							Season 2015/2016						
		Maize hybrid (H)			Average (H)	LSD at 0.05			Maize hybrid (H)			Average (C)	LSD at 0.05		
		SC. 2031	SC. 2030	TWC 1100		F	H	F x H	SC. 2031	SC. 2030	TWC 1100		F	H	F x H
Straw yield kg/fed.	100 % Mineral	4091.4	3662.0	3983.3	3912.2b	219.1	203.6	ns	3526.5	4391.7	3791.7	3903.3a	198.4	230.9	519.9
	75 % M +25% OM	4816.9	4160.6	4234.0	4403.8a				3557.5	3846.4	3795.5	3733.1ab			
	50 M + 50 OM	3897.6	4121.6	3624.6	3881.3b				3524.8	3347.5	3230.8	3367.7c			
	25 M + 75 OM	3925.6	3733.2	3757.6	3805.5bc				4219.6	3311.5	3174.5	3568.5b			
	100% OM	3757.6	3393.6	3526.1	3559.1c				3133.8	3025.5	2806.2	2988.5d			
Average (H)		4097.8a	3814.2b	3825.1b					3592.4a	3584.5ab	3359.7b				
Biological yield (kg/fed)	100 % Mineral	6843.3	6577.6	6677.8	6699.6b	218.9	203.2	457.7	6312.0	7232.0	6504.0	6682.7a	317.9	258.1	ns
	75 % M +25% OM	7912.0	7254.7	6959.1	7375.3a				6408.0	6903.2	6816.0	6709.1a			
	50 M + 50 OM	6336.1	6720.1	5868.1	6308.1c				6352.0	6048.0	5848.0	6082.7b			
	25 M + 75 OM	6210.7	5773.3	5516.1	5833.4d				6860.1	5798.7	5328.3	5995.7b			
	100% OM	6096.1	5472.1	5699.2	5755.8d				5511.0	5496.0	5120.0	5375.7c			
Average (H)		6679.6a	6359.6b	6144.1c					6288.6a	6295.6a	5923.3b				
Harvest index(HI%)	100 % Mineral	6843.3	6577.6	6677.8	41.6a	1.3	1.2	ns	44.1	39.3	41.7	41.7b	ns	1.9	ns
	75 % M +25% OM	7912.0	7254.7	6959.1	40.3b				44.5	44.3	44.3	44.4a			
	50 M + 50 OM	6336.1	6720.1	5868.1	38.5c				44.5	44.7	44.8	44.6a			
	25 M + 75 OM	6096.1	5472.1	5699.2	38.2c				38.5	42.9	40.4	40.6b			
	100% OM	6210.7	5773.3	5516.1	34.7d				43.1	45.0	45.2	44.4a			
Average (H)		6679.6b	6359.6a	6144.1b					42.9	43.2	43.3				

- Mean values in the same column/row marked with the same letters are not significantly different at 0.05 level of probability.
- ns: not significant difference at 0.05 level of probability according to LSD.

CONCLUSION

It can be concluded that fertilizing maize hybrid Sc. 2031 by 75% mineral fertilization + 25% organic manure achieved the highest values of yield and its components under study conditions.

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الملخص العربى

استجابة بعض هجن الذرة الشامية الجديدة للتسميد المعدني والعضوي فى الأرض المستصلحة

محمد أحمد عبد الجواد نصار ، ابراهيم فتح الله رحاب ، عصام اسماعيل قنديل ، على أحمدعلي الصاوي البنا ، كمال عبد المنعم محمد إبراهيم نصر

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أقيمت تجربتان حقليتان بمزرعة خاصة بمنطقة شمال التحرير – محافظة البحيرة – مصر خلال موسمى الزراعة ٢٠١٥ و ٢٠١٦ لدراسة تأثير التسميد المعدني والعضوى على ثلاثة هجن من الذرة الشامية. وكان التصميم المستخدم هو القطع المنشقة مرة واحدة فى ثلاثة مكررات حيث وزعت معاملات مكونه من توليفة السماد المعدني والعضوي فى القطع الرئيسية (١٠٠% سماد معدني ، ٧٥% سماد معدني + ٢٥% سماد عضوى ، ٥٠% سماد معدني + ٥٠% سماد عضوي ، ٢٥% سماد معدني + ٧٥ سماد عضوي ، ١٠٠% سماد عضوى) ، بينما وزعت الثلاثة هجن الذرة

الشامية (انتاج شركة هاي تك) فى القطع تحت الرئيسية (هجين فردى ٢٠٣١ ، هجين فردي ٢٠٣٠ ، وهجين ثلاثي ١١٠٠).

ويمكن تليخص أهم النتائج فيما يلي:

- أظهرت توليف المعاملات من التسميد المعدني والعضوى تأثير معنوي على ارتفاع النبات ، طول الكوز وعدد الحبوب/صف و عدد الحبوب/كوز ووزن ١٠٠ حبة ومحصول الحبوب والقش والمحصول البيولوجي ودليل الحصاد ، حيث أن المعاملة بـ ٧٥% سماد معدنى + ٢٥% سماد عضوى (أبقار) أعلى قيم لمعظم الصفات المذكورة خلال موسمي الزراعة.
- وجد أن هناك اختلاف معنوي بين الثلاثة هجن من الذرة الشامية فى معظم الصفات المدروسة خلال موسمي الدراسة ٢٠١٥ ، و ٢٠١٦ ، حيث أن الهجين فردي ٢٠٣١ تفوق على الهجينين فردى ٢٠٣٠ ، الثلاثي ١١٠٠ فى معظم الصفات ، فى حين أنه لا يوجد فروق معنوية بين الهجين فردى ٢٠٣٠ ، الهجين الثلاثي ١١٠٠ فى معظم صفات المحصول ومكوناته للذرة الشامية خلال موسمي الزراعة.
- كان تأثير التداخل بين عاملى الدراسة معنوياً على أرتفاع النبات ومكوناته للذرة الشامية مثل طول الكوز وعدد الحبوب/صف وعدد الحبوب/كوز ووزن ١٠٠ حبة ومحصول الحبوب والقش والمحصول البيولوجي ، خلال موسمى الزراعة. حيث حقق زراعة هجين الذرة الشامية (فردي ٢٠٣١) تحت توليفة (٧٥%) تسميد معدني + ٢٥% تسميد عضوي أعلى قيم لهذه الصفات.

التوصية

يوصي البحث بزراعة هجين الذرة الشامية (فردي ٢٠٣١) تحت توليفة (٧٥% تسميد معدني + ٢٥% تسميد عضوي) حيث حققت تلك المعاملة أعلى قيم لصفات المحصول ومكوناته تحت ظروف الأراضى الجديدة بمنطقة شمال التحرير – محافظة البحيرة.

Effect of Mineral, Organic and Bio-fertilization on Cucumber (*Cucumis sativus* L.) Grown Under Plastic Houses Conditions

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ABSTRACT: Two greenhouse experiments were conducted during 2014/ 2015 and 2015/2016 seasons to layout beneficial fertilization protocol enhances the production and quality of cucumber under plastic houses. The target fertilization program seeks to achieve the best combination of various fertilizers (bio-, organic and inorganic) that lead to the highest yield and quality of produced cucumber especially during the winter season. Therefore, two successive experiments were carried out in a randomized complete blocks design with 3 replications. Each replicate included 13 treatments. All determined treatments were distributed randomly within each block. The obtained results demonstrated that the combination including microbein +10 m^3/fed. of chicken manure either 25% or 50 % NPK of recommended fertilization (Treatment 5 or 8) recorded the highest mean values of the studied vegetative growth characteristics and SPAD reading. Plants fertilized with either microbein +5m^3 of chicken manure (Treatment 1) or 100% of NPK recommended dose (Treatment 13); recorded the least time that spanned or elapsed to occur the first flowers of cucumber. Noticeable increments in number of gyneocious flowers and nitrogen in fruits (N%) were due to the treatments of microbein + 25% of recommended dose + 10 m^3/fed., chicken manure (Treatment 5), in both season. Both combinations among microbein + 25% NPK of the recommended dose +10 m^3 /fed (Treatment 5) and microbein + 50% NPK of the recommended dose + 10 m^3 chicken manure (Treatment 8); recorded the highest mean values of the give traits (i.e. number of fruit, average fruit weight, fruit and early yield /plant, early and total yield / m^2), during both seasons. In the case of fruit dry weight percentage character, the highest percentage was obtained from treatment of microbein + 75% of recommended dose + 5 m^3/fed., chicken manure (Treatment 10). The cucumber's plants which fertilized with microbein + 25% NPK of recommended dose + 10 m^3/fed. chicken manure (Treatment 5), led to the longest fruits and the highest mean values of fruit shape, in both seasons. Meanwhile, the combination of microbein + 50 % NPK of a recommended dose + 10 m^3/fed. chicken manure (Treatment 8), caused the highest values for fruit diameter and total soluble solids. The highest mean values of acidity and vitamin C were recorded when the plants were fertilized with a combination of microbein + 10m^3/fed. chicken manure (Treatment 2), in both seasons. From the results, we can conclude that, the combination among microbein + 25% NPK of recommended fertilization +10 m^3/fed. of chicken manure (Treatment 5) or among microbein + 50 % NPK of recommended fertilization +10 m^3/fed. organic manure chicken manure (Treatment 8); considered as the best combination treatment as it gave the highest mean values of vegetative growth characters, yield and its components and fruit quality of cucumber plants grown under plastic houses conditions.

Keywords: Cucumber, mineral fertilization, inorganic fertilization, organic fertilization, bio-fertilization.

INTRODUCTION

Cucumber (*Cucumis sativus* L.) belongs to the Cucurbitaceae family. It is one of the most important vegetable crops grown under plastic houses in Egypt and the worldwide. It is a sub-tropical vegetable crop that grows successfully under conditions of high light, high humidity, high soil moisture, temperature and fertilizers in green-house (El-Aidy *et al*., 2007). Cultivation of cucumber is very crucial because of its high rate of consumption, whereas it can be served as fresh or industrialized products, in addition to its nutritional value. In Egypt, it is grown as a summer crop in the open field in the period from March to September, and under plastic house conditions from September to May. In the last century, in general, chemical fertilizers were used in agriculture. Whereas, fertilizer is a major part of the crop expenses for cucumber production, and it is critical for successful crop yields and high fruit quality. Fertilizer requirements of cucumber are quite high due to its high yielding potential per unit area and time. Accordingly, mineral nutrition with suitable levels of nitrogen (N), phosphorus (P) and potassium (K) had a key role for improving the growth and fruit yield of cucumber, as well as influencing the cucumber plant's ability to withstand negative effects from pests, water, temperature, and other stresses. However, generally, excessive amount of inorganic fertilization are applied to vegetables to achieve higher yield (Stewart *et al*., 2005; Deore *et al*., 2010) and enhance the growth (Dauda *et al*., 2008; Deore *et al*., 2010). Also, using of inorganic fertilization only may lead to risks not only for human beings' health, but also for environment, too (Arisha and Bradisi, 1999; Deore *et al*., 2010). Nevertheless, N along with P and K, are, still, classified as primary macronutrients or major nutritive elements, which are needed in relatively large quantities and are often deficient in crops not receiving fertilizer application (Marschner, 1986). Nowadays, the best integrated fertilization management which includes inorganic, organic and bio-fertilization; plays crucial roles in this respect. Therefore, the absence of fertilization program for cucumber production under greenhouses conditions remains limiting factor, needs more research to develop an appropriate fertilization program satisfies the requirements to achieve the highest yield with best quality of cucumber plants grown under plastic houses environments.

Despite organic manures are known to improve the soil properties *via* increasing the limited moisture holding capacity. In addition, they can change the chemical properties of the soil *via* lowering its pH among some other factors. Also, they can provide the plants with many essential nutrients as nitrogen, phosphorus or potassium or a combination of these three elements (Haug, 1993 and Elsokkary *et al*., 1995). On the other tank, the use of manures (organic fertilization) only cannot satisfy the cultivated crop with nutrients (Kondapa *et al*., 2009; Deore *et al*., 2010). In spite of the positive potential of compost on yield of food crops its low nutrients content and high cost relative to inorganic fertilizers; makes its use as alone provided nutrient supplies not practical matter (Buchanan and Gliessman, 1991; Bittenbender *et al*., 1998). However, they may be used in combination with other fertilizers is necessary in order to increase soil organic matter, and reduce loss of inorganic N from the rhizosphere. Also, biofertilization is an avenue to enhance soil *via* different aspects (Revillas *et al*., 2000). However, biofertilization are substrates that include living organisms upon their application to the seeds or plants; they colonize the rhizosphere or the interior of the plant and enhance growth through enrichment of the availability of primary nutrients to host plants (Vessey, 2003 and Shanmuga *et al*., 2013). Biofertilizers, however, contain symbiotic or nonsymbiotic microorganisms that stimulate the plant growth. Likewise, co-cultivation of plants with biofertilizers; could give rise to resistance to diseases, production of hormones-like substances (cytokinins, auxins, gibberellins…etc.) and water –soluble vitamins (Kumar *et al*., 2001; Shanmuga *et al*., 2013). Such class of biofertilization, microorganisms assist in nitrogen fixation, hence optimizing the nitrogen uptake from other sources (Agrinos, 2011). Bio-fertilizers is a broad term used for products containing living or dormant microorganisms such as bacteria, fungi, actinomycetes and algae either alone or in combination, which help in fixing atmospheric N or solubilize/mobilize soil nutrient in addition to secrete growth promoting substance (Rai, 2006). The beneficial effect of N_2–fixing bacteria inoculation has been proved by many scientists at different parts of the world on plant growth, dry weight, total nitrogen content and yield of various crops (Nayak *et al.*,1986). Some of these scientists reported that the inoculation with N_2-fixess can safe half the normal field rate of mineral nitrogen fertilizer (Badawy *et al.*, 1997).

In this respect, Hassan (2015) indicated that bio-fertilizers accelerate the decomposition rate of compost applied to soil and enhances the mineralization and availability of plants' nutrients. Also, Saeed *et al.* (2015) stated that bio-fertilizer (Azotobar wal) and 1/2 chemical fertilizer (Urea); brought about the highest mean values of cucumber growth traits of "Saffe" cv. grown under greenhouse conations. Moreover, Abdel Naby *et al*. (2014) reported that a combination of chicken manure at rate of $15m^3$/fed. with foliar spraying of yeast extract at rate of 5g/l and mineral fertilizers with ammonium nitrate (33.5%N) at 125 kg/fed; gave rise to increase cantaloupe yield which surpassed the check treatment plants. Also, Feleafel *et al*. (2014) demonstrated that using of NPK as fertigation, up rate 125% of recommended dose; (220, 150, 150kg N, P_2O_5, K_2O /ha, respectively) brought about significant increases for plant height and leaves' number after 30, 50 and 70 days of sowing seeds(DAS), branches' number at 30 DAS, only, also leaf minerals (N, P and K) contents, percentage of fruit setting, fruit weight, fruits' number and yield of fruits of the greenhouse cucumber plants, cv. "Alrased 92 F1". Anjanappa *et al*. (2012) illustrated that the cucumber "Hassan" cv. plants grown under protected condition and provided with 75% recommended dose of fertilizer (60:50:80 kg NPK/ha) + 75% from recommended (2.5 t/ha) "FYM" farm yard manure + *Azotobacter* (AZT) 5kg/ha + Phosphobacteria (PSB) 5kg/ha + Trichoderma (TD) 5 kg/ha; recorded the maximum vine length, maximum number of branches per vine, least number of days elapsed until the first male and female flower appearance, maximum number of male flowers per vine, lowest sex ratio, highest number fruits per vine, maximum fruit weight and maximum fruit yield per vine. While the minimum number of male flowers, lowest number of fruits per vine and lowest fruit weight was registered with treatment provided with 100%FYM + AZT + PSB + TD.

Vega Ronquillo *et al*. (2009) declared that the plants that received earthworm humus had the greater fruit weight and yield. The results, also, showed that the best substrates, from agronomic and economic points of view, were compost enriched with partially acidulated phosphate rocks, compost enriched with triple super phosphate and earthworm humus. The economic evaluation of the results demonstrated the advantage of the use of processed organic fertilizers with earthworm humus with the most earnings. Bindiya *et al*. (2006) revealed that combined application of vermicompost (2 t/ha) + half recommended NPK (50:30:30 kg/ha) + *Azotobacter* and phosphate solubilizing bacteria (PSB) each at 5 kg/ha; gave rise to increase vine length and developing more number of branches per vine; showed quicker earliness and days to 50 percent flowering of the tested cucumber cultivar and gave ultimately higher yield of cucumber fruits (9.2 t/ha). The highest yield and net returns were obtained with vermicompost in combination with biofertilizers and chemical fertilizers but high benefit cost ratio with recommended fertilizer dose.

The objectives of these experiments were to study the effect of mineral (NPK), organic and bio-fertilization on cucumber (*Cucumis sativus* L.) growth performance under plastic houses conditions to determinate the suitable fertilization program to cucumber plants "Barracuda F_1 hybrid" during its scarcity period of the year (from September to May).

MATERIALS AND METHODS

Two field experiments were carried out during the two successive winter seasons of 2014-2015 and 2015-2016, at private farm, Abou El-Matameer city, Behiera Governorate, Egypt, under unheated plastic houses. Before transplanting, random soil sample of 30 cm depth from different places of the greenhouse were taken for some important chemical and physical analyses as described by Page *et al*. (1982) and Jackson (1965). The experimental soil physical and chemical properties are given in Table (1).

Cucumber seeds were sown under plastic house on October 26th, during both seasons, in seedling foam trays (84 eyes) filled with a mixture of Peat moss: Vermiculite (1:1 v/v), supplemented with 300 g Ammonium Sulphate (20.5% N), 400 g Calcium Superphosphate (15% P_2O_5), 150 g Potassium Sulphate (48% K_2O), 50 g micronutrient and 50 g of a fungicide (thiophenate methyle) for each 50 kg of the mixture. Seedlings of 25 days old were transplanted in the plastic houses on November 20th during both the seasons at 30 cm apart and 1 m width of ridge. The experimental plot consisted of one ridge with 3 m long and 1 meter width making an area of 3 m^2 using drip irrigation system. All missing transplants were replaced by another ones of the same age , one week later after transplanting.

The plastic house was 24 m long and 6 m width making an total area 144 m^2, during both seasons, 50 cm from both sides of the plastic house's arch near from plastic and 30 cm from begining (entrance) and end (exit or out) of the plastic house were left without planting. So, the total number of plants/ plastic house were 390 plants (2.71 plants/m^2).

Cucumber cultivar' seeds coined as "Barracuda F_1 hybrid" was used for the experimentation. It was purchased form Agrotech for Modern Agriculture Co., Egypt. The bio-fertilizer “Microbein” is a mixture of non- symbiotic N-fixing bacteria of the genera *Rhizobium*, *Azospirillum, Azotobacter* and *klebsiella* as well as the phosphate dissolving bacteria *Baccillus* was purchased from the General Organization for Agricultural Equalization Fund, Ministry of Agricultural, Egypt. Microbein as a bio fertilizer was dissolved in distilled water, then the transplants were irrigated with it in foam trays; whereas, each plant received 0.5 g microbein dissolved in 20 cm^3 distilled water and transplanting after ten minutes from treatment, and some plants were maintained to be control ones (without manipulation).

Organic fertilization was done using matured chicken manure which obtained from the local area and its chemical analysis is presented in Table (2). Chicken manure treatments were assigned as 5, 10 and 15 m^3/Feddan.

Table (1). Physical and chemical properties of the experimental site during both seasons of the study (2014/2015 and 2015/2016).

Soil properties	Season	
	2014/2015	2015/2016
Physical analysis:		
Clay (%)	14.48	14.50
Silt (%)	8.00	7.50
Sand (%)	77.52	78.00
Textural class	Sandy loam	Sandy loam
Chemical analysis:		
Soluble cations in (1:5) soil: water extract (meq/l)		
Ca^{++}	0.25	0.20
Mg^{++}	0.32	0.25
K^{+}	0.31	0.35
Na^{+}	1.92	2.00
Soluble anions in (1:5) soil: water extract (meq/l)		
CO_3^{--}	0.00	0.00
HCO_3^{-}	1.18	1.20
Cl^{-}	0.72	0.80
SO_4^{--}	0.75	0.80
pH (1:2.5 soil suspension)	8.10	8.20
EC(dS /m) at 25° C	0.25	0.28
Available N (mg/kg soil)	10	15
Available P (mg/kg soil)	31	37
Available K (mg/kg soil)	360	412

The analyses were carried out at Nubariya Research Station, Agricultural Research Center, Nubariya, Egypt.

Table (2). Chemical analyses of the mature chicken manure for both seasons of the study (2014/2015 and 2015/2016).

Properties	Season	
	2014/2015	2015/2016
pH (1:10 manure suspension)	7.57	7.52
EC (1 :10) water extract, dS/m	2.96	2.86
O. M. %	17.73	17.67
C/N ratio	8.1:1	8.2:1
Soluble cations (meq/L)		
Ca^{++}	3.06	3.00
Mg^{++}	2.72	2.70
Na^{+}	14.30	14.20
K^{+}	33.90	34.20
Available nutrients (%)		
Nitrogen (N)	1.27	1.25
Phosphours (P)	1.02	1.04
Potassium (K)	2.20	2.10

Mineral fertilization NPK treatments were at the following rates: (0%, 25%, 50%, 75% and 100%) of recommended dose; 200 kg. N, 75 kg. P_2O_5 and 150 kg. K_2O/feddan, respectively. Ammonium nitrate (33.5% N) and nitric acid (15% N) as a source of nitrogen were added. Phosphoric acid (55% P_2O_5) and calcium superphosphate (15% P_2O_5) as a source of phosphorus were used. In addition, potassium sulphate (48% K_2O) as a source of potassium was added and calcium nitrate (15.5%N +19% Ca_2O) as a source of nitrogen and calcium was applied. The amounts of recommended dose were add as 415 kg/fed. ammonium nitrate, 200 kg/fed. calcium nitrate, 200 kg/fed. nitric acid, 100 kg/fed. calcium superphosphate, 82 kg/fed. phosphoric acid and 312.5 kg/fed. potassium sulphate. The ratios among the three-used mineral fertigation were distributed according to plant growth periods are listed in Table (3). A drip irrigation network was designed for this study. The drip irrigation network consisted of lateral's GR of 16 mm in diameter, with emitters at 0.3 m distance, with allocating a lateral for each row. The emitters had a discharge rate of 4 $l.h^{-1}$. Both conducted experiments were layout in a randomized complete blocks design, with three replications. Each replicate included 13 treatments as illustrated in Table (4). All determined treatments were distributed randomly within each block. Total experimental area was 144 m^2 (6 m x 24 m) during both seasons and 0.30 m between plants and 1.0 m pathway. The planting distance adopted at both sites was 0.30 m × 1.0 m, and the plant population per plot was ten plants. The experiment plots were tested as free of weeds by hand hoeing. Cucumber plants were trained vertically on single stem, where all lateral branches were removed from both cotyledonary leaves until the second true leaf. After that, the all lateral branches were cut off after two leaves (two fruits) until 2m height till the end of the growing seasons. Harvesting of the fruits was done for early yield after 40 days, then for the rest of harvesting, daily in summer seasons and each 2 days in winter seasons. The harvesting fruits were counted and weighted using electronic scale.

Four plants form each treatment in each replications were randomly selected and tagged for records on growth, early yield and total yield as well fruit quality parameters.

1. Vegetative growth characters: all the following characters were determined after 120 days of transplant:
Plant height (cm), was recorded from the base of the plant to the terminal growing point of tagged plants using a meter scale; stem diameter (cm), was measured using caliper and the averages were determined. The diameter was measured from about 5cm from the soil surface around the base of the plants.
Number of leaves per plant were counted. Number of branches per plant were counted. Plant fresh weight (kg) was determined as the average fresh weight of plant foliage. Plant dry weight (g) was dried in an electrical oven at 70˚ C till the constant weight and then the average dry weight of whole plant foliage was calculated.

2. Flowering characteristics: four plants from each experimental plot were chosen at random and the following data were recorded:
Time spanned to the first flower appearance (days), which was determined as time spanned from transplanting to the first flower appearance (day). Number of

flowers per plant the whole numbers of the opened flowers per plant all over the season were counted.

3. Fruit number and yield parameters, were determined *via* number of fruits per plant was determined from the total number of fruits harvested over the entire harvest period (130 days). Fruit yield per plants (kg), was calculated from the fruit harvested over the all picking times. Fruit yield per square meter (kg/m^2), was recorded and fruit yield/square meter compared as fruit yield per square meter = average fruit yield/plant x number of plants/square meter. Average fruit weight (g), was calculated as total fruit yield (kg)/ total

Table (3). Chemical fertilization program as ratio among N: P_2O_5: K_2O

Fertilization period	N	P_2O_5	K_2O
Till flowering	1.00	0.50	1.00
Till the harvesting	2.25	0.75	1.50
Till the end of harvesting	2.55	0.85	1.70

Table (4). Total treatments in each replicate were 13 treatments as follows

Treatment No.	Microbein	NPK fertigation % from recommended	Organic fertilization m^3/feddan
1	With	0	5
2	With	0	10
3	With	0	15
4	With	25	5
5	With	25	10
6	With	25	15
7	With	50	5
8	With	50	10
9	With	50	15
10	With	75	5
11	With	75	10
12	With	75	15
13	Without	100	0

Number of fruits per plant. Early yield was considered as the weight of all harvested fruits during the first 40 days of harvesting per plant and per square meter and expressed in kg. Fruit dry matter, randomly fruit samples of 100 g of fresh weight were dried in anelectrical oven at 70˚ C till the constant weight then the percentage of fruit dry weight was calculated according to the following formula: Fruit dry matter = $\frac{\text{Dry weight}}{\text{Fresh weight}} \times 100$

4. Fruit quality, four fruits were randomly taken from each plot of all pickings to study the morphological and chemical characters of the fruits in both seasons.
Morphological characters: fruit length (cm) and fruit diameter (cm) were measured and fruit shape index were calculated as (fruit length/ fruit diameter).
Chemical composition, The following fruit constituents were determined in fruit samples taken specially for chemical characteristics as follows (1)**:** The total soluble solids (T.S.S.) or degrees Brix (Bx°) is numerically equal to the

percentage of sugar and other dissolved in a solution. This scale is used in the food industry for measuring the approximate amount of sugars in fruit juices.There, a solution that is 25 degrees Brix has 25g of sugar per 100 g of solution (Caralcanti *et al.*, 2010; Majiid *et al.*, 2011).It was estimated in the juice of the fresh fruits using a hand refractometer according to (A.O.A.C., 1992). (2) Total titratable acidity (%), it was determined in the fruit juice, as citric acid percent (mg/100 cm^3 juice), by titration with 0.1 N sodium hydroxide (NaOH) after adding a few drops of phenolphthalein as an indicator, as the method described in the A.O.A.C. (1992), (3) Total, reducing and non-reducing sugars, which were determined for each fruit sample according to the method described by Malik and Singh (1980) and (4)Vitamin C (Ascorbic acid), was measured by titration with iodide potassium according to method of Ranganna (1986) and calculated as mg vitamin C/ 100 cm^3 juice.

5. Plant chemical analysis Plant N, P and K contents were determined as follows: (1) N, P and K contents of fruits and leaves, the kjeldahe digestion procedure was conducted as described by Okalebo *et al.* (2002). The total nitrogen in plant samples was determined using the microkjedal method of distillation and titration as described by Pregel (1945). Total P was determined following color development using the Bray P1 extractant, measured by the Murphy blue coloration (Murphy and Riely, 1962) and determined on a Spectrophotometer (model Perkin Elmer Lamda 45). Total K in samples was read by aspirating directly into Jenway flame photometer (PFP7) and (2) Leaf colour degrees or Leaf chlorophyll indication (SPAD), for determination chlorophyll readings, at harvest, leaf greenness (chlorophyll content) was done using a non- destructive method using a SPAD 502 chlorophyll meter for each plant, 3 recently full- expanded leaves were randomly chosen for SPAD measurement at the average of 3 readings was recoded (Yadva, 1986; Marquard and Tipton, 1987) .

Statistical Analysis :

Data of the present study were statistically analysed according to the design used. Data were tested by analysis of variance and the comparisons among the means of different treatments were carried out, using the revised least significant difference test, as illustrated by (Duncan, 1965; Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

1. Vegetative growth characters:

Data listed in Tables (5 and 6) indicated that the combination among microbein + 25% NPK of recommended fertilization +10 m^3/fed. of chicken manure (Treatment 5) or among microbein + 50 % NPK of recommended fertilization + 10 m^3/ fed. chicken manure (Treatment 8), also, was accompanied with the highest mean values of the vegetative characteristics.

Table (5). Effect of bio-, mineral and organic fertilizers on some vegetative growth characters of Cucumber plants during 2014/2015 and 2015/2016 growing seasons.

Treatment No.	Plant height (cm)		Stem diameter (cm)		No. leaves/ plant		No. branches/plant	
	2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016
1	251.7D	241.3D	0.66 E	0.76 F	81.00 E	79.67 G	17.33 D	16.33E
2	273.3C	269.7 C	0.73 DE	0.83 EF	92.00 D	86.67 F	19.67 D	18.67 DE
3	286.7B	272.0 C	0.70 DE	0.80 EF	94.67 CD	87.00 F	19.00 D	19.00 DE
4	330.0 A	330.0 A	0.97 B	1.03 CD	101.00 AB	103.70 C-E	28.00 BC	24.00 C-E
5	330.0 A	330.0 A	1.33 A	1.26 A	102.00 AB	110.70 A	31.67 AB	36.00 A
6	330.0 A	330.0 A	0.93 BC	0.93 DE	99.00 A-C	107.00 B	29.33 A-C	21.33C-E
7	330.0 A	330.0 A	1.03 B	1.03 CD	101.00 AB	103.30 DE	28.33 A-C	26.00 CD
8	330.0 A	330.0 A	1.26 A	1.23 AB	105.00 A	108.30 AB	32.33 A	34.33 AB
9	330.0 A	330.0 A	0.94 BC	0.90D-F	104.00 A	106.30 BC	29.33 A-C	25.33 CD
10	330.0 A	330.0 A	1.00 B	1.00CD	102.00 AB	102.70 E	26.67 C	24.33 CD
11	330.0 A	330.0 A	1.03 B	1.10BC	103.70 AB	105.70 B-D	27.67 BC	27.33 BC
12	330.0 A	330.0 A	0.96BC	0.93DE	100.30 A-C	101.70 E	27.00 C	25.00 CD
13	290.B	287.0 B	0.83CD	0.90D-F	97.67 B-D	89.00 F	20.33 D	20.67 C-E

Values having the same alphabetical letter in common, within each column, do not significantly differ, using the Revised L.S.D. test at 0.05 level of probability.

Table (6). Effect of bio-, mineral and organic fertilizers on some vegetative growth characters of Cucumber plants during 2014/2015 and 2015/2016 growing seasons.

Treatment No.	Plant fresh weight (g)		Plant dry weight (g)	
	2014/2015	2015/2016	2014/2015	2015/2016
1	763.3D	845.0E	73.13H	84.32B-D
2	836.7D	895.0DE	71.10H	76.29D
3	853.3D	896.0DE	94.90C-G	80.89CD
4	1057.0C	1060.0C	103.60B-E	93.28 A-D
5	1227.0AB	1300.0A	120.10AB	101.00A-C
6	1142.0A-C	1130.0BC	90.00D-H	105.10AB
7	1174.0A-C	1082.0C	82.20F-H	110.30A
8	1277.0A	1244.0AB	106.90B-D	101.60A-C
9	1071.0BC	1095.0BC	77.80GH	96.88A-D
10	1083.0BC	1025.0CD	84.75E-H	101.40A-C
11	1117.0A-C	1095.0BC	113.50A-C	85.41B-D
12	1103.0BC	1033.0CD	133.10A	100.90A-C
13	854.0D	895.0DE	100.60B-F	105.70AB

Values having the same alphabetical letter in common, within each column, do not significantly differ, using the Revised L.S.D. test at 0.05 level of probability.

Such a result can be explained on the basis that the sandy soils of the experimental sites have relatively low amounts of nutrients (Table 1), thus the application of chicken manure at the rate of 10 m^3 $fed.^{-1}$ improved the physical, chemical and biological properties of the soil during the growing period, beside; the availability of all type of nutritive constituents either from beneficial microorganism (microbein), mineral and organic fertilizers. It is obvious that combination of microbein + organic fertilization at 5 m^3 /fed. (Treatment 1); recorded the lowest mean values compared to the other treatments during both seasons of the experimentation. These findings may be attributed to the fact that the amount of the macronutrients supplied by organic fertilizer (i. e. chicken manure) is too low compared to those provided by mineral fertilizer which was nil (without) level in this treatment. Nevertheless, the lowest amount of chicken manure (5m^3 /fed.) and microbein added dose which could provide such growth promotion activity of the rhizosphere beneficial microorganisms could maintain the growth of the plants. The obtained results, in general, are matching well with those reported by several researchers (Umamaheshwarappa *et al*., 2005; Anjanappa *et al*., 2012).

2. Flowering characters:

Data presented in Table (7) declared that plants fertilized with either microbein plus 5m^3/fed of chicken manure (Treatment 1) or 100% of NPK recommended dose (Treatment 13) recorded the least time that spanned or elapsed to occur the first flowers of cucumber "Baracoda" cv. plants which were ranged between 30-32 days for the former treatment and 30 days for the latter during both seasons of the study. This may be due to the effect of the given combination on the facilitation of all available nutritive elements which enhanced the reproductive growth on the time spanned until the first flowering after 30 days. This finding may be taken place due to N fertilization which promotes flowering (Ross and Pharis, 1985). This finding, also, could be attributed to the balanced nutritive elements released from combination of microbein + 5 m^3/fed chicken manure (Treatment 1) and P of mineral fertilizer (Treatment 13) which enhanced the availability of phosphorus, the essential and key factor, for initiation of flowering, and subsequently the early flowering. This result is incompatible with those of Sharma *et al*. (1997); Patil *et al*. (1998). While plants that received microbein + 25% of recommended dose + 10 m^3/fed., chicken manure (Treatment 5); gave the highest time spanned until the occurrence of first flower, during both seasons of the study. The increments in number of gyneocious flowers were due to the treatments of microbein + 25% of recommended dose + 10 m^3/fed. chicken manure (Treatment 5), during both seasons, could be accounted for higher accessibility and the absorbance of nutritive elements *via* path organic and inorganic fertilizers in addition to the role of bio-fertilizers in enhancing production of plant growth promoting substances, i.e. cytokinins, auxins, gibberellins etc. which exert significant effects on initiation and of flower initials and their developing. The obtained results are in compliance with these reported by Nirmala *et al*. (1999); Singh *et al*. (1995); Anjanappa *et al*. (2012). On the other hand, the lowest number of gyneocious flowers were produced from treating the plants with microbein + 5 m^3/fed. chicken manure (Treatments 1).

3. Yield and its components:

Data presented in Tables (8 and 9) expressed that both combinations among microbein + 25% NPK of the recommended dose +10 m^3 /fed. (Treatment 5) and microbein + 50% NPK of the recommended dose (Treatment 8); recorded the highest mean values of the give traits (i.e. number of fruit, average fruit weight, fruit and early yield /plant, early and Total yield / m^2) during both seasons. In the case of fruit dry weight percentage character, the highest percentage was obtained from treatment of microbein + 75% of NPK recommended dose + 5 m^3/fed. chicken manure (Treatment 10).

Table (7). Effect of bio-, mineral and organic fertilizers on some flowering characters of Cucumber plants during 2014/2015 and 2015/2016 growing seasons.

Treatment No.	Time spanned to the first flower appearance (days)		Number of flowers/ Plant	
	2014/2015	2015/2016	2014/2015	2015/2016
1	32.33CD	30.33D	52.33DE	51.67G
2	34.00BC	32.67A-D	53.33C-E	53.67FG
3	35.00A-C	30.33D	52.00E	52.67FG
4	35.33A-C	30.67D	58.33B-E	65.00DE
5	37.33A	34.33AB	73.33A	76.67A
6	35.67AB	34.33AB	60.67B-D	67.33B-E
7	33.00B-D	31.67B-D	58.67B-E	65.67C-E
8	34.67A-C	33.00A-D	66.67AB	72.00AB
9	35.67AB	34.00A-C	59.00B-E	64.00E
10	30.67D	31.00CD	59.33B-E	70.33B-D
11	32.33CD	32.67A-D	61.33BC	70.67BC
12	33.00B-D	35.33A	59.00B-E	66.67B-E
13	30.00D	30.00D	57.00C-E	57.67F

Values having the same alphabetical letter in common, within each column, do not significantly differ, using the revised L.S.D. test at0.05 level of probability.

Table (8). Effect of bio-, mineral and organic fertilizers on yield characters of cucumber plants fruits during 2014/2015 and 2015/2016 growing seasons.

Treatment No.	No. fruit per plant		average fruit weight (g)		fruit yield/ plant (kg)		early yield/ plant (kg)	
	2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016
1	44.33E	43.00F	81.90D	74.33G	3.60E	3.19F	0.91EF	0.77E
2	44.00E	41.67F	86.53CD	81.00F	3.80E	3.37F	0.99EF	0.93 DE
3	45.00E	41.67F	86.27CD	81.00F	3.90E	3.44F	0.84F	0.90DE
4	52.67CD	52.33B-E	92.90A-C	100.00D	4.90CD	5.23B-D	1.64B	1.57BC
5	63.33A	56.67AB	91.83A-C	105.30AB	5.80A	5.95A	2.10A	2.17A
6	54.3B-D	58.00A	95.77AB	94.00E	5.20BC	5.43B	1.38C	1.65B
7	51.33CD	53.00B-D	97.33A	101.30BC	5.00CD	5.37BC	1.72B	1.43BC
8	60.00AB	55.67A-C	96.20AB	107.70A	5.76AB	5.99A	2.10A	2.10A
9	53.67CD	51.67C-E	93.13A-C	101.00BC	5.00CD	5.29BC	1.38C	1.52BC
10	54.67BC	53.00B-D	93.30A-C	101.70BC	5.10CD	5.38B	1.69B	1.62BC
11	51.67CD	50.00DE	90.83A-D	100.30D	4.70CD	5.01CD	1.70B	1.51BC
12	52.67CD	51.00DE	87.23B-D	96.33DE	4.60D	4.91D	1.30CD	1.40C
13	48.67DE	48.00E	82.10D	84.33F	4.00E	4.048E	1.10DE	1.09D

Values having the same alphabetical letter in common, within each column, do not significantly differ, using the revised L.S.D. test at 0.05 level of probability.

Table (9). Effect of bio-, mineral and organic fertilizers on yield characters of cucumber plants fruits during 2014/2015 and 2015/2016 growing seasons.

Treatment No.	early yield/m^2(kg)		total yield/m^2(kg)		fruit dry matter(%)	
	2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016
1	2.48E	2.11E	9.75D	8.65F	4.80A	3.80D-F
2	2.68EF	2.52DE	10.30D	9.14F	4.60AB	4.60A-E
3	2.29F	2.45DE	10.57D	9.34F	4.40AB	5.20A-C
4	4.46B	4.26BC	13.28C	14.18B-D	4.60AB	5.30AB
5	5.69A	5.89A	15.72A	16.15A	4.90A	3.30EF
6	3.75C	4.48B	15.00AB	14.72B	4.90A	4.10B-E
7	4.67B	3.92BC	13.55BC	14.56BC	4.60AB	5.00A-D
8	5.69A	5.70A	15.63A	16.24A	4.20AB	2.60F
9	3.74C	4.11BC	13.55BC	14.34BC	3.70B	4.00B-E
10	4.58B	4.39BC	13.82BC	14.60B	4.60AB	5.70A
11	4.60B	4.09BC	12.74C	13.59CD	5.00A	3.90C-F
12	3.52CD	3.80C	12.46C	13.32D	5.10A	3.60EF
13	2.99DE	2.96D	10.84D	10.97E	4.70AB	3.70D-F

Values having the same alphabetical letter in common, within each column, do not significantly differ, using the revised L.S.D. test at 0.05 level of probability.

Increased fruit yield in the combination among microbein + 25 or 50% NPK of the recommended dose +10 m^3/fed. chicken manure could be attributed to the lowest number of days spanned for flower emergence, production higher number of flowers, number of fruits/plant and highest average fruit weight which were positively contributes towards fruit's yield. Increased yield was correlated to balanced nutrition, better uptake of nutrients by plants which assisted for good fruit set and yield. More yield of cucumber in this investigation could be attributed to the impact of fertilizers' mixture which encourages photosynthesis by more production of endogenous plant growth substances. The profound effect of both bio-and organic fertilizers on yield and quality of cucumber's outcomes may be attribute to either the execute or pass off growth promoting substance such as cytokinins (Tomer *et al.*, 1995), the auxin Indole acetic acid (Marha *et al.*, 2000), gibberellins like substances (Brown *et al.*, 1995) and /or *via* releasing siderophores compounds (Marin *et al.*, 2001) that function as chelating agents for iron elements acting its function to enhance the facilitating of iron for different biophysical and biochemical activities of cucumber plants. The indirect effect of microbein is basically through or *via* amelioration of soil structure and by means of the delivery or discharge of polysaccharides- like substance which enhance the soil physical and chemical properties (Hamdi, 1982). Both combinations of treatments T5 and T8; caused a high improvement in plant hormones as auxin as IAA and GAs in addition to the vitamin "Biotin, folic acid and vitamin B group" of bio-fertilizer in addition to the impact of organic fertilizer as a source of slow releasing nutritive elements and rapid dissolved NPK elements as a mineral (inorganic) fertilizer represent a synergism of combination components that to be available for plants to improve the plants quantitative vegetative growth [plant height, leaf number /plant ,branches number plant, fresh and dry weight of plants and plant greenness (SPAD readings] and qualitatively (fruit length, diameter, shape index, fruits sugars, titratable acidity, vitamin C, and T.S.S.). The above-mentioned findings are in conformity with those of Sarhan (2008) on potato and Sarhan *et al*. (2011) on summer squash. The obtained data disclose that devoid or the absence of NPK fertilizer at any rates from the combined mixture (i.e. treatments 1, 2 and 3) or adding NPK at 100% alone (Treatment 13) brought about the lowest mean values of the given traits, during both seasons.

4. Fruit quality characters

4.1. Fruit length, diameter and shape index

Data in Table (10) revealed that the cucumber plants which fertilized with microbein + 25% NPK of recommended dose + 10 m^3/fed. chicken manure (Treatment 5); led to the longest fruits and the highest mean values of fruit shape index during both season. Meanwhile, the combination of microbein + 50 % NPK of a recommended dose + 10 m^3/fed. chicken manure (Treatment 8), caused the highest values for fruit diameter. The highest mean values of fruit length and diameter may be brought about due to the impact of bio-fertilizer (microbein) which involves life effective bacteria which have the capability to fix nitrogen, and they have the ability to provide some micronutrients, and phytohormones as cytokinin-like, auxin-like, and gibberellins-like substances. Additionally, the slow releasing of the organics NPK which need a mineralization process that provides for long time and mineral NPK of the rapid release, both play the major role in this respect.

Table (10). Effect of bio-, mineral and organic fertilizers on some fruit quality characters of cucumber plants during 2014/2015 and 2015/2016 growing seasons.

Treatment	Fruit length (cm)		Fruit diameter (cm)		Fruit shape index	
No.	2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016
1	14.33E	13.03G	2.86A-C	2.80F	5.03BC	4.66D
2	14.47DE	13.73F	3.10AB	2.90EF	4.67C	4.73CD
3	14.91B-E	13.70F	2.98A-C	2.96DE	4.99BC	4.62D
4	. 15.50A-D	15.57BC	2.91A-C	3.06B-D	5.39A-C	5.07AB
5	16.07A	16.07A	2.71C	3.20AB	5.92A	5.02A-C
6	15.28A-E	14.87D	3.10AB	3.03C-E	4.92BC	4.90A-D
7	15.87AB	15.63BC	3.10AB	3.13A-C	4.99BC	4.98A-C
8	15.98AB	15.93AB	3.18A	3.23A	5.16A-C	4.92A-D
9	15.91AB	15.73A-C	2.80BC	3.10A-D	5.68AB	5.07AB
10	15.61A-C	15.77A- C	3.20A	3.10A-D	4.86C	5.08AB
11	15.36A-E	15.67BC	3.13AB	3.13A-C	4.88C	4.99A-C
12	15.40A-E	15.53C	2.98A-C	3.00C-E	5.20A-C	5.17A
13	14.60C-E	14.20E	2.95A-C	2.96DE	4.93BC	4.79B-D

Values having the same alphabetical letter in common, within each column, do not significantly differ, using the revised L.S.D. test at0.05 level of probability.

Further, the phytohormones-like substance affect, also, fruit (length, diameter and shape index) *via* their functions on cell growth indirectly (longitudinal and equatorial), subsequently all the fruit characters (El-Sayed *et al*., 2015). However, the obtained data are in agreement with those reported by Shebl (2002) who stated that squash fruit length and diameter were, significantly, increased due to applying of 50% of mineral NP+ bio-fertilizers (nitrobein

+phosphorein + microbein). In this connection, EL Sayed *et al*. (2015) reported that application of 75 % mineral NPK recommended dose in combination with bio-fertilizers of nitrobein and phosphorin; gave the highest mean values of cucumber fruit length and diameter. On the other extreme, cucumber's plants fed with microbein + 5 m^3/fed. chicken manure (Treatment 1), possessed the lowest mean values of the fruit's characteristics (i.e. fruits length, diameter and index) during both seasons of the study compare to the other treatments. Also, Hassouna *et al*. (1998) reported that the lowest records of cucumber fruit shape were an achieved by the low level of N, P or NP (25% in combination with bio-fertilizers during both seasons of their study).

4.2. Fruits reducing, non-reducing and total sugars

Data in Table (11) disclosed that the highest percentage of reducing sugars, during the first season (2014/ 2015), the highest percentage was recorded due to fertilizing the plants with mineral nutrition i.e with 100% NPK of the recommended dose only (Treatment 13). This finding could be attributed to the nature of inorganic or mineral fertilization (NPK) as salts capable of increasing soil salinity and lead to increase the osmotic pressure of soils water potential formation *via* activation many reactions involved in carbohydrates metabolism. On the other hand, the lowest value was obtained due to supplying the plants with a combination of microbein + 50% NPK of recommended dose +15m^3/fed. of chicken manure (Treatment 9). In another way, it has been known that NPK are salts capable of inducing such stress caused by these salts presented in soil, which change water status and brings about osmotic effects outside the cells leading to hypertonic state (water drowns out of the cells by osmosis) accompanied with water deficit, and accumulation of compatible solutes (soluble sugars, proline, glycine, betaine, free amino acids and polyamine) which may help to maintain the relatively higher water content obligatory for plant growth and cellular functions (Ranganayakulu *et al*., 2013), achieved clearly in form and of reducing sugars. In the second season (2015/2016), the highest percentages were occurred at two treatments due to fertilization of the plants with mineral nutrition, i.e with 100% NPK of the recommended dose only (Treatment 13), also when the plants were fertilized with microbein + 50% NPK of the recommended dose +15m^3/fed. chicken manure (Treatment 9) and owing to fertilizing the plants with a combination of microbein + 75% NPK of the recommended dose + 10m^3/fed. of chicken manure (Treatment11). Meanwhile, the lowest percentage was reported due to enrichment the plants with microbein + 25% NPK of the recommended dose + 5m^3/fed. of chicken manure (Treatment 4). This result may be attributed to as synchronization of availability of the proper forms of nutritive elements *via* organic or inorganic fertilization in addition to the bio-fertilization, or this combination wasn't the appropriate formulae to achieve better feedback of the given trait. By other words, organic manure mineralizes and uptake slowly, compare to the inorganic fertilization NPK which release readily to the plants which may affect microbein function. These finding could be accounted to the presence of nitrogen either in mineral or in combination with the other two resources (organic and bio-fertilization) which could activate many enzymes having a direct effect on photosynthesis and might increase the dry matter and subsequently enhanced reducing sugar content or many enzymes involved in metabolism of reducing sugar content (Mottaghian *et al*., 2008).

Table (11). Effect of bio-,mineral and organic fertilizers on some fruit quality characters of cucumber plants during 2014/2015 and 2015/2016 growing seasons.

Fertilization treatment	Fruits sugars as % of dry weight					
	Reducing sugars		Non-reducing sugars		Total sugars	
	2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016
1	2.15DE	2.97AB	2.04BC	0.32G	4.20B-D	3.30EF
2	2.68BC	3.00AB	1.62D-F	0.65FG	4.30BC	3.65DE
3	2.96AB	2.97AB	0.59G	0.31G	3.55E	3.28EF
4	2.30DE	1.13D	1.89B-D	1.83AB	4.19B-D	2.96F
5	2.30DE	2.35C	1.45EF	1.08C-E	3.75DE	3.44EF
6	2.38CD	3,15A	1.72C-E	0.80D-F	4.10B-D	3.95CD
7	2.65BC	2.95AB	1.30F	1.12C-E	3.95C-E	4.07CD
8	2.37CD	2.77AB	2.20AB	1.92A	4.57AB	4.70A
9	1.98E	3.08A	1.82CD	1.49BC	3.78DE	4.57AB
10	2.14DE	3.00AB	1.74C-E	1.15CD	3.89C-E	4.16BC
11	2.35CD	3.12A	2.49A	0.55FG	4.85A	3.68C-E
12	2.09DE	2.90.AB	1.90B-D	1.91AB	4.32BC	4.81A
13	3.25A	3.02A	0.85G	0.72E-G	4.00C-E	3.75C-E

Values having the same alphabetical letter in common, within each column, do not significantly differ, using the revised L.S.D. test at 0.05 level of probability.

As for the non-reducing sugars (i.e. sucrose), data divulged that during the first and second seasons the highest mean values were recorded upon addition the combinations that consisted of microbein + 75% of NPK recommended dose + 10 m^3/fed. chicken manure (Treatment11) and the combination of microbein + 50% NPK of recommended dose +10 m^3/fed. of chicken manure (Treatment 8), each in turn. While the lowest percentage was achieved due to fertilizing the plants with microbein + 15m^3/fed. chicken manure (Treatment 3). In terms of total sugars during the first season (2014/ 2015), the highest percentage was recorded when the plants were fertilized with microbein +75% NPK of the recommended dose +10m^3/fed. chicken manure (Treatment11), meanwhile the lowest percent was due to fertilizing the plants with microbein + 15m^3/fed. chicken manure (Treatment3). Meanwhile, during the second season (2015/2016), the highest percent of total sugars was recorded upon fertilizing the plants with microbein +75% NPK of the recommended dose + 15m^3/fed. chicken manure (Treatment12), while the lowest value was obtained due to fertilizing with a combination of microbein +25% NPK of the recommended dose +5m^3/fed. chicken manure (Treatment4) with no difference with treatment No.3.

4.3. Fruits titratable acidity, Vitamin C (Ascorbic acid) and TSS%

Data of Table (12) show that the highest percent values of acidity were recorded when the plants were fertilized with a combination of microbein + 10m^3/fed. chicken manure (Treatment 2), during both seasons.

Meanwhile, the lowest percent values of acidity were obtained when the tested plants were fertilized with microbein +50% of NPK recommended dose $+15m^3$/fed. of chicken manure (Treatment 9), during both seasons of the study. These findings may be taken place due to the presence of 50% NPK of recommended dose within the combination, and the synergistic effect of the combination among bio-, mineral and organic fertilizers as amendments. This is owing to the amelioration or amendment of soil chemical and physical properties and accessibility or facilitation of nutritive elements either mineralize slowly or rapidly and enhancement of bio-fertilizer (microbien) in turn improve plant growth and fruit production and their quality (Itoo and manivannan, 2004).

Results of Neri *et al*. (2002) support the data recorded in our study. Respecting vitamin C data disclosed that the highest values of the given trait (more or less) during both seasons, were recorded due to fertilizing the plants with a combination of microbein + 10 m^3/fed. chicken manure (Treatment 2). On the other extreme, the lowest value of vitamin C was recorded in the first season (2014/ 2015), when plants were fertilized with a combination microbein + 50 % NPK of recommended dose + 15 m^3 /fed. chicken manure (Treatment 9). While, during the second season (2015/ 2016) the lowest value was recorded upon treating the plants with a combination of microbein + 75 % NPK of recommended dose + 15 m^3/fed. chicken manure (Treatment 12).

This may be attributed to either the discharge or leakage of bio-fertilizer (microbein) to growth promoting substances as cytokinins (Tomer *et al*., 1995), the auxin Indole- acetic acid (Marha *et al*., 2000), gibberellins - like substances and /or releasing siderophyres substances (Marin *et al.,*2011) that function as chelating agent for iron element acting its function to enhance the facilitating of iron for different biophysical and biochemical activities, and then raised the content of vitamin C in cucumber plants. Further, this finding is also may account to releasing of organic acids as citric acid and malic acid, which are in charge for acidity of fruits trait to be more acid, hence effect on fruit quality (Taiwo *et al*., 2007). Furthermore, the indirect effect microbein is basically through or *via* ameliorate the soil structure and by means of the delivery or discharge of polysaccharides- like compounds which improve the soil physical and chemical properties and subsequently nutrition of fruits (Hamdi, 1982).

Table (12). Effect of bio-, mineral and organic fertilizers on some fruit quality characters (acidity, vitamin C (as ascorbic acid), and total soluble solids (°Brix) of cucumber plants during 2014/2015 and 2015/2016 growing seasons.

Treatment No.	Acidity %		Vitamin C% (Ascorbic acid)		TSS %(Brix)	
	2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016
1	0.20C	0.26C	6.40BC	5.86D	5.20C	3.49E
2	0.22A	0.33A	7.20A	6.52AB	5.60AB	3.69DE
3	0.19D	0.28BC	6.70B	6.28BC	3.90G	3.37E
4	0.13H	0.28BC	5.80DE	6.43AB	4.70DE	3.60DE
5	0.18E	0.33AB	6.00C-E	6.66A	4.90D	4.10CD
6	0.12 I	0.25C	4.50F	6.05CD	3.80G	3.86DE
7	0.16F	0.28BC	6.10CD	6.07CD	5.30C	4.49BC
8	0.20C	0.26C	6.60B	5.89D	5.80A	5.60A
9	0.12 I	0.25C	4.60F	6.53AB	4.50E	4.54BC
10	0.14G	0.26 C	4.80F	6.58A	4.60E	4.62BC
11	0.21B	0.25 C	5.90DE	6.11CD	5.40BC	3.79DE
12	0.18 E	0.29A-C	5.60E	5.53E	4.70DE	5.00B
13	0.21C	0.28A-C	6.40BC	6.52AB	4.20F	3.89DE

Values having the same alphabetical letter in common, within each column, do not significantly differ, using the Revised L.S.D. test at 0.05 level of probability.

Similar performance was obtained by Sarhan *et al*. (2011) on summer squash. This finding could be brought about due to the complementary effect of the three variables under the study to reduce the activities involved in vitamin C biosynthesis. As for total soluble solids of the fruits, data revealed that the highest Brix values of fruit juice were recorded during both seasons upon fertilizing the plants with a combination comprise microbein + 50 % NPK of recommended dose + 10 m^3/fed. chicken manure (Treatment 8). Meanwhile, the lowest values were recorded when the plants were fertilized with microbein + 15 m^3/fed. chicken manure (Treatment 3), during both seasons. These findings could be explained on the basis that the nutritional integration in the defined combination (Treatment 8) which their contents, rapidly, released nutritive elements (NPK) and slow release nutritive elements of organic fertilizer too, in addition to the key role of microbein, enhanced vegetative growth to photosynthize more photosynthates *viz* carbohydrates and starch which convert into sugars. In other words, due to the gradual and steady release of inorganic nutrients and gradual release of organic fertilizer during the whole both seasons, compare to those recorded the lowest values of T.S.S. Similar results were, also, reported by Voth *et al.* (1967) and El-Gizy (1978). Likewise, these findings may be taken place owing to the negative relationship between N-supplying and fruit sugar content could be attributed to that under high N conditions; greater amounts of carbohydrates probably directed and utilized in mounting vigorous vegetative growth and little proportion may be left to supply the growing fruits with sufficient carbohydrates. The observed reduction in fruit total soluble solids might be due to corresponding decrement in the sugar content which make up 70-80% of T.S.S as stated by Culpepper *et al*. (1935).

5. Plant chemical analysis

5.1. Leaf colour degree or chlorophyll index (SPAD)

Data presented in Table (13) demonstrated that the combination of the utilized fertilizers with the presence of applied bio-fertilizer (Microbein) +75% of NPK recommended dose +15m^3/fed. chicken manure (i.e. treatment 12) and the treatments of microbein + 25 or 50% of NPK recommended dose + 10m^3/fed. chicken manure (Treatments 5 and 8); registered the highest SPAD reading. The absence of NPK mineral fertilizer; led to the lowest mean values of SPAD readings, regardless the presence of the both bio-fertilizer (microbein) and organic fertilization at various added amounts (Treatments 1, 2 and 3). This finding could be gave rise to the very close relationship between chlorophyll and nitrogen content especially in mineral (inorganic) forms (Field and Mooney, 1986; Amaliotis *et al.*, 2004). Also, it is an acceptable finding owing to considering nitrogen as a structural element of chlorophyll and protein molecules, thereby affects the formation of chloroplasts and accumulation within or inside them (Tucker, 2004; Daughtry *et al.*, 2000). Meanwhile, the combination of the utilized fertilizers as bio-fertilizer (Microbein) + 75% of NPK recommended dose +15m^3/fed. chicken manure (i.e. Treatment 12); registered the highest SPAD reading (49.23) compared with those recorded the lowest mean values. In our study, SPAD readings were found under low N supplementation conditions, but not under high N ones. This difference is mainly due to enlarged chloroplasts occupying almost the entire all space, which inhibited chloroplast movement under high N conditions.

Table (13). Effect of bio-, mineral and organic fertilizers on total chlorophyll content of cucumber plants during 2014/2015 and 2015/2016 growing seasons:

Treatment No.	Chlorophyll index (reading by (SPAD) units	
	2014/2015	**2015/2016**
1	36.33EF	43.80BC
2	34.30F	36.90C
3	39.00E	39.93BC
4	45.93BC	42.80BC
5	46.50A-C	51.13A
6	44.80B-D	41.50BC
7	37.33EF	41.83BC
8	47.80AB	43.60BC
9	43.5CD	42.40BC
10	42.50D	46.53AB
11	44.00CD	44.10AB
12	49.23A	43.40BC
13	44.00CD	46.30AB

Values having the same alphabetical letter in common, within each column and main factor, do not significantly differ, using the Revised L.S.D. test at 0.05 level of probability.

The proportionality between chlorophyll content and leaf N content per leaf area may vary because nitrogen partitioning among photosynthetic proteins changes in response to light, nitrogen supplementation and among species (Takashima *et al*., 2004). Xiong *et al.* (2015) declared that the proportion of leaf N allocated to chlorophyll increased with increasing leaf N content in monocot, but it decreased in dicot, which may be attributed to their structural differences. A portion effect of organic and inorganic fertilizers on chlorophyll contents might be due to the fact that N is a constituent of chlorophyll molecule. Moreover, nitrogen is the main constituent of all amino acids in proteins and lipids that acting as a structural compound of chloroplasts (Bader and Fekry, 1998; Arisha and Bradisi, 1999).

5.2. Chemical analysis of fruits and leaves characters

5.2.1. Chemical analysis of fruits

About the N content of cucumber fruits (% of dry weight), data presented in Table (14) declared that fertilizing the plants with microbein + 25% NPK of the recommended dose + 5m^3/fed. chicken manure (Treatment 5), caused the highest values of nitrogen during both seasons of the study (1.98 and 2.67%, respectively). Meanwhile, the lowest values (N %) as 1.30 and 2.09, each in turn were obtained when plants were fed with microbein + 50% NPK of the recommended dose + 10m^3/fed. chicken manure (Treatment 8). It is noticeable that doubling the amounts of mineral (inorganic) fertilizer and organic manure (Treatment 8) may assigned higher amount of fertilization (inorganic and organic fertilizers) directed, straight forward, for vegetative growth, and lesser portion of N accumulated, indirectly, within the fruit tissues. In this respect, Shen *et al.* (2010) reported that the activities of the enzymes of dehydrogenase, urease and neutral phosphatase, nitrification capacity, and microbial functional diversity were decreased, significantly, with increasing N application rate which may reflect negatively on fruits' N content. Meanwhile, the other combinations; caused an average values of N%, which may be owe to the variability in the accessible or available nutrients to the plants among different fertilization combinations. With respect to cucumber's fruits content of P (% of dry weight), data showed that fertifying the plants with microbein + 25 %NPK of recommended dose+ 5 m^3/fed. chicken manure (Treatment 4) or due to feeding the plants with microbein + 25 % NPK of recommended dose + 10 m^3/fed. chicken manure (Treatment 5) with no significant with one other treatment, led to recording the highest value of P for fruits during the first season (2014 /2015) as 0.53 and the highest one during the second as 0.44 when the plants amended with a combination of microbein + 15 m^3/fed. chicken manure (Treatment 3) or a combination of microbein + 25% NPK of recommended dose + 5 m^3/fed. chicken manure (Treatment 4). This could be taken place due to the balanced ratio among the tested items at the given combination (T5), which provide more phosphorus used for building up nucleic acids, phospholipids…. etc. which stimulate and directed major portion of it to be accumulate in the fruits. Meanwhile, the least significant values of P% content were recorded due to application of the treatments (T1, T10, T11, T12) during the first season (2014 /2015) as 0.37; 0.36; 0.37 and 0.36%, serially, and due to T7 in the second one as 0.27. In other words, these finding could be taken place due to the existence of chicken manure and its high contents of nitrogen, phosphorus and potassium than other manures (Ghanbarrcon *et al*., 2008) and data recorded in this study (Table 2), but its slow releasing during mineralization stage, brought about the minimum P content within fruit's tissues. Meanwhile, Garg and Bahl (2008) reported that poultry droppings readily supply phosphorus to plants than other organic wastes. As for potassium (K) fruits content, data declared that amendment the plants with the combination of microbein + 75 %NPK of recommended dose + 10 m^3/fed. chicken manure (Treatment 11), or microbein + 75 % NPK of recommended dose + 15 m^3/fed. (Treatment 12) without significant difference in the first season (2014/2015) as 2.43 or 2.71% and the combination of Treatment 11 as indicated earlier; gave the highest values in the second season (2015 /2016) as 5.52%. While, the lowest values of the defined trait as 1.01 and 0.99% during both seasons, respectively, may be caused due to supplement the culture soil with microbein as bio-fertilizer + 5 m^3/fed. chicken manure (treatment T1). This increment of K fruit's content could be accounted for the enrichment of soil of the three major elements (N, P, K) in the soil analyses during the second season (2015 /2016) compared to the first season (2014 /2015).

Table (14). Effect of bio-, mineral and organic fertilizers on mineral nutrient content of cucumber fruits during 2014/2015 and 2015/2016 growing seasons.

Treatment N0.	Nutrient contents of fruits (as % of dry weight)					
	N		P		K	
	2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016
1	1.81C	2.57AB	0.37D	0.37CD	1.01G	0.99G
2	1.40FG	2.15EG	0.41CD	0.39A-C	1.34FG	1.49F
3	1.59DE	2.35C-E	0.46A-C	0.44A	1.25FG	1.14G
4	1.84BC	2.13FG	0.49AB	0.42AB	1.86DE	3.87C
5	1.98AB	2.67A	0.53A	0.35CD	2.10B-D	4.36B
6	1.98AB	2.29D-F	0.49AB	0.39A-C	1.90C-E	3.21D
7	1.56DE	2.27D-G	0.40CD	0.26F	2.03B-E	4.00C
8	1.30G	2.09G	0.39CD	0.33DE	2.35A-C	4.03BC
9	1.59DE	2.45B-D	0.49 AB	0.29EF	2.11B-D	2.71E
10	1.60DE	2.53 A-C	0.36D	0.35CD	2.10B-D	4.14BC
11	1.47EF	2.68A	0.37D	0.35CD	2.43AB	5.51A
12	1.38FG	2.53A-C	0.36D	0.39A-C	2.71A	3.00DE
13	1.65D	2.24E-G	0.42 B-D	0.38 BD	1.58EF	3.20D

Values having the same alphabetical letter in common, within each column, do not significantly differ, using the Revised L.S.D. test at 0.05 level of probability.

5.2.2. Leaves N, P and K contents:

Data outlined in Table (15) manifested that fertilizing the cucumber plants with a combination of microbein + 25% NPK of recommended dose + 5m^3 /fed. chicken manure (Treatment 4); led to the highest percentage of leaf's N content as 3.06 and 3.04% within leaves' tissues during both seasons**.** While the highest percentages of P within leaf tissues was achieved during both season of the study (in spite of no significant differences among some other treatments) as 0.32 and 0.48%, when the plants were fed with a combination of microbein +75% NPK of recommended dose + 5m^3 /fed. chicken manure (Treatment 10). Meanwhile, the highest percentages of K within cucumber leaf tissues as 1.96

and 4.12%, consecutively, during both seasons (despite insignificant difference among some other treatment) were achieved when the cucumber plants were enriched with a combination of microbein + 50% NPK of recommended dose + 10m^3 /fed. chicken manure (Treatment 8). On the other hand, the lowest values of N, P, and K contents as 2.45, 2.39; 0.24, 0.37and 0.96%, orderly within leaf tissues were gained, generally, except for K content during the first year (2014/2015), were recorded when cucumber plants were fertilized with a combination of microbein + +5m^3 /fed. chicken manure (Treatment 1). Hence, the above- mentioned results reflect the positive effect of the presence of a combination among the three sources of nutritive constituents, especially in the presence of mineral fertilizer components, i.e. and neither its absence (Treatment 1) nor its presence alone (Treatment13). Subsequently, the critical balance among them especially at Treatment 4, declared its significant for the sake of high contents of N, P and K in leaf tissues. The present results are in conformity with those reported by many researchers as El-Sayed *et al.*, 2015).

Table (15). Effect of bio-,mineral and organic fertilizers on mineral nutrient content of cucumber leaves during 2014/2015 and 2015/2016 growing seasons:

Treatment No.	Nutrient contents of leaves (as % of dry weight)					
	N		P		K	
	2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016
1	2.45CD	2.39CD	0.24C	0.37C	1.92AB	0.96D
2	2.40CD	2.49C	0.30AB	0.44A	1.88 AB	1.00D
3	2.75A-C	2.37CD	0.30AB	0.38BC	1.71B	1.00D
4	3.05A	3.04A	0.33A	0.36C	1.89AB	2.94C
5	2.55B-D	2.54BC	0.26BC	0.46A	1.89AB	3.83AB
6	2.43CD	2.21D	0.31AB	0.42AB	1.95AB	2.78C
7	2.40CD	3.15A	0.32A	0.38BC	1.77B	3.12C
8	2.35D	2.76B	0.24C	0.37BC	1.95AB	4.12A
9	2.48B-D	2.52BC	0.34A	0.37C	2.24A	2.84C
10	2.65B-D	2.57BC	0.31A	0.47A	2.19A	3.09C
11	2.45CD	2.43CD	0.25C	0.45A	2.03AB	3.19BC
12	2.70A-D	2.48C	0.30AB	0.36C	1.99AB	2.70C
13	2.82AB	2.310CD	0.26BC	0.36C	1.16C	3.22BC

Values having the same alphabetical letter in common, within each column, do not significantly differ, using the Revised L.S.D. test at 0.05 level of probability.

In conclusion: Evidently, from these results, it may be concluded to use bio-fertilizer microbein with a low or moderate supply of NPK 25% or 50 % of recommended fertilization combined with 10 m^3/fed. of chicken manure to fertilize cucumber plants "Barracuda F_1 hybrid" grown under plastic houses. The efficiency of biofertilizer , in this respect, was more pronounced at the low and moderat levels (25% or 50 % NPK of recommended). These combination treatments gave the highest mean values of vegetative growth, yield and its components and fruit quality of cucumber plants, during winter season. Hence, this treatment combination will save some of the high costs of chemical fertilizers and may reduce the risk of environmental pollution.

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الملخص العربي

تأثير التسميد المعدني والعضوي والحيوي علي نباتات الخيار النامية تحت ظروف البيوت البلاستيكية

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أجريت هذه الدراسة بغرض إعداد برنامج تسميدي شامل يؤدي إلى زيادة إنتاجية وجودة محصول الخيار النامي تحت ظروف البيوت البلاستيكية. و كان الهدف من برنامج التسميد هو تحقيق أفضل توليفة من مختلف الأسمدة (الحيوية والعضوية والغير عضوية) التي تؤدي للحصول على أعلى محصول وجودة من نباتات الخيار وخصوصا خلال الموسم الشتوى. تم اجراء التجارب خلال موسمي ٢٠١٥/٢٠١٤ و٢٠١٦/٢٠١٥ في تصميم القطاعات

العشوائية الكاملة بثلاث مكررات. واشتملت كل مكررة على١٣ معاملة. ووزعت كل المعاملات بطريقة عشوائية داخل كل قطاع. وأظهرت النتائج المتحصل عليها أن المعاملة المكونة من التوليف بين السماد الحيوي الميكروبين + ٢٥٪ NPK من كمية السماد الموصى به + ١٠م^{٣} / فدان سماد داجني (معاملة ٥) أو بين الميكروبين + ٥٠٪ NPK من السماد الموصى به + ١٠ م^{٣} / فدان سماد اداجني (معاملة ٨)، قد أدت للحصول على أعلى متوسطات القيم من صفات النمو الخضري وقراءة SPAD. بينما النباتات المسمدة إما بالميكروبين + ٥م ^{٣} / فدان من السماد الدجني (معاملة ١) أو ١٠٠٪ من جرعةNPK الموصى بها (معاملة ١٣) سجلت أقل وقت لظهور أول زهرة من نبات الخيار. وكانت الزيادة في عدد الأزهار المؤنثة والنسبة المئوية لمحتوى الثمار من النيتروجين نتيجة التسميد بالميكروبين + ٢٥٪ من الجرعة الموصى بها من NPK + ١٠ م^{٣} / فدان سماد داجني (المعاملة٥) على حد سواء خلال موسمي النمو. كلا التوليفات بين الميكروبين + ٢٥٪ NPK من الجرعة الموصى بها + ١٠ م^{٣} / فدان سماد داجني (المعاملة ٥) والميكروبين + ٥٠٪ NPK من الجرعة الموصى بها + ١٠ م^{٣}/ فدان سماد داجني (المعاملة ٨) سجلت أعلى قيم المتوسطات للصفات المحصولية (أي عدد الثمار، ومتوسط وزن الثمرة والمحصول الكلي والمبكر للنبات، والمحصول الكلي والمبكر للمتر المربع) خلال موسمي النمو. في حالة النسبة المئوية للمادة الجافة في الثمار تم الحصول على أعلى نسبة من المعاملة بالميكروبين + ٧٥٪ من الجرعة الموصى بها من NPK + ٥ م^{٣} / فدان سماد داجني (معاملة ١٠). نباتات الخيار المسمدة بالميكروبين + ٢٥٪ NPK من الجرعة الموصى بها + ١٠ م^{٣} / فدان من سماد الدجاج (المعاملة ٥)، أدى للحصول على أعلى متوسطات القيم لطول الثمرة ومعامل شكل الثمرة خلال موسمي الدراسة.بينما النباتات المعاملة بالميكروبين + ٥٠٪ NPK من الجرعة الموصى بها + ١٠ م^{٣} / فدان سماد دجاج (المعاملة ٨) أدت للحصول على أعلى متوسطات القيم لقطر الثمرة ونسبة المواد الصلبة الذائبة الكلية. وتم الحصول على أعلى متوسطات القيم لصفتي النسبة المئوية للحموضة ومحتوى الثمار من فيتامين C عندما تم تسميد النباتات بالميكروبين + ١٠ م^{٣} / فدان من السماد الداجني (معاملة ٢) خلال موسمي النمو.

وبناء على النتائج المتحصل عليها يمكننا أن نستنتج أن المعاملة بالميكروبين + ٢٥٪ أو ٥٠% NPK من الجرعة الموصى بها + ١٠ م^{٣} / فدان من سماد الدواجن (المعاملة ٥ أو٨) قد أدت للحصول على أعلى متوسطات القيم لصفات النمو الخضري ومحصول وجودة ثمار نباتات الخيار مقارنة بالمعاملا ت الأخرى.

Using Biochar for Removal of Heavy Metals from Aqueous Solutions

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ABSTRACT: The rice straw waste (RSW), bagasse waste (BGW), sunflower seed cover (SSC) and black carbon (Charcoal (CHAR), Wood Coal (WC) and Biochar(BC)) were used as bio-sorbent materials. Biochar (BC) was obtained by pyrolysis the SSC under oxygen-limited atmosphere in a muffle furnace. A batch sorption experiments were carried out to study the role of bio-sorbents (RSW, BGW, SSC, CHAR, and WC) on removal of some heavy metals from aqueous solution. The equilibrium isotherms for each single heavy metal; Pb^{+2}, Ni^{+2}, Cd^{+2} and Co^{+2} onto the bio-sorbents were fitted. The removal efficiency ranged from 61.7 to 98.05% for SSC; from 65.13 to 92.10% for CHAR; from 57.10 to 98.88% for WC; and from 7.06 to 70.91% for BGW. The results indicated that BC has a high affinity for heavy metals (Pb^{+2}, Ni^{+2}, Cd^{+2} and Co^{+2}) sorption comparable with CHAR and WC. About 98.55% of heavy metals were removed using BC and about 96.79% was removed using WC and about 91.26% was removed using CHAR. The equilibrium sorption data have fit to some isotherm models. The new model (GK, three parameters model) proved to be more accurate and stable for describing the sorption of heavy metals on black carbon. The present study suggests that BC and CHAR are the most effective sorbents for heavy metals removal. The results are very useful for the removal of heavy metals from wastewater, making them suitable for agricultural purposes. The present study recommends a future studies are needed to verify removal efficacy of biochar from different sources for treating heavy metals-contaminated wastewater.

Keywords: sunflower seed cover, biochar, pyrolysis, charcoal, wood coal, sorption, heavy metals

INTRODUCTION

Heavy metals pollution is one of major important environmental problems today. Various industries produce and discharge wastes containing different heavy metals into the environment, Three kinds of heavy metals are of concern, including toxic metals (such as Hg, Cr, Pb, Zn, Cu, Ni, Cd, As, Co, Sn, etc.), precious metals (such as Pd, Pt, Ag, Au, Ru etc.) and radionuclides such as U, Th, Ra, Am, etc. (Wang and Chen, 2006).

The removal of metal ions from aqueous solution mainly consists of physical, chemical and biological technologies. Conventional methods for removing metal ions from aqueous solution have been suggested, such as chemical precipitation, filtration, ion exchange, electrochemical treatment, membrane technologies, adsorption on activated carbon, evaporation, etc.(Doijode, 2001).

A lot of materials have been investigated as bio-sorbents for the removal of metals or organics extensively. The bio-sorbents can be basically classified into the following categories: bacteria (e.g. *Bacillus subtillis*), fungi (e.g. *Rhizopus arrhizus*), yeast (e.g., *Saccharomyces cerevisiae*), algae, industrial wastes (e.g., S. cerevisiae waste biomass from fermentation and food industry), agricultural wastes (e.g. corn core) and other polysaccharide materials, etc. (Vijayaraghavan and Yun, 2008). These biomasses have been reported to bind a variety of heavy metals to different extents (Gupta *et al.*, 2000). Some potential biomaterials with high metal binding capacity have been identified in part. Some types of bio-sorbents bind and collect the majority of heavy metals with no specific priority, while others can even be specific for certain types of metals (Volesky and Holan, 1995).

In recent years, agricultural by-products have been widely viewed as inexpensive, convenient, and effective adsorbents for the treatment of heavy metals ions. Previous studies have revealed that agricultural waste materials, such as rice bran, bark of trees, groundnut shells, coconut shells, cotton seed hulls, waste tea leaves, orange peels, soybean hulls, sugar beet pulp, sunflower stalks, and cotton stalks can effectively remove heavy metals from aqueous solutions (Sud *et al.*, 2008). Agricultural waste materials have been used not only in their natural forms but also after some physical or chemical modifications (Chen, 2011a and b). In general, raw lignocellulosic bio-sorbents can be modified by various methods to improve their sorptive properties (Miretzky and Cirelli, 2010).

Mathematical modelling is the derived relation among the components present in a system. In the case of sorption process the components are equilibrium concentration, initial concentration, adsorbents doses, reaction/contact time, reaction rate etc. There are also some empirical models used for describing the sorption process. Modelling is the method of prediction of impact of any component on any other components as well as on the results. Nowadays, several computers simulated model is using for prediction of sorption in different biosorption process.

Equilibrium study provides fundamental information required to evaluate the affinity or capacity of an adsorbent, which is one of the most important criteria in selecting a suitable adsorbent (Yang *et al.,* 2010). Meanwhile, equilibrium behavior of an adsorption system is an essential prerequisite during mathematical modelling of the adsorption kinetics. A clear review of the various equilibrium isotherms and their applications is in the literature (Al-Duri *et al.,* 1995).

Bio-char is produced by pyrolysis of bio-materials such as agricultural waste, crop residues, forestry waste, industrial by-product, municipal waste and animal manure, in a zero or a low oxygen environment (Hunt *et al*., 2010). Biochar has a high in surface area and has negative surface charge density (Lehmann, 2006). Biochar is created from organic wastes which have undergone pyrolysis by heating at extremely high temperatures in the absence of oxygen (Chan *et al*., 2007). The bi-char is composed primarily of polyaromatic carbon and can resist decomposition for hundreds or more years (Doydora *et al*., 2011). The present study adopts a non-expensive and safe technology for removal of heavy metals (Pb, Cd, Ni and Co) from aqueous solution using some bio-sorbent materials including biochar.

MATERIALS AND METHODS

MATERIALS

Rice straw waste (RSW):

The rice husk waste was collected from a farm at Kafr Al-Dawar city , Egypt and dried in the oven at 105 C° for 24 hours then crushed and passed through a 0.50 mm sieve.

Bagasse (BG):

The sugar cane waste (bagasse, BG) was collected from the juices shops, dried in the oven at 105 C° for 24 hours and then crushed and passed through a 0.50 mm sieve.

Sunflower seeds cover (SSC):

Sunflower seed cover (SSC) was obtained from sunflower oil extraction factory .The SSC was washed with water and air dried, then oven dried at 70 C° for 48 hours, crushed and passed through 0.50 mm sieve.

Charcoal and Wood Coal:

The carbon used in the present study was charcoal (CHAR) obtained from El-Gomhouria Company for Trading Chemicals and Medical Supplies, Alexandria and wood coal (WC) was obtained from ready local markets. The two carbon sources were crushed and passed through 0.50 mm sieve.

Biochar:

The Bio-char was prepared from sunflower seed cover (SSC) and pyrolyzed under oxygen-limited atmosphere in a muffle furnace (mLm, VEB ELEKTRO BAD FRANKENHAUSEN, Russia) according to the method described by (Chun *et al*., 2004). The produced biochar was stored for the following experiments in air–tight containers. The biochar production rate was calculated using the following equation:

Production rate (%) = (M-Biochar/M-Raw material) × 100
Where: M-Biochar and M-Raw material are the mass of the biochar and its raw material, respectively.

The sunflower seed cover (SSC), Charcoal (CHAR), Wood Coal (WC) and Biochar (BC) were subjected to analysis by Scanning electron microscopy (SEM), Fourier Transform Infrared (FTIR) and X-rat diffraction (XPD). These methods were used to characterize their surface functional groups.

Scanning Electron Microscopy (SEM) was used for recognize the surface structure and morphology of the samples using a HITACHI S2600N-type scanning electron microscope (SEM), operating at 20kV in vacuum. The SEM studies were performed on powder samples. For the elemental analysis the electron microscope was equipped with an energy dispersive X-ray attachment (EDAX/2001 device).

Fourier Transform Infrared spectra (FTIR) were recorded. The functional groups present in the prepared powder and in the powders calcined at different temperatures were identified by FTIR (Spectrum BX Spectrometer). For this 1% of the powder was mixed and ground with 99% KBr, then the spectrum was taken in the range of 4400 to 350 cm^{-1} .

X-ray Photoelectron Spectroscopy (XPS) is one of the most important techniques for the study of the evidence for successful doping of Eu+3 in Eu:HAp. It can be said that the surface sensitivity (typically 40–100 Å) makes this technique ideal for measurements as oxidation states or biomaterials powder. In this analysis we have used a VG ESCA 3 MK II XPS installation (Ekα = 1 486.7 eV). The vacuum analysis chamber pressure was p ~ 3×10-8torr. The XPS recorded spectrum involved an energy window w = 20 eV with the resolution R = 50 eV with 256 recording channels. The XPS spectra were processed using Spectral Data Processor v 2.3 (SDP) Software.

METHODS

The batch sorption of heavy metals (EXP 1):

Stock solutions of the Pb^{2+}, Ni^{2+}, Cd^{2+} and Co^{2+} 1000 mg/l were prepared from analytical grade of high purity salts ($Pb(NO_3)_2$, $Ni(NO_3)_2$-$6H_2O$, $Cd(NO_3)2$-$4H_2O$ and $Co(NO_3)_2$-$6H_2O$ in 5% HNO_3). Subsequent dilutions of 2.3438, 0.1021, 0.4067 and 1.0045 mg/l for Pb^{2+}, Cd^{2+}, Co^{2+} and Ni^{2+}, respectively were prepared by suitably diluting stock solution with double distilled water. The experiments were performed in 100 ml flasks containing 50 ml of heavy metals with different concentrations plus 0.5 g of RSW, SSC, BGW, CHAR and WC Pb biomass with three replicates for each experiment. The mixture was shaken in a rotary shaker at 50 rpm for one hour followed by filtration using Whatman filter paper (No.1). The filtrate containing the residual concentration of heavy metals was stored for analysis.

The batch sorption of heavy metals (EXP 2):

Was done with CHAR, WC and BC using concentrations of 1, 2.5, 5.0 and 10.0 mg/l for Pb; 0.1, 0.5 , 1.0 and 2.0 mg/l for Cd; 0.1, 0.5, 1.0 and 2.0 mg/l for Ni and 0.1, 0.5, 1.0, 2.0 and 5.0 mg/l for Co. The experiments were performed in 100 ml flasks containing 50 ml of heavy metals with different concentration plus 0.5 g of the materials with three replicates for each experiment. The mixture was shaken in a rotary shaker at 50 rpm for one hour followed by filtration using Whatman filter paper (No.1).

The filtrate was analyzed for the tested heavy metals using Plasma Spectrometry, ICP (Ultima 2 JY Plasma) according to Ivajlo *et al.* (2008). The data were fitted using some sorption models.

According to Sethuraman and Balasubramanian (2010), the percentage of heavy metals removal was calculated as follows:

$$\text{Removal (\%)} = \frac{C_0 - C_e}{C_0} \times 100 \qquad (1)$$

Where, C_o and C_e represent the initial and equilibrium concentrations of heavy metals.

According to Vijayaraghavan *et al*. (2006); Vieira and Volesky (2003) the equilibrium sorption capacity was calculated by:

$$q_e = \frac{(C_0 - C_e) \times V}{m} \qquad (2)$$

Where;
q_e = equilibrium sorption capacity (mg/g),
V = suspension volume (l),
m = mass of sorbents material (g),
C_e = ions concentration at equilibrium (mg/l), and
C_0 = initial ions concentration (mg/l)

To study and compare the sorption of heavy metals on sorbent materials, the sorption data were fitted to some sorption models using software IsoFit (Matott and Rabideau, 2008), and the results are shown in Table (1).

Isotherm sorption models have been used to predict the ability of a certain adsorbent to remove a pollutant down to a specific discharge value. When a mass of adsorbent and a waste stream are in contact for a sufficiently long time, equilibrium between the amount of pollutant adsorbed and the amount remaining in solution will develop. For any system under equilibrium conditions, the amount of material adsorbed onto the media can be calculated using the mass balance of Equation (1):

$$\frac{x}{m} = (C_0 - C_e)\frac{v}{m} \qquad (3)$$

Where, x/m (typically expressed as mg heavy metal/kg media), C_o is the initial heavy metals concentration in solution, C_e is the concentration of the heavy metals in solution after equilibrium has been reached, v is the volume of the solution to which the media mass is exposed (L), and m is the mass of the media (g).

Table (1). Isotherm sorption models used in the present study

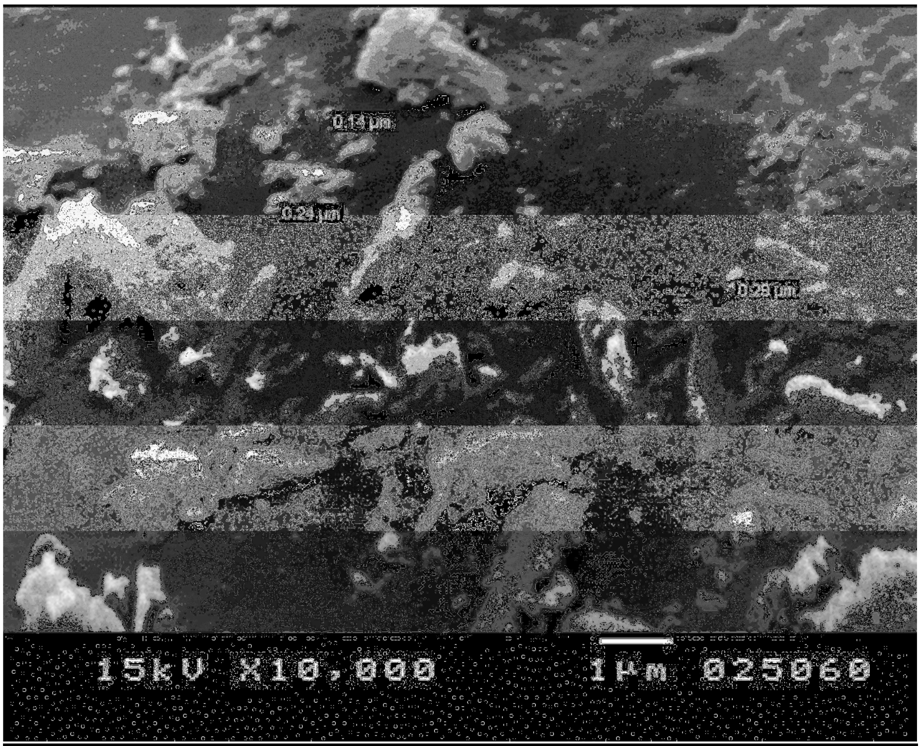
Isotherm model	Equation
Single parameter model	
Linear or Henry Faust and Aly(1987) Xue *et al.* (2001)	$q_e = K_{HE} C_e$ (4)
Two parameters model	
Freundlich Jain *et al.*(2003)	$q_e = K_F C_e^{1/n}$ (5)
Three parameters model	
GK New model	$q_e = \left(\frac{K_{GK1} C_e}{1 + K_{GK2} C_e}\right)\left[1 - \exp\left(-K_{GK3} C_e\right)\right]$ (6)
Four parameters model	
Fritz–Schluender II Fritz and Schluender (1974)	$q_e = \frac{A_{FS} C_e^{\alpha_{FS}}}{1 + B_{FS} C_e^{\beta_{FS}}}$ (7)
Five parameters model	
Fritz–Schluender III Fritz and Schluender (1974)	$q_e = \frac{\alpha_1 C_e^{\beta_1}}{\alpha_2 + \alpha_3 C_e^{\beta_2}}$ (8)

Notations

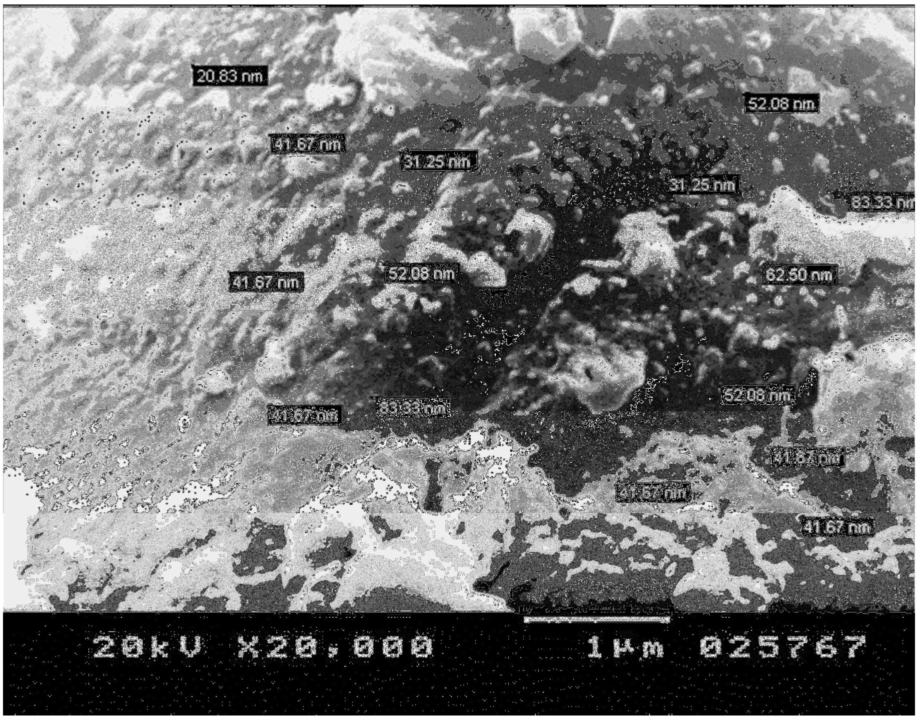
A_{FS} Fritz–Schluender four-parameter model constant
B_{FS} Constant in Fritz–Schluender four-parameter model
Ce Equilibrium concentration of sorbate in solution, mg L^{-1}
C0 initial concentration in solution, mg l^{-1}
K_{GK1} GK isotherm constant
K_{GK2} GK isotherm constant
K_{GK3} GK isotherm constant
K_F Freundlich isotherm constant, L g^{-1}
K_{HE} Henry's law constant, L g^{-1}
n Exponent in Freundlich isotherm
q_e Amount of sorbate sorbed at equilibrium, mg g^{-1}
q_t Amount of sorbate sorbed at time t, mg g^{-1}
R^2 Correlation coefficient
α_1 Fritz–Schluender five-parameter model sorption capacity, mg g^{-1}
α_2 Fritz–Schluender five-parameter model constant
α_3 Fritz–Schluender five-parameter model constant
α_{FS} Fritz–Schluender four-parameter model exponent
β_1 Fritz–Schluender five-parameter model exponent
β_2 Fritz–Schluender five-parameter model exponent
β_{FS} Fritz–Schluender four-parameter model exponent

RESULTS AND DISCUSSION

Scanning electron micrographs (SEM) images are very useful to obtain accurate details about surface structure of bio-sorbents. The comparison of the images between biochar and their raw materials (SSC) might then allow us to understand morphological changes during the carbonization stage (Ozcimen and Ersoy–Mericboyu, 2010). The SEM pictures of SSC and the BC produced at 400˚C are given in Plates 1 and 2, respectively. The surfaces of SSC and BC were imaged with many hollow channels in diameters of around 0.14 to 0.29 micrometers for SSC and from 20 to 83 nm for BC. These porous structures of the SSC and BC are likely to provide a high internal surface area, adsorption ability for heavy metals. The structural difference may reflect the specific surface area and the adsorption capacity as environmental and cost–effective sorbents for nutrients or pollutants.

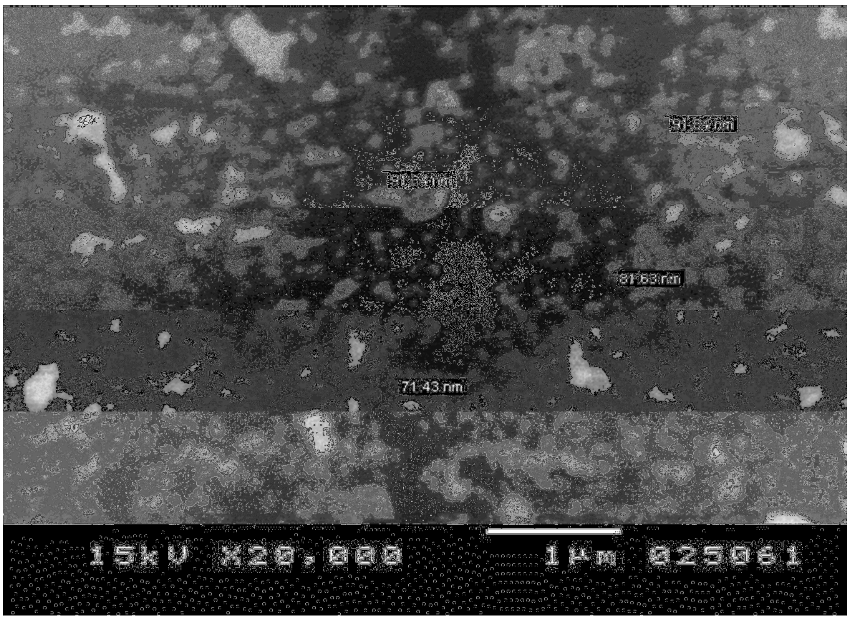


Plat (1). SEM micrograph of sunflower seed covers (SSC)



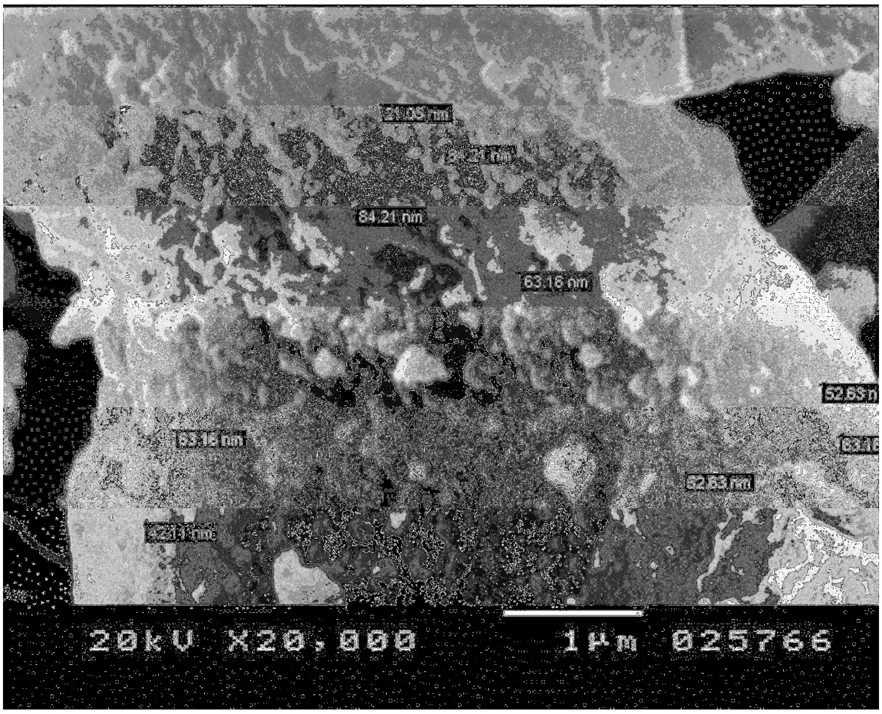
Plat (2). SEM micrograph of Biochar (BC)

Plat 3 shows the SEM image of Charcoal. It can be observed that the Charcoal is in the form of nano-spheres, which exist in contact with each other and form chains having diameters between 71 and 91 nm.



Plat (3). SEM micrograph of Charcoal (CHAR)

SEM Images of Wood Coal (WC) is presented in Plat 4. The spheres having diameters between 71 and 91 nm and can be distinguished from each other and is in agreement with SEM results.



Plat (4). SEM micrograph of Wood coal

The functional groups identified from the FTIR spectra for the SSC, CHAR, WC and BC samples are illustrated in Figures (1 to 4). The spectra of SSC demonstrated many bands at 1645 cm^{-1} (amides group), 1259 cm^{-1} (aromatic group), and 1150-1040 cm^{-1} (alkyl group), as shown in Fig.1. The spectra of Charcoal demonstrated many bands at 1635 cm^{-1} (amides, hydroxyarylketones, carboxyl groups), 1259 cm^{-1} (aromatic group), and 1150-1040 cm^{-1} (alkyl group), Fig. 2. The spectra of Wood Coal (WC) demonstrated many bands at 1640 cm^{-1} (amides group), 1023 cm^{-1} (carboxyl group), and 1150-1040 cm^{-1} (alkyl group), as shown in Fig. 3. The spectra of biochar demonstrated many bands at 1676 cm^{-1} (amides and carboxyl groups), 1459 cm^{-1} (amide group), and 549 cm^{-1} (alkyl group), as shown in Fig. 4.

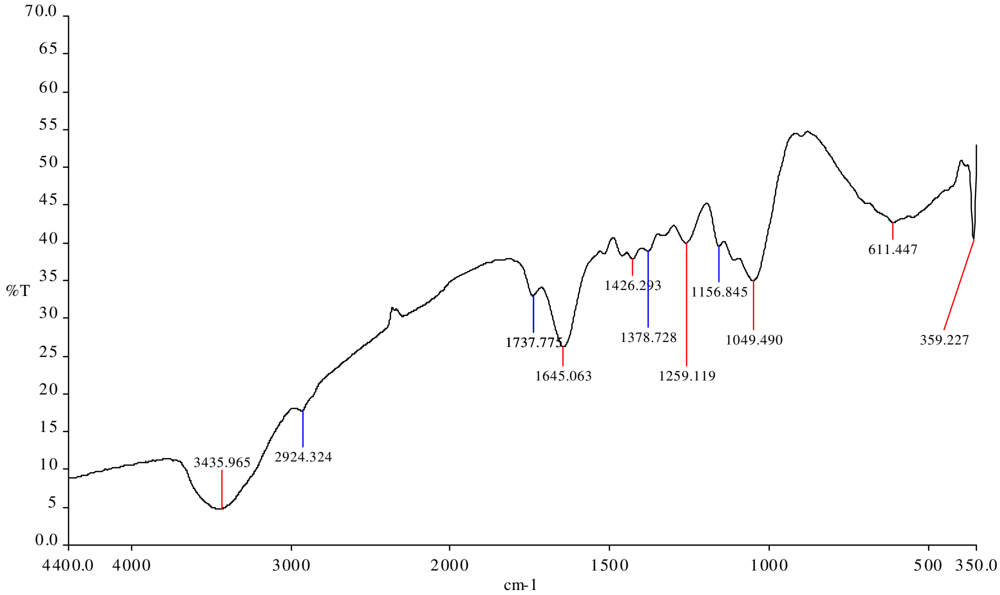


Fig. (1). FTIR Spectra of sunflower seed cover (SSC)

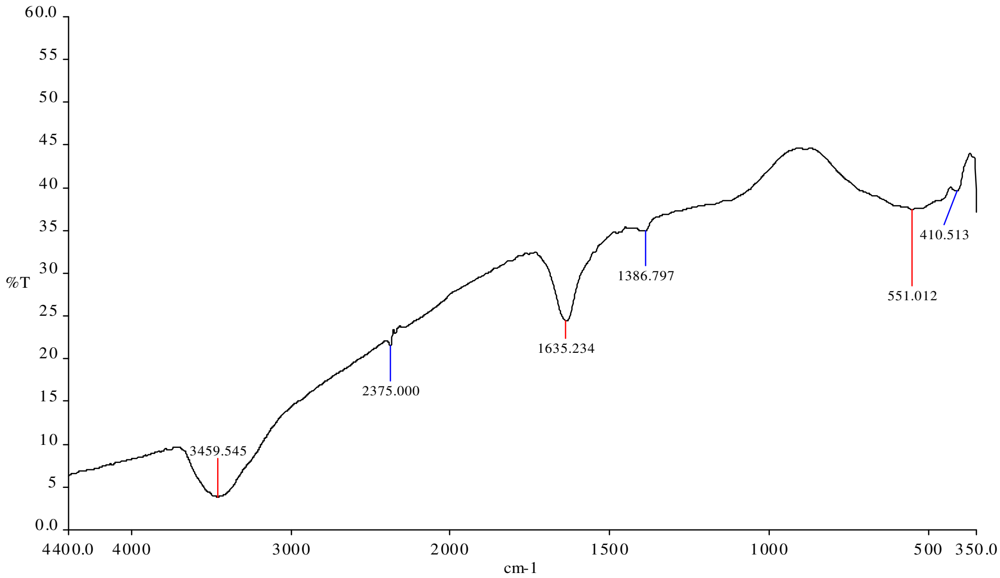


Fig. (2). FTIR Spectra of Charcoal (CHAR)

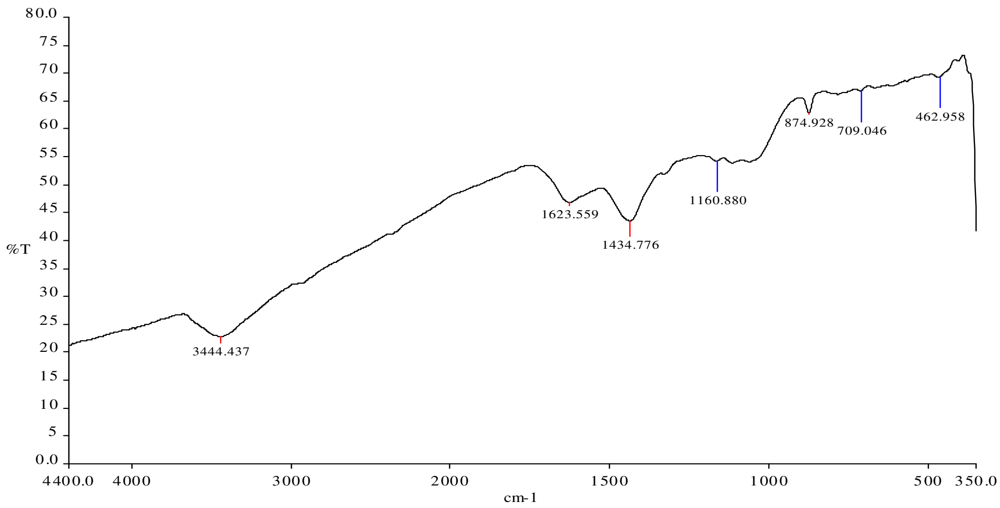


Fig. (3). FTIR Spectra of Wood Coal (WC)

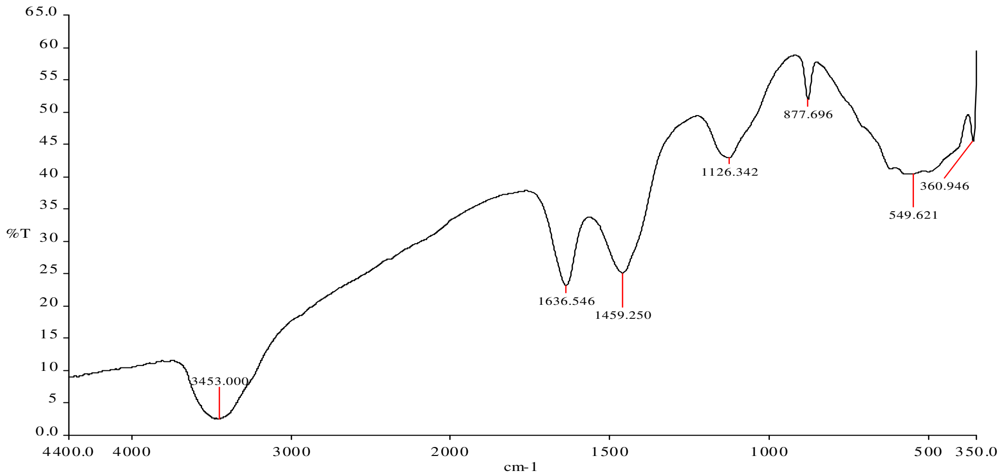


Fig. (4). FTIR Spectra of Biochar (BC)

Sorption of heavy metals

The equilibrium isotherms for each single heavy metal (Pb^{+2}, Ni^{+2}, Cd^{+2} and Co^{+2}) onto CHAR, Wood Coal, BGW, RSW, SSC are presented in Tables (2 to 5), respectively and Figs 5 to 8. From Table (2), it was observed that the three waste bio-sorbents (Bagasse; Rice straw waste and sunflower seed cover), each sorbed more than 50% of the initial concentration of the heavy metal ions from the aqueous solution. Actually, sunflower seed cover, charcoal and wood coal are the best bio-sorbents to remove the heavy metals from aqueous solution. The removal percentage ranged from 61.7 to 98.05% for sunflower seed cover; from 65.13 to 92.10% for charcoal; and from 57.10 to 98.88% for wood coal. According to Sethuraman and Balasubramanian (2010), The present results indicate that sunflower seed cover, charcoal, and wood coal are the best materials to remove the heavy metals from aqueous solution.

Table (2). Removal of lead (Pb) from aqueous solution using different bio-sorbents

Material	C_0 mg/l	Ce mg/l	S mg/kg	% Removal
Charcoal	2.3438	0.1049	223.89	95.52
Wood Coal	2.3438	0.0263	231.75	98.88
Bagasse	2.3438	0.8433	150.05	64.02
Rice straw waste	2.3438	0.1860	215.78	92.06
Sunflower seed cover	2.3438	0.0458	229.80	98.05

Table (3). Removal of nickel (Ni) from aqueous solution using different bio-sorbents

Material	C_0 mg/l	C_e mg/l	S mg/kg	% Removal
Charcoal	1.0045	0.0791	92.54	92.13
Wood Coal	1.0045	0.1609	84.36	83.98
Bagasse	1.0045	0.4270	57.75	57.49
Rice straw waste	1.0045	0.1588	84.57	84.19
Sunflower seed cover	1.0045	0.0467	95.78	95.35

Table (4). Removal of cadmium (Cd) from aqueous solution using different bio-sorbents

Material	C_0 mg/l	C_e mg/l	S mg/kg	% Removal
Charcoal	0.1021	0.0356	6.65	65.13
Wood Coal	0.1021	0.0438	5.83	57.10
Bagasse	0.1021	0.0297	7.24	70.91
Rice straw waste	0.1021	0.0376	6.45	63.17
Sunflower seed cover	0.1021	0.0391	6.30	61.70

Table (5). Removal of cobalt (Co) from aqueous solution using different bio-sorbents

Material	C_0 mg/l	C_e mg/l	S mg/kg	% Removal
Charcoal	0.4067	0.3259	8.08	19.87
Wood Coal	0.4067	0.1628	24.39	59.97
Bagasse	0.4067	0.3780	2.87	7.06
Rice straw waste	0.4067	0.2793	12.74	31.33
Sunflower seed cover	0.4067	0.0987	30.80	75.73

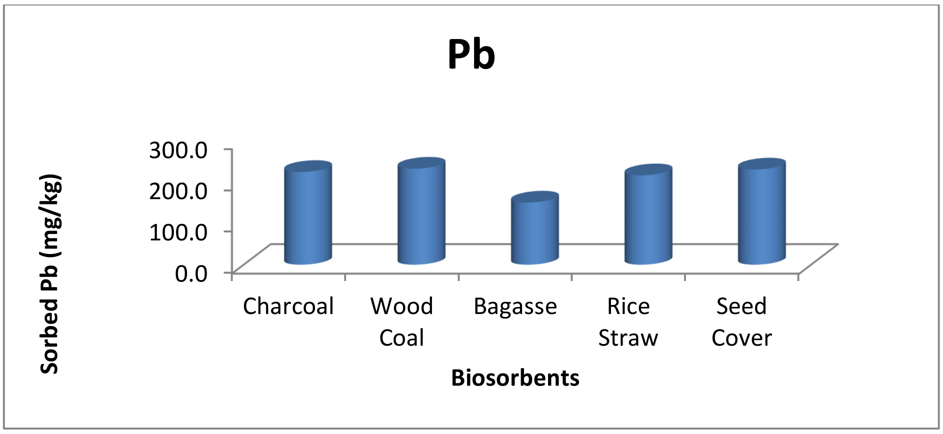


Fig. (5). Sorption capacity of Pb on bio-sorbents

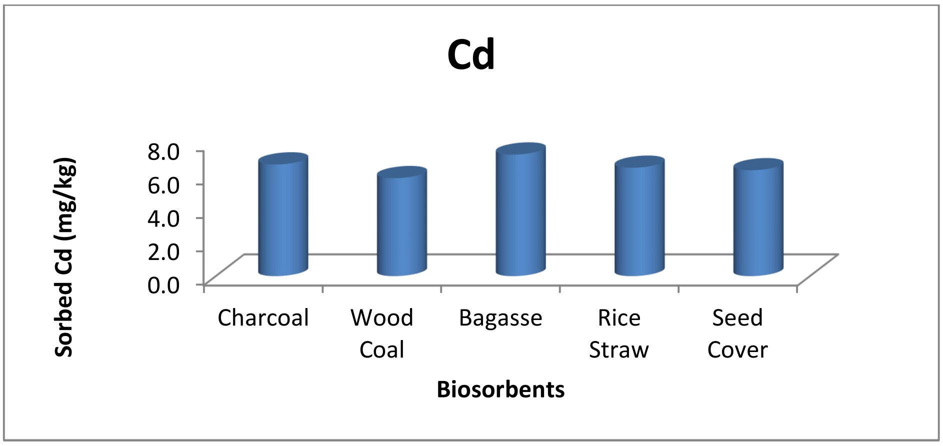


Fig. (6). Sorption capacity of Cd on bio-sorbents

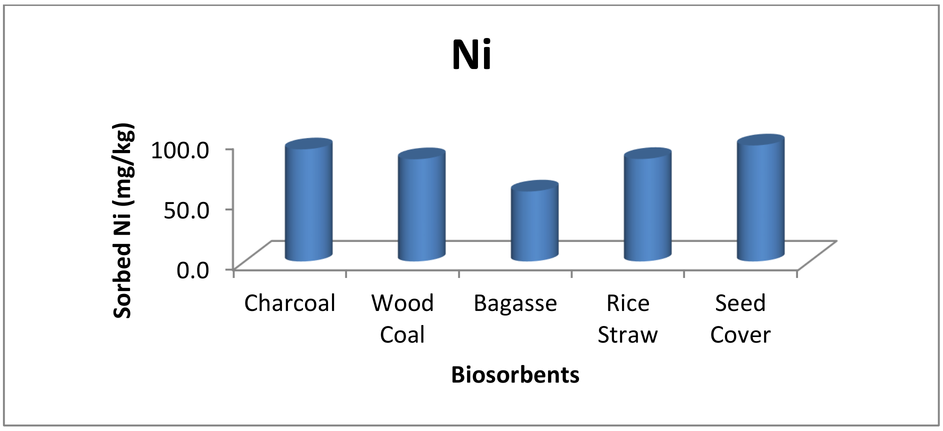


Fig. (7). Sorption capacity of Ni on bio-sorbents

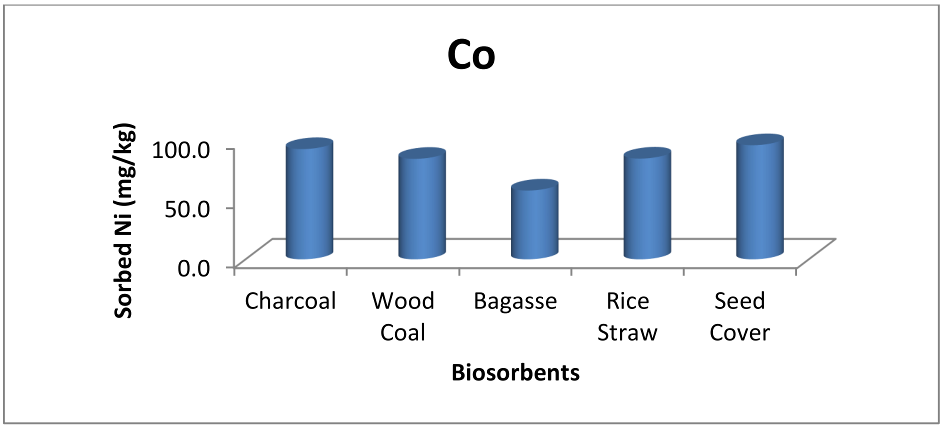


Fig. (8). Sorption capacity of Co on bio-sorbents

Effective sorption of heavy metals using agricultural by-products such as modified rice husk may be documented (Lee *et al*., 1998 and Kumar and Bandyopadhyay, 2006), rice husk activated carbon (Guo *et al*., 2002) and maize husk (Jogi and Ansari, 2003). In general, an adsorbent can be termed as a low cost adsorbent if it requires little processing, is abundant in nature, or is a by-product or waste material from another industry (Khan *et al*., 2004).

The present results are in agreement with Aqeel *et al*. (2011). The removal efficiencies of lead, copper, and zinc were increased as their initial concentrations in the polluted solution decrease. Khan *et al.* (2004) mentioned that the sorption capacity is depended on the investigated period of contact adsorbent and the nature of the wastewater.

Also, natural low-cost material for the removal of heavy metals by adsorption include rice straw (Hui *et al*., 2008), black gram husk (Holan and Volesky, 1994), sugarcane bagasse (Volesky and Holan, 2008) and wheat bran were studied. Rice straws proved to be the best bio-sorbents for Pb (II) and Ni (II) in aqueous solution. The biosorption characteristics fit well with Langmuir and Freundlich isotherm (Khalid *et al*., 2010). Also, Mathew (2008) stated that rice husk showed a maximum removal efficiency of 99.5% for Ni (II), 80.0 % for Cd (II), 72.8% for Cr (VI), 56.2% for Cr (III) and 40.0% for Cu (II).

Rice straw and sugarcane bagasse are abundant agro-residues. The sugarcane bagasse is currently used as a biofuel and in the manufacture of pulp and building materials. On the other hand, open field burning of rice straw frequently causes serious air pollution (Nelson *et al*., 1980). Thus a new technology for utilization of these agro-residues to a more value added material should be developed. Many researchers proposed the use of lignocellulosic waste as bio-sorbents for the removal of heavy metal ions in wastewater (Lee and Rowell, 2004).

Rice straw possesses high oxygen; which is largely fixed in hydroxyl group of polysaccharides. These groups help in biosorption process by making a complex between metal ions present in aqueous solution and oxygen of hydroxyl group.

Biosorption has been demonstrated as an efficient and economical method for the removal of heavy metals in wastewaters (Benguella and Benaissa, 2002). Several naturally available biomasses, such as seaweeds and wheat straw, can be used as bio-sorbents. Non-living microorganisms, seaweeds, crab shells and other waste biomasses have also been tested and shown as promising sources of bio-sorbents (Gadd, 1992; Vieira and Volesky, 2003).

The availability of a biomass at a low-cost is a key factor dictating its selection for a biosorption process. Biosorption was earlier considered to follow a mechanism similar to that of adsorption (Wagner and Jula, 1981). Several governing mechanisms of metal uptake by a biomaterial have been proposed, including chemisorption, complexation, chelation of metals, ion exchange, adsorption and micro-precipitation (Volesky, 2000). The metal binding depends on the bio-sorbents type, the metal ion species and concentration, temperature, pH, and ionic interference by other metal ions in the solution Sorption of heavy metals on Bio-char in comparison with Charcoal and Wood Coal were tested. Also, some sorption models such as linear, Freundlich, GK (new model), Fritz-Schluender II and Fritz-Schluender III were used for sorption description. Tables (6 to 9) show the equilibrium sorption of heavy metals. Tables (9 to11) show the parameters of all tested sorption models.

The results indicated that all tested models accurately fitted the sorption data where the determination coefficient (R^2) was more than 0.97. The sorption capacity was in the order of Cd > Ni > Pb > Co. Also, the ability of used materials was in the order of Biochar > Wood Coal > Charcoal where the average removal percent was 98.55, 96.79 and 91.26%, respectively.

Table (6). Equilibrium sorption of Pb on different black carbon (CHAR, WC and Bio-char)

C_0 mg/l	Charcoal			Wood Coal			Biochar		
	C_e mg/l	S mg/kg	Removal %	C_e mg/l	S mg/kg	Removal %	C_e mg/l	S mg/kg	Removal %
1.0	0.100	90.0	90.00	0.015	98.5	98.49	0.015	98.5	99.58
2.5	0.311	219.0	87.58	0.025	247.5	99.00	0.025	247.5	99.39
5.0	0.696	430.5	86.09	0.042	495.8	99.16	0.042	495.8	99.15
10.0	1.594	840.6	84.06	0.075	992.5	99.25	0.075	992.5	99.22

Table (7). Equilibrium sorption of Cd on different black carbon (CHAR, WC and Bio-char)

C_0 mg/l	Charcoal			Wood Coal			Biochar		
	C_e mg/l	S mg/kg	Removal %	C_e mg/l	S mg/kg	Removal %	C_e mg/l	S mg/kg	Removal %
0.1	0.001	9.9	98.90	0.001	9.9	98.70	0.000	10.0	99.70
0.5	0.007	49.3	98.62	0.003	49.7	99.34	0.001	49.9	99.72
1.0	0.020	98.0	98.01	0.006	99.4	99.42	0.003	99.7	99.72
2.0	0.053	194.8	97.38	0.010	199.1	99.53	0.005	199.5	99.77

Table (8). Equilibrium sorption of Ni on different black carbon (CHAR, WC and Bio-char)

C_0 mg/l	Charcoal			Wood Coal			Biochar		
	C_e mg/l	S mg/kg	Removal %	C_e mg/l	S mg/kg	Removal %	C_e mg/l	S mg/kg	Removal %
0.1	0.001	9.9	98.70	0.009	9.1	90.87	0.002	9.8	98.00
0.5	0.024	47.6	95.26	0.028	47.3	94.50	0.006	49.4	98.76
1.0	0.062	93.9	93.85	0.050	95.0	94.97	0.010	99.1	99.05
2.0	0.145	185.5	92.73	0.110	189.1	94.53	0.018	198.2	99.10

Table (9). Equilibrium sorption of Co on different black carbon (CHAR, WC and Bio-char)

C_0 mg/l	Charcoal			Wood Coal			Biochar		
	C_e mg/l	S mg/kg	Removal %	C_e mg/l	S mg/kg	Removal %	C_e mg/l	S mg/kg	Removal %
0.1	0.008	9.2	91.90	0.007	9.3	92.90	0.005	9.5	94.70
0.5	0.055	44.5	89.04	0.018	48.2	96.46	0.012	48.8	97.54
1.0	0.155	84.5	84.53	0.036	96.4	96.37	0.021	97.9	97.87
2.0	0.395	160.5	80.24	0.072	192.8	96.38	0.040	196.0	98.02
5.0	1.102	389.9	77.97	0.198	480.2	96.04	0.099	490.1	98.02

The results indicated that biochar has a high affinity for heavy metals (Pb^{2+}, Ni^{2+}, Cd^{2+} and Co^{2+}) sorption comparable with Charcoal and Wood Coal. Biochar is high in the surface area and has negative surface charge density (Lehmann, 2006). These properties increase the capacity of the biochar to hold nutrients and became more stable (Tables 10 to 12). The new model (GK, three parameters model) proved to be more accurate and stable for describing the sorption of heavy metals on black carbon.

Table (10). Parameters of some models for heavy metals sorption on Charcoal

Sorption model	Parameters	Pb	Ni	Co	Cd
Linear	K_{HE}	552.29	1345.05	367.71	3996.75
	R^2	0.9865	0.9814	0.9864	0.9683
Freundlich	K_F	575.4762	798.4964	358.9239	1538.656
	1/n	0.8137	0.7589	0.8029	0.7012
	R^2	1.0000	0.9988	0.9982	0.9994
GK	K_{GK1}	746.77	1946.24	796.97	6863.33
	K_{GK2}	0.2626	3.6333	2.4566	16.2221
	K_{GK3}	168.81	6601.10	1763.74	3863.12
	R^2	0.9991	0.9961	0.9962	0.9971
Fritz-Schluender II	A_{FS}	594.69	800.93	302.16	1545.17
	α_{FS}	0.8277	0.7580	0.6756	0.7019
	B_{FS}	0.0318	0.0073	0.0074	0.0072
	β_{FS}	0.5128	0.3777	0.3797	0.3798
	R^2	1.0000	0.9988	0.9993	0.9994
Fritz-Schluender III	α_1	245.11	293.34	149.52	382.99
	β_1	1.0527	0.7649	0.6800	0.7068
	α_2	0.0289	0.0208	0.0224	0.0204
	α_3	0.3965	0.3465	0.4757	0.2286
	β_2	0.2585	0.0061	0.0061	0.0061
	R^2	1.0000	0.9988	0.9993	0.9994

Biochar was found to be an effective sorbent for the removal of heavy metals from aqueous solutions. The biochar was found to be the better for removal of cadmium than other heavy metals at the monitored experimental conditions, about 98.55% of heavy metals were removed using biochar and about 96.79% was removed using wood coal and about 91.26% was removed by charcoal. The equilibrium data have been found to follow the GK isotherm models. Das *et al.* (2007) proposed that complexation through functional groups such as hydroxyl, alkyl, amide and carboxyl groups are the main mechanism for heavy metals sorption by black carbon. Results of this study suggested that sunflower seed cover (SSC) can be converted into biochar as an effective sorbent for heavy metals removal. Two distinct mechanisms were responsible for heavy metals sorption on sunflower seed cover biochar; (1) the first mechanism involved complexation with carboxylic and phenolic hydroxyl groups, and (2) the second mechanism was involved in heavy metals binding with graphite-like structure. Further studies are needed to verify removal efficacy of biochar for treating heavy metals-contaminated wastewater.

Table (11). Parameters of some models for heavy metals sorption on wood coal

Sorption model	Parameters	Pb	Ni	Co	Cd
Linear	K_{HE}	12637.83	1752.56	2463.11	19690.93
	R^2	0.9621	0.9956	0.9978	0.9564
Freundlich	K_F	27921.89	1707.30	2255.90	59490.19
	1/n	1.2859	0.9892	0.9518	1.2341
	R^2	0.9978	0.9956	0.9990	0.9938
GK	K_{GK1}	13643.11	1946.24	2750.63	21784.57
	K_{GK2}	0.1077	3.6333	0.4615	0.4082
	K_{GK3}	51.1989	6601.1010	150.7458	326.9032
	R^2	0.9996	0.9961	0.9990	0.9974
Fritz-Schluender II	A_{FS}	24398.80	1558.39	2178.07	46345.99
	α_{FS}	1.2348	0.9507	0.9316	1.1803
	B_{FS}	0.0059	0.0060	0.0061	0.0059
	β_{FS}	0.9024	0.8778	0.8985	0.9258
	R^2	0.9996	0.9978	0.9998	0.9893
Fritz-Schluender III	α_1	461.79	149.49	63.69	270.38
	β_1	1.2429	1.2369	1.1531	1.1938
	α_2	0.0179	0.0387	0.0141	0.0057
	α_3	5.98E-05	5.99E-05	6.04E-05	5.99E-05
	β_2	0.3029	0.3024	0.3013	0.3027
	R^2	0.9805	0.9981	0.9881	0.9900

Table (12). Parameters of some models for heavy metals sorption on Biochar

Sorption model	Parameters	Pb	Ni	Co	Cd
Linear	K_{HE}	12725.40	10635.54	4927.49	40581.21
	R^2	0.9898	0.9790	0.9972	0.9864
Freundlich	K_F	10933.94	26316.85	5695.16	127258.40
	1/n	0.9449	1.2157	1.0578	1.2070
	R^2	0.9905	0.9960	0.9985	0.9976
GK	K_{GK1}	13303.67	2216.66	5023.19	43534.06
	K_{GK2}	0.1959	2.5829	0.1892	0.1874
	K_{GK3}	116.67	64.96	118.19	760.59
	R^2	0.9788	1.0000	0.9996	0.9929
Fritz-Schluender II	A_{FS}	18550.80	14844.67	5272.23	158285.30
	α_{FS}	1.1459	1.0758	1.0259	1.2483
	B_{FS}	0.0059	0.0059	0.0061	0.0059
	β_{FS}	0.9016	0.9012	0.8729	0.9127
	R^2	1.0000	1.0000	0.9998	0.9978
Fritz-Schluender III	α_1	392.70	523.16	68.22	930.10
	β_1	1.0051	1.2093	1.0434	1.2425
	α_2	0.0292	0.0196	0.0124	0.0055
	α_3	0.0031	0.0030	6.04E-05	0.0028
	β_2	0.3062	0.3115	0.3015	0.3308
	R^2	0.9896	0.9951	0.9994	0.9968

CONCLUSION

The current results are very useful in the wastewaters treatment for the removal of heavy metals, making them suitable for agricultural purposes. The present study suggested that Bio-char can be produced by pyrolysis of bio-materials such as agricultural waste, crop residues, industrial by-product, municipal waste and animal manure, in a zero or a low oxygen environment. Also, the present study recommends a future studies are needed to verify removal efficacy of biochar from different sources for treating heavy metals-contaminated wastewater.

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الملخص العربي

إستخدام البيوتشار لإزالة العناصر الثقيلة من المحاليل المائية

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تم إستخدام مخلفات قش الارز، مخلفات عصر القصب، مخلفات معاصر بذرة زهرة الشمس والكربون الاسود (الشاركول والفحم النباتى) كمواد إدمصاص للعناصر الثقيلة. وقد تم الحصول على الكربون العضوى (البيوتشار) بحرق مخلفات معاصر بذرة زهرة فى فرن إحتراق على درجة ٤٠٠ مئوية. أجريت تجارب ادمصاص لدراسة دور كل من مخلفات بذرة زهرة الشمس، الشاركول، الفحم النباتي، مخلفات عصر القصب فى التخلص من بعض العناصر الثقيلة (Pb, Cd, Ni and Co) من المحاليل المائية. وقد تراوحت كفاءة الإزالة بين ٦١.٧ الى ٩٨,٠٥% لمخلفات بذرة زهرة الشمس، من ٦٥,١٣ الى ٩٢,١% للشاركول، من ٥٧,١ الى ٩٨,٨٨% للفحم النباتي ومن ٧.٠٦ الى ٧٠.٩١% لمخلفات عصر القصب. كما تم مقارنة الشاركول، الفحم النباتي البيوتشار فى قدرتها على الادمصاص وقد أشارت النتائج أن البيوتشار له المقدرة العالية لإدمصاص العناصر الثقيلة مقارنة بالشاركول والفحم النباتي. وقد كانت الإزالة بما يعادل أكثر من ٩٨% مع البيوتشار يليه الشاركول بنسبة أكثر من ٨٤%. وقد تم توقيع بيانات الإدمصاص على خمسة نماذج وأوضحت النتائج أن النموذج الجديد المقترح (يحتوى على ٣ ثوابت) أثبت أنه أكثر دقة وثبات لوصف إدمصاص العناصر الثقيلة على البيوتشار. وتقترح الدراسة الحالية أن البيوتشار والشاركول من أكثر المواد التى قدرة على إزالة العناصر الثقيلة من المحاليل المائية. الدراسة الحالية مفيدة فى معالجة مياه الصرف الصناعي لإزالة العناصر الثقيلة وجعلها مناسبة للأغراض الزراعية. وتوصى الدراسة الحالية بإجراء دراسات مستقبلية مفصلة لتوضيح قدرة البيوتشار من مصادر مختلفة فى إزالة العناصر الثقيلة من مياه الصرف الصناعي الملوثة.

changes in loans per feddans granted to the cotton crop for the study (1997- 2014), respectively, and interpreted about 65%, 36.6% of changes in loans per feddans granted the maize crop shamia respectively.
Keywords: Development and Agricultural Credit Bank, Performance Evaluation, Liquidity Rates, Efficiency of Credit, Medium & Short-Term Loans, Agricultural loans.

coverage of production costs fedayee operation the most important crops in the governorate of the lake. (4) The study of the determinants of the demand for loans meanwhile the most important agricultural crops in the governorate of the lake. (5) To reach a group of recommendations emanating from the results obtained which could be useful to policy makers in this area. The study reached the following conclusions: (1) That the liquidity rates had taken an upward trend during the period (1995- 2014) and averages of the recent period had reached about1327.33, 24.46, 12.80same arrangement, which indicates it is in the interests of improved banking performance Agricultural Credit and Development Bank. (2) That each of the rate of the right of ownership to the deposits and the rate of the right of ownership to the risky assets and the rate of the right of ownership to investments in securities non-governmental or is guaranteed (safety margin) and the rate of the right of ownership to the loans had taken a downward trend during the study and averages of the recent period had reached about 9.28%, 8.96%, 212.64%, 9.85% In the same order in which indicates it is in the interests of improved banking performance of the bank. (3) That each of the lending rate of deposits and the rate of lending to the resources the rate of employment of the resources and the rate of the overdraft had taken a downward trend during the period of study and averages of the recent period had reached about 94.20%, 85.88%, 93.07%, 0.0008% in the same order in which indicates that the rate of the first, second and third in the invalid banking performance Agricultural Credit and Development Bank of Egypt, while the fourth ratio tended to be in the interest of improved banking performance of the bank in the recent period. (4) That all the rate of return on capital and the rate of return to the right of ownership and the rate of return on deposits and the rate of return on the resources and the rate of return on the total assets and the rate of return on assets taxpayers and the rate of return to total loans had taken an upward trend during the study period, and averages of the recent period had reached about 5.96%, 4.94%, 0.46%, 0.42%, 0.36%, 0.43% and 0.49% in the same order, which indicates it is in the interests of improved banking performance of the Bank of Development and Agricultural Credit in the second period. (5) Some of the standards of efficiency and the credit for each of the wheat harvest and rice, cotton, maize, Beheira Governorate, through the relationship between productivity meanwhile loan per feddans during periods of study (1995 - 2004), (2005 - 2014) Make sure moral model used at the level of 0.01 for each of wheat, rice and maize, as confirmed the lack of moral cotton crop, to study the relationship between productivity factor meanwhile continued and the ratio of the coverage of the loan per feddans variable costs an independent factor during periods of study (1995 - 2004), (2005 - 2014) these crops ensure moral model used at the level of 0.01 wheat, rice, cotton, and make sure the moral crop of maize. (6) The study of the determinants of the demand for loans meanwhile each of wheat, rice, cotton, maize, in Beheira Governorate, showed that each of the coverage of the Loan variable costs and net revenue per feddans explain about 35.7%, 66.8 % of changes in loans per feddans granted to the wheat crop, respectively, while explains the net revenue per feddans about 90% of changes in loans per feddans granted to the rice crop, respectively, all of the coverage of the loan per feddans variable costs and net revenue per feddans explain about 30.5%, 77.2% of

المراجع

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Efficiency and Effectiveness of The Performance of Bank for Development and Agricultural Credit: A Case Study of El-Beheira Governorate

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ABSTRACT: Research aimed at identifying the efficiency and effectiveness of the performance of the Agricultural Credit and Development Bank, Egyptian in addition to its role in agricultural development, Beheira Governorate, to this aim was to be achieved through the study of the following objectives: (1) Assess the performance of banks the Agricultural Credit and Development Bank. (2) The identification of the most important indicators of credit to the most important agricultural crops in the governorate of the lake. (3) Assess the levels of efficiency of agricultural credit and the extent of the contribution of agricultural loans in the

الإحتمالى ١%. (٣) تمثل كل من نسبة تغطية القرض الفدانى للتكاليف المتغيرة وصافى العائد للفدان التأثير الإيجابى على القروض الفدانية لمحصول الذرة الشامية ، ولتقدير الأهميه النسبيه لتلك المتغيرات فى تأثيرها على القروض الفدانية لمحصول الذرة الشامية تم الإعتماد على معامل الإرتداد الجزئى القياسى لتلك المتغيرات ، حيث تبين أن متغير نسبة تغطية القرض الفدانى للتكاليف المتغيرة يحتل المرتبة الأولى فى تأثيره على القروض الفدانية لمحصول الذرة الشامية ، ثم متغير صافى العائد للفدان على القروض الفدانية لمحصول الذرة الشامية ، حيث يقدر معامل الإرتداد الجزئى القياسى لكل منهم بحوالى ٠,٦٥ ،٠,٣٧ بنفس الترتيب.

لتقدير مستوى المخاطرة المالية لمحصول الذرة الشامية التى يتعرض لها المزارع يتم طرح ضعف الإنحراف المعيارى من متوسط صافى العائد الفدانى وقدرت بحوالى ١٦٨١,٤٦ وبالتالى لكى يكون مزارع هذا المحصول قادراً على الوفاء بالتزاماته المالية عند الإقتراض من البنوك الزراعية لإنتاج هذا المحصول لابد أن يزيد متوسط صافى العائد لمحصول الذرة الشامية بأكثر من ١٦٨١,٤٦ جنيه/فدان، وللتعرف على مدى تحسن القدرة المالية لمزارعى المحصول تم حساب نفس المؤشر لأخر خمس سنوات وقد قدر مستوى المخاطرة المالية بحوالى ٢٨٧٤,٩١ جنيه/الفدان مما يشير إلى قدرة المزارع على الوفاء بالتزاماته المالية عند الإقتراض من البنوك الزراعية.

التوصيات

توصى الدراسة ببعض التوصيات التى قد تساعد متخذ القرار بهدف زيادة كفاءة السياسة الائتمانية الزراعية وتعزيز دور بنك التنمية والائتمان الزراعى وتعظيم استفادة القطاع الزراعى من الخدمات التى يقدمها البنك لتحقيق مزيد من التنمية وهى كما يلى: (١) ضرورة الأهتمام بتقديم القروض الجيدة دون المغالاة فى الضمانات والشروط إعتماداً على المتابعة الائتمانية ومراعاة السلوك الإنتاجى للمقترض وقدرته على إدارة أمواله ومركزه المالى وبالتالى تحديد مقدرته على السداد ويمكن فى ضوء ذالك تحديد حجم الائتمان للعميل. (٢) ضرورة زيادة فعالية البنك نحو توجيه الاستثمارات الزراعية وتتمثل فى تدعيم قدرته على بلورة فرص الإستثمار والإعداد الجيد للمشروعات الاستثمارية بل والترويج لها وتدعيمها فنياً وإدارياً فى مراحلها الأولى وضرورة دخول البنك فى أنشطة سريعة الدوران وتعطى عائداً مجزياً. (٣) وضع الضوابط العلمية لمواجهة المخاطر المتعلقة بعدم سداد القروض من خلال القوانين وتقديم الاستثمارات للمزراعين للاستغلال الأمثل لمواردهم الزراعية. (٤) توفير مصادر التمويل اللازمة للبنك بأقل تكلفة عن طريق استحداث وفتح أنشطة مصرفية جديدة وسهلة الحصول عليها. (٥) تحقيق مستوى ملائم من السيولة النقدية لبنك التنمية والائتمان الزراعى المصرى من خلال ما يعرف بالنظام الإحتياطى النقدى. (٦) يجب توظيف الأموال والمزج الأمثل لمصادر الأموال فكلما تم ذلك إنخفضت تكلفة رأس المال وزاد ربحية البنك.

وتشير النتائج المتحصل عليها من النموذج المقدر إلى: (١) يقدر معامل التحديد المعدل ($R^{\backslash 2}$) بحوالى ٠,٩٢ وهذا يعنى أن المتغيرات التفسيرية التى يتضمنها النموذج المقدر تفسر حوالى ٩٢% من التغيرات التى تحدث فى المتغير التابع (Y) ، وتقدر قيمة (F) بحوالى ٩٠,٦٤ وهى قيمة معنوية عند مستوى الإحتمالى ١%. (٢) تبلغ القيمة المقدرة لإختبار ديربن واطسون (D.W) حوالى ١,٣٦ وهى تشير إلى عدم وجود إرتباط ذاتى بين البواقى عند المستوى الاحتمالى ١%. (٣) تمثل كل من متغيرات نسبة تغطية القرض الفدانى للتكاليف المتغيرة ، صافى العائد للفدان التأثير الإيجابى على القروض الفدانية لمحصول القطن ، ولتقدير الأهمية النسبية لتلك المتغيرات فى تأثيرها على القروض الفدانية لمحصول القطن تم الإعتماد على معامل الإرتداد الجزئى القياسى لتلك المتغيرات ، حيث تبين أن متغير صافى العائد للفدان يحتل المرتبة الأولى فى تأثيره على القروض الفدانية لمحصول القطن ، ثم متغير نسبة تغطية القرض الفدانى للتكاليف المتغيرة على القروض الفدانية لمحصول القطن ، حيث يقدر معامل الإرتداد الجزئى القياسى لكل منهم بحوالى ٠,٧٧ ، ٠,٣٠ بنفس الترتيب.

ولتقدير مستوى المخاطرة المالية لمحصول القطن التى يتعرض لها المزارع يتم طرح ضعف الإنحراف المعيارى من متوسط صافى العائد الفدانى وقدرت بحوالى ١٥٧٠,١٢ وبالتالى لكى يكون مزارع هذا المحصول قادراً على الوفاء بالتزاماته المالية عند الإقتراض من البنوك الزراعية لإنتاج هذا المحصول لابد أن يزيد متوسط صافى العائد لمحصول القطن بأكثر من ١٥٧٠,١٢ جنيه/فدان، وللتعرف على مدى تحسن القدرة المالية لمزارعى المحصول تم حساب نفس المؤشر لأخر خمس سنوات وقد قدر مستوى المخاطرة المالية بحوالى ٢٥٣٣,٧٠ جنيه/الفدان مما يشير إلى قدرة المزارع على الوفاء بالتزاماته المالية عند الإقتراض من البنوك الزراعية.

٣-٤- محددات الطلب على القروض الفدانية لمحصول الذرة الشامية:

يتحدد الطلب على القروض الفدانية لمحصول الذرة الشامية بمجموعة من العوامل أهمها: التكاليف المتغيرة للفدان بالجنيه (X_1)، الانتاجية الفدانية بالطن/الفدان (X_2)، نسبة تغطية القرض الفدانى للتكاليف المتغيرة بالجنيه (X_3)، صافى العائد للفدان (X_4)، وبإجراء تحليل الإنحدار المتعدد المرحلى للمتغيرات التفسيرية خلال فترة الدراسة (١٩٩٧-٢٠١٤) فى الصورة الخطية والصورة النصف لوغارتمية لتقدير دالة الطلب على القروض الفدانية لمحصول الذرة الشامية تبين أفضلية الصورة النصف لوغارتمية فى تمثيل البيانات المستخدمة فى التقدير كما يلى:

$$LnY = 5.841 + 0.035\,X_3 + 0.00006\,X_4$$

$$(38.496)\quad(7.539)\quad(4.242)$$

$$R^{\backslash 2} = 0.92 \quad F = 296.61 \quad D.W = 1.576$$

$$b'_3 = 0.650 \qquad b'_4 = 0.366$$

وتشير النتائج المتحصل عليها من النموذج المقدر إلى: (١) يقدر معامل التحديد المعدل ($R^{\backslash 2}$) بحوالى ٠,٩٢ وهذا يعنى أن المتغيرات التفسيرية التى يتضمنها النموذج المقدر تفسر حوالى ٩٢% من التغيرات التى تحدث فى المتغير التابع (Y) ، وتقدر قيمة (F) بحوالى ٢٩٦,٦١ وهى قيمة معنوية عند مستوى الإحتمالى ١%. (٢) تبلغ القيمة المقدرة لإختبار ديربن واطسون (D.W) حوالى 1,58 وهى تشير إلى عدم وجود إرتباط ذاتى بين البواقى عند المستوى

٣-٢- محددات الطلب على القروض الفدانية لمحصول الأرز:

يتحدد الطلب على القروض الفدانية لمحصول الأرز بمجموعة من العوامل أهمها: التكاليف المتغيرة للفدان بالجنيه (X_1) ، الانتاجية الفدانية بالطن/الفدان (X_2)، نسبة تغطية القرض الفدانى للتكاليف المتغيرة بالجنيه (X_3) ، صافى العائد للفدان (X_4). وبإجراء تحليل الإنحدار المتعدد المرحلى للمتغيرات التفسيرية خلال فترة الدراسة (١٩٩٧-٢٠١٤) فى الصورة الخطية والصورة النصف لوغارتمية لتقدير دالة الطلب على القروض الفدانية لمحصول الأرز تبين أفضلية الصورة النصف لوغارتمية فى تمثيل البيانات المستخدمة فى التقدير كما يلى:

$$LnY = 6.555 + 0.001\ X_4$$
$$(2.512) \quad (9.163)$$

$$R^2 = 0.90 \qquad F = 73.08 \qquad P\text{-Value} = 0.000$$

وتشير النتائج المتحصل عليها من النموذج المقدر إلى: (١) يقدر معامل التحديد (R^2) بحوالى ٠,٩٠ وهذا يعنى أن المتغير التفسيري التى يتضمنه النموذج المقدر تفسر حوالى ٩٠% من التغيرات التى تحدث فى المتغير التابع (Y)، وتقدر قيمة (F) بحوالى ٧٣,٠٨ وهى قيمة معنوية عند مستوى الإحتمالى ١%. (٢) يمثل متغير صافى العائد للفدان التأثير الإيجابى على القروض الفدانية لمحصول الأرز .

لتقدير مستوى المخاطرة المالية لمحصول الأرز التى يتعرض لها المزارع يتم طرح ضعف الإنحراف المعيارى من متوسط صافى العائد الفدانى وقدرت بحوالى ٢٠٤,٣٢ وبالتالى لكى يكون مزارع هذا المحصول قادراً على الوفاء بالتزاماته المالية عند الإقتراض من البنوك الزراعية لإنتاج هذا المحصول لابد أن يزيد متوسط صافى العائد لمحصول الأرز بأكثر من ٢٠٤,٣٢ جنيه/فدان، وللتعرف على مدى تحسن القدرة المالية لمزارعى المحصول تم حساب نفس المؤشر لأخر خمس سنوات وقد قدر مستوى المخاطرة المالية بحوالى ٣٦٥٩,٦٨ جنيه/الفدان مما يشير إلى قدرة المزارع على الوفاء بالتزاماته المالية عند الإقتراض من البنوك الزراعية.

٣-٣- محددات الطلب على القروض الفدانية لمحصول القطن:

يتحدد الطلب على القروض الفدانية لمحصول القطن بمجموعة من العوامل أهمها: التكاليف المتغيرة للفدان بالجنيه (X_1)، الانتاجية الفدانية بالطن/الفدان (X_2)، نسبة تغطية القرض الفدانى للتكاليف المتغيرة بالجنيه (X_3)، صافى العائد للفدان (X_4). وبإجراء تحليل الانحدار المتعدد المرحلى للمتغيرات التفسيرية خلال فترة الدراسة (١٩٩٧-٢٠١٤) فى الصورة الخطية والصورة النصف لوغارتمية لتقدير دالة الطلب على القروض الفدانية لمحصول القطن تبين أفضلية الصورة النصف لوغارتمية فى تمثيل البيانات المستخدمة فى التقدير كما يلى:

$$LnY = 5.140 + 0.024\ X_3 + 0.0004\ X_4$$
$$(18.197) \quad (3.712) \quad (9.385)$$
$$R'^2 = 0.92 \qquad F = 90.54 \qquad D.W = 1.356$$
$$b'_3 = 0.305 \qquad b'_4 = 0.772$$

٣- محددات الطلب على القروض الفدانية لأهم المحاصيل الزراعية:

يفترض أن يتأثر الطلب على القروض الفدانية بكثير من المحددات من أهمها، المساحة المزروعة بالمحصول والأنتاجية الفدانية، وصافى عائد الفدان والتكاليف المتغيرة وغيرها(**حسين ،٢٠٠٠**)، ويتم دراسة أهم هذه المحددات المؤثرة على القروض الفدانية لأهم المحاصيل والتى تشمل القمح والأرز والقطن والذرة الشامية وذلك خلال فترة الدراسة (١٩٩٧- ٢٠١٤).

٣-١- محددات الطلب على القروض الفدانية لمحصول القمح:

يتحدد الطلب على القروض الفدانية لمحصول القمح بمجموعة من العوامل أهمها: التكاليف المتغيرة للفدان بالجنيه (X_1) ، الإنتاجية الفدانية بالطن/الفدان (X_2)، نسبة تغطية القرض الفدانى للتكاليف المتغيرة بالجنيه (X_3)، صافى العائد للفدان (X_4) . وبإجراء تحليل الإنحدار المتعدد المرحلى للمتغيرات التفسيرية خلال فترة الدراسة (١٩٩٧- ٢٠١٤) فى الصورة الخطية والصورة النصف لوغارتمية لتقدير دالة الطلب على القروض الفدانية لمحصول القمح تبين أفضلية الصورة النصف لوغارتمية فى تمثيل البيانات المستخدمة فى التقدير كما يلى:

$$\mathbf{LnY = 5.024 + 0.025\, X_3 + 0.0002\, X_4}$$

$$\mathbf{(10.847)\quad (83.063)\quad (-12.137)}$$

$$\mathbf{R'^2 = 0.81 \qquad F = 32.49 \qquad D.W = 1.144}$$

$$\mathbf{b'_3 = 0.357 \qquad b'_4 = 0.668}$$

وتشير النتائج المتحصل عليها من النموذج المقدر إلى: (١) يقدر معامل التحديد المعدل (R'^2) بحوالى ٠,٨١ وهذا يعنى أن المتغيرات التفسيرية التى يتضمنها النموذج المقدر تفسر حوالى ٨١% من التغيرات التى تحدث فى المتغير التابع (Y)، وتقدر قيمة (F) بحوالى ٣٢,٤٩ وهى قيمة معنوية عند مستوى الإحتمالى ١%. (٢) تبلغ القيمة المقدرة لاختبار ديربن واطسون (D.W) حوالى ١,١٤ وهى تشير إلى وجود إرتباط ذاتى بين البواقى عند المستوى الاحتمالى ١%. (٣) تمثل كل من متغيرات نسبة تغطية القرض الفدانى للتكاليف المتغيرة بالجنيه ، صافى العائد للفدان التأثير الإيجابى على القروض الفدانية لمحصول القمح. ولتقدير الأهمية النسبية لتلك المتغيرات تم الإعتماد على معامل الإرتداد الجزئى القياسى لتلك المتغيرات، حيث تبين أن متغير صافى العائد للفدان يحتل المرتبة الأولى فى تأثيره على القروض الفدانية لمحصول القمح ، ثم متغير نسبة تغطية القرض الفدانى للتكاليف المتغيرة على القروض الفدانية لمحصول القمح، حيث يقدر معامل الارتداد الجزئى القياسى لكل منهم بحوالى ٠,٦٧، ٠,٣٦ بنفس الترتيب.

لتقدير مستوى المخاطرة المالية لمحصول القمح التى يتعرض لها المزارع يتم طرح ضعف الإنحراف المعيارى من متوسط صافى العائد الفدانى وقدرت بحوالى ٢٢٠٣,٠٩ وبالتالى لكى يكون مزارع هذا المحصول قادراً على الوفاء بالتزاماته المالية عند الإقتراض من البنوك الزراعية لإنتاج هذا المحصول لابد أن يزيد متوسط صافى العائد لمحصول القمح بأكثر من ٢٢٠٣,٠٩ جنيه/فدان، وللتعرف على مدى تحسن القدرة المالية لمزارعى المحصول تم حساب نفس المؤشر لأخر خمس سنوات وقد قدر مستوى المخاطرة المالية بحوالى ٣٨٦٧,٣٨ جنيه/الفدان مما يشير إلى قدرة المزارع على الوفاء بالتزاماته المالية عند الإقتراض من البنوك الزراعية.

جدول رقم (١٥). المؤشرات الائتمانية لمحصول الذرة الشامية خلال الفترة (١٩٩٥ - ٢٠١٤).

السنوات	القروض الفدانية (بالجنيه)	التكاليف المتغيرة (بالجنيه)	نسبة التغطية%	الإنتاجية الفدانية (طن/الفدان)
١٩٩٥	٥٨٧	٩٣٥,٠٥	٦٢,٧٧	٣,٠٤
١٩٩٦	٦٥٢	٩٦٦,٩٤	٦٧,٤٢	٣,٢٥
١٩٩٧	٧٢٤	١٠١٦,٥	٧١,٢٢	٣,٤٢
١٩٩٨	٨٠٤	١٢٠٩,٤	٦٦,٤٧	٣,٦٥
١٩٩٩	٨٩٣	١٤٠٢,٣	٦٣,٦٨	٣,٧٦
٢٠٠٠	٩٩٢	١٤٣٠,١	٦٩,٣٦	٣,٦٨
٢٠٠١	١١٠٢	١٤٧١,٩	٧٤,٨٦	٣,٨١
٢٠٠٢	١٢٢٤	١٤٨٠,٠	٨٢,٧٠	٢,٨٠
٢٠٠٣	١٣٥٩	١٧٠٩,٠	٧٩,٥٢	٣,٠٧
٢٠٠٤	١٥٠٩	١٨٤٦,٠	٨١,٧٤	٣,٨٤
متوسط الفترة الأولى	**٩٨٤,٦**	**١٣٤٦,٧**	***٧١,٦٤**	**٣,٤٣**
٢٠٠٥	١٦٧٦	٢٠٥٥,٠	٨١,٥٥	٣,٨٤
٢٠٠٦	١٨٦٢	٢٣٣٩,٥	٧٩,٥٨	٣,٦١
٢٠٠٧	٢٠٦٨	٢٦٢٤,٠	٧٨,٨١	٣,٧٥
٢٠٠٨	٢٢٩٧	٢٩٦٣,٥	٧٧,٥٠	٣,٧٦
٢٠٠٩	٢٥٥٢	٣٣٠٣,٠	٧٧,٢٦	٣,٧٣
٢٠١٠	٢٨٣٥	٣٧١٠,٠	٧٦,٤١	٣,٦١
٢٠١١	٣١٥٠	٤٠٨٢,٠	٧٧,١٦	٣,٧٣
٢٠١٢	٣٥٠٠	٤٣٤٠,٠	٨٠,٦٤	٣,٧٨
٢٠١٣	٣٨٥٠	٤٧٣٥,٠	٨١,٣٠	٣,٧٦
٢٠١٤	٤٢٣٥	٤٩١٠,٠	٨٦,٢٥	٣,٧٢
متوسط الفترة الثانية	**٢٨٠٢,٥**	**٣٥٠٦,٢**	**٧٩,٦٠***	**٣,٧٣**
المتوسط العام	**١٨٩٣**	**٢٤٢٦,٤**	***٧٥,٥٢**	**٣,٥٨**

***المتوسط الهندسى**

المصدر: (١) وزارة الزراعة وإستصلاح الأراضى،قطاع الشئون الاقتصادية ، الإدارة المركزية للإقتصاد الزراعى ، نشرة الإقتصاد، أعداد متفرقة.

(٢) البنك الرئيسى للتنمية والإئتمان الزراعى، الإدارة العامة للإحصاء، سجلات قسم الإحصاء ، بيانات غير منشورة.

(٣) موقع البنك الرئيسى http://www.pbd.eg.

جدول رقم (١٦). العلاقات بين أهم المؤشرات الائتمانية لمحصول الذرة الشامية خلال الفترة (١٩٩٥- ٢٠١٤).

NO.	Equation*	R2	F	P-Value
1	$\ln \hat{y}_1 = 67.996 + 5.541X_1$ (32.520) (3.946)	0.46	27.00	0.009
2	$\ln \hat{y}_2 = 3.346 + 3.44\ X_2$ (26.928) (2.031)	0.18	4.12	0.05

* القيم بين الأقواس تمثل قيمة (t) المحسوبة، وتمثل y_1 نسبة تغطية القرض الفدانى للتكاليف المتغيرة ،X_1 تمثل القرض الفدانى ، وتمثل y_2 الإنتاجية الفدانية ، X_2 تمثل القرض الفدانى خلال الفترة (١٩٩٥- ٢٠١٤).

المصدر: حسبت من بيانات الجدول رقم (١٥) باستخدام البرنامج الإحصائى SPSS.

٢-٤- المؤشرات الائتمانية لمحصول الذرة الشامية:

تتمثل أهم المؤشرات الائتمانية لمحصول الذرة الشامية فى الأتى:

٢-٤-١- قيمة القرض الفدانى ونسبة تغطية القرض الفدانى للتكاليف المتغيرة:

بدراسة تطور قيمة القرض الفدانى ونسبة تغطية القرض الفدانى للتكاليف المتغيرة لمحصول الذرة الشامية خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤) ، (٢٠٠٥ – ٢٠١٤) يتضح أن قيمة القرض الفدانى زاد من حوالي ٩٨٤,٦ جنيه بنسبة ٢٦% كمتوسط للفترة الأولى إلى حوالي ٢٨٠٢,٥ جنيه بنسبة ٧٤% كمتوسط للفترة الثانية كما هو موضح بالجدول رقم (١٥)، تبين أنها قد تراوحت بين حد أدنى بلغ حوالى ٥٨٧ جنيه فى عام ١٩٩٥، وحد أقصى بلغ حوالى ٤٢٣٥ جنيه في عام ٢٠١٤ ، فى حين بلغ المتوسط السنوى لها خلال نفس الفترة حوالى١٨٩٣ جنيه. وبتقدير العلاقة بين القرض الفدانى ونسبة تغطية القرض الفدانى للتكاليف المتغيرة لمحصول الذرة الشامية خلال تلك الفترة، تبين من المعادلة رقم (١) بالجدول رقم (١٦) أنها أخذت إتجاهاً تصاعدياً بمعدل نمو سنوى بلغ حوالى ٥٥٤%.

٢-٤-٢- بعض معايير الكفاءة الائتمانية لمحصول الذرة الشامية:

تتمثل أهم معايير الكفاءة الائتمانية لمحصول الذرة الشامية فى العلاقة بين الإنتاجية الفدانية والقرض الفدانى، والعلاقة بين الإنتاجية الفدانية ونسبة تغطية القرض الفدانى للتكاليف المتغيرة كما يلى:

٢-٤-٢-١- العلاقة بين الإنتاجية الفدانية والقرض الفدانى:

وبدراسة العلاقة بين الإنتاجية الفدانية لمحصول الذرة الشامية كعامل تابع والقرض الفدانى كعامل مستقل خلال فترة الدراسة (١٩٩٥– ٢٠١٤) كما هو موضح فى الجدول رقم (١٥)، يتضح أن قيمة الإنتاجية الفدانية زادت من حوالي ٣,٤٤ طن/الفدان بنسبة ٤٧,٩٢% كمتوسط للفترة الأولى إلى حوالي ٣,٧٣ طن/الفدان بنسبة ٥٢,٠٦% كمتوسط للفترة الثانية وتبين أنها قد تراوحت بين حد أدنى بلغ حوالى ٢,٨٠ طن/الفدان فى عام ٢٠٠٢ ، وحد أقصى بلغ حوالى ٣,٨٥ طن/الفدان في عام ٢٠٠٤ ، فى حين بلغ المتوسط السنوى لها خلال نفس الفترة حوالى ٣,٥٨ طن/الفدان. وبتقدير العلاقة بين الإنتاجية الفدانية والقرض الفدانى لمحصول الذرة الشامية خلال تلك الفترة، تبين من المعادلة رقم (٢) بالجدول رقم (١٦) أنها أخذت إتجاهاً تصاعدياً بمعدل نمو سنوى بلغ حوالى ٣٤٤,٤%.

٢-٤-٢-٢- العلاقة بين الإنتاجية الفدانية ونسبة تغطية القرض الفدانى للتكاليف المتغيرة:

وبدراسة العلاقة بين الإنتاجية الفدانية لذرة الشامية كعامل مستقل ونسبة تغطية القرض الفدانى للتكاليف المتغيرة كعامل تابع خلال فترة الدراسة (١٩٩٥– ٢٠١٤) كما هو موضح فى الجدول رقم (١٠)، يتضح أن قيمة نسبة تغطية القرض الفدانى للتكاليف المتغيرة زادت من حوالي ٧١,٦٤% بنسبة ٤٧,٤٧% كمتوسط للفترة الأولى إلى حوالي ٧٩,٦٠% بنسبة ٥٢,٥٢% كمتوسط للفترة الثانية، وتبين أنها قد تراوحت بين حد أدنى بلغ حوالى ٦٢,٧٧% فى عام ١٩٩٥، وحد أقصى بلغ حوالى ٨٦,٢٥ % في عام ٢٠١٤ ، فى حين بلغ المتوسط السنوى لها خلال نفس الفترة حوالى ٧٥,٥٢%.

جدول رقم (١٣). المؤشرات الائتمانية لمحصول القطن خلال الفترة (١٩٩٥ - ٢٠١٤).

السنوات	القروض الفدانية(بالجنبه)	التكاليف المتغيرة (بالجنبه)	نسبة التغطية%	الإنتاجية الفدانية (طن/الفدان)
١٩٩٥	٦٧١,٠	١٠٠٧,٥٨	٦٦,٥٩	٧,٧٨
١٩٩٦	٧٤٥,٠	١٢٠٠,٢٠	٦٢,٠٧	٥,٩٨
١٩٩٧	٨٢٧,٠	١٢٨٠,٥٠	٦٤,٥٨	٦,٨٠
١٩٩٨	٩١٨,٠	١٢٨٩,٠٠	٧١,٢١	٦,٤٣
١٩٩٩	١٠٢٠	١٨٤٣,٧٠	٥٥,٣٢	٦,٠٧
٢٠٠٠	١١٣٣	٢٠٥٢,٩٠	٥٥,١٩	٧,٢١
٢٠٠١	١٢٥٨	٢٠٥٧,٩٥	٦١,١٢	15،7
٢٠٠٢	١٣٩٧	٢٠٦٣,٠٠	٦٧,٧١	19،7
٢٠٠٣	١٥٥٢	٢١١١,٠٠	٧٣,٥٢	٦,٦٣
٢٠٠٤	١٧٢٤	٢١٩٠,٠٠	٧٨,٧٢	٧,٣٩
متوسط الفترة الأولى	**١١٢٤,٥**	**١٧٠٩,٥٨**	**٦٥,٢١***	**٦,٨٦**
٢٠٠٥	١٩١٥	٢٦١٧,٠٠	٧٣,١٧	٦,٠٨
٢٠٠٦	٢١٢٧	٢٩٦٥,٠٠	٧١,٧٣	٧,١٠
٢٠٠٧	٢٣٦٣	٣٤٣٧,٠٠	٦٨,٧٥	٧,١١
٢٠٠٨	٢٦٢٥	٤١٢٠,٠٠	٦٣,٧١	٧,٠١
٢٠٠٩	٢٩١٦	٣٩٩٨,٠٠	٧٢,٩٣	٧,٠٦
٢٠١٠	٣٢٤٠	٤٥٧١,٠٠	٧٠,٨٨	٧,٢٢
٢٠١١	٣٦٠٠	٥١٩٣,٠٠	٦٩,٣٢	٧,٦٦
٢٠١٢	٤٠٠٠	٥٥٧٤,٠٠	٧١,٧٦	٥,٧١
٢٠١٣	٤٤٠٠	٥٦٢٦,٠٠	٧٨,٢٠	٦,٣١
٢٠١٤	٤٨٤٠	٥٦٧٨,٠٠	٨٥,٢٤	٧,١٤
متوسط الفترة الثانية	**٣٢٠٢,٦**	**٤٣٧٧,٩٠**	**٧٢,٣٧***	**٦,٨٤**
المتوسط العام	**٢١٦٣,٥٥**	**٣٠٤٣,٧٤**	**٦٨,٧٠***	**٦,٨٥**

***المتوسط الهندسى**

المصدر: (١) وزارة الزراعة وإستصلاح الأراضى،قطاع الشئون الإقتصادية ،الإدارة المركزية للإقتصاد الزراعى، نشرة الإقتصاد، أعداد متفرقة.

(٢) البنك الرئيسى للتنمية والإئتمان الزراعى، الإدارة العامة للإحصاء ، سجلات قسم الإحصاء، بيانات غير منشورة.

(٣) موقع البنك الرئيسى http://www.pbd.eg.

جدول رقم (١٤). العلاقات بين أهم المؤشرات الائتمانية لمحصول القطن خلال الفترة (١٩٩٥- ٢٠١٤).

No.	Equation*	R^2	F	P-Value
١	$\text{Ln}\ \hat{y}_1 = 61.126 + 5.398\ X_1$ (25.682) (3.469)	٠.٤٠	١٢.٠٣٢	٠.٠٠٢

*القيم بين الأقواس تمثل قيمة (t) المحسوبة ، وتمثل y_1 نسبة تغطية القرض الفدانى للتكاليف المتغيرة ، X_1 تمثل القرض الفدانى خلال الفترة (١٩٩٥- ٢٠١٤).

المصدر: حسبت من بيانات الجدول رقم (١٣) باستخدام البرنامج الإحصائى SPSS.

٢-٣- المؤشرات الائتمانية لمحصول القطن:

تتمثل أهم المؤشرات الإئتمانية لمحصول القطن فى الأتى:

٢-٣-١- قيمة القرض الفدانى ونسبة تغطية القرض الفدانى للتكاليف المتغيرة لمحصول القطن:

بدراسة تطور قيمة القرض الفدانى ونسبة تغطية القرض الفدانى للتكاليف المتغيرة لمحصول القطن خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤) ، (٢٠٠٥ – ٢٠١٤) يتضح أن قيمة القرض الفدانى لمحصول القطن زاد من حوالي ١١٢٤,٥ جنيه بنسبة ٢٥,٩٨% كمتوسط للفترة الأولى إلى حوالي ٣٢٠٢,٦ جنيه بنسبة٧٤,٠١% كمتوسط للفترة الثانية كما هو موضح بالجدول رقم (١٣) ، وتبين أنها قد تراوحت بين حد أدنى بلغ حوالى ٦٧١ جنيه فى عام ١٩٩٥، وحد أقصى بلغ حوالى ٤٨٤٠ جنيه في عام ٢٠١٤ ، فى حين بلغ المتوسط السنوى لها خلال نفس الفترة حوالى ٢١٦٣,٥٥ جنيه. وبتقدير العلاقة بين القرض الفدانى ونسبة تغطية القرض الفدانى للتكاليف المتغيرة لمحصول القطن خلال تلك الفترة تبين من المعادلة رقم (١) بالجدول رقم (١٤) أنها أخذت إتجاهاً تصاعدياً بمعدل نمو سنوى بلغ حوالى ٥٣٩,٨%.

٢-٣-٢- بعض معايير الكفاءة الائتمانية لمحصول القطن:

تتمثل أهم معايير الكفاءة الائتمانية لمحصول القطن فى العلاقة بين الانتاجية الفدانية والقرض الفدانى العلاقة بين الإنتاجية الفدانية ونسبة تغطية القرض الفدانى للتكاليف المتغيرة وكما يلى:

٢-٣-٢-١- العلاقة بين الانتاجية الفدانية والقرض الفدانى لمحصول القطن:

بدراسة العلاقة بين الإنتاجية الفدانية للقطن كعامل تابع والقرض الفدانى كعامل مستقل خلال فترة الدراسة (١٩٩٥– ٢٠١٤) كما هو موضح فى الجدول رقم (١٣)، يتضح أن قيمة الانتاجية الفدانية قلت من حوالي ٦,٨٦ طن/الفدان بنسبة ٥٠,٠٧% كمتوسط للفترة الأولى إلى حوالي ٦,٨٤ طن/الفدان بنسبة ٤٩,٩٢% كمتوسط للفترة الثانية وتبين أنها قد تراوحت بين حد أدنى بلغ حوالى ٥,٧١ طن/الفدان فى عام ٢٠١٢، وحد أقصى بلغ حوالى٧,٧٨ طن/الفدان في عام١٩٩٥ ، فى حين بلغ المتوسط السنوى لها خلال نفس الفترة حوالى ٦,٨٥ طن/الفدان.

٢-٣-٢-٢- العلاقة بين الإنتاجية الفدانية ونسبة تغطية القرض الفدانى للتكاليف المتغيرة لمحصول القطن:

بدراسة العلاقة بين الإنتاجية الفدانية للقطن كعامل تابع ونسبة تغطية القرض الفدانى للتكاليف المتغيرة كعامل مستقل خلال فترة الدراسة (١٩٩٥– ٢٠١٤) كما هو موضح فى الجدول رقم (١٣)، يتضح أن قيمة نسبة تغطية القرض الفدانى للتكاليف المتغيرة زادت من65,21% بنسبة ٤٧,٤٧% كمتوسط للفترة الأولى٧٢,٣٧% بنسبة ٥٢,٥١% كمتوسط للفترة الثانية ، وتبين أنها قد تراوحت بين حد أدنى بلغ حوالى ٥٥,١٩% فى عام ٢٠٠٠ ، وحد أقصى بلغ حوالى ٨٥,٢٤% في عام ٢٠١٤ ، فى حين بلغ المتوسط السنوى لها خلال نفس الفترة حوالى ٦٨,٧٠%.

جدول رقم (١١). المؤشرات الائتمانية لمحصول الأرز خلال الفترة (١٩٩٥ - ٢٠١٤)

السنوات	القروض الفدانية (بالجنبه)	التكاليف المتغيرة (بالجنبه)	نسبة التغطية%	الإنتاجية الفدانية (طن/الفدان)
١٩٩٥	٠,٤٢٢	٦٥,٩٩٦	٣٤,٤٢	٤٣,٣
١٩٩٦	٠,٤٦٨	٠,١٠٧٩	٣٧,٤٣	٥٥,٣
١٩٩٧	٠,٥١٩	٠,١٣٠٤	٨٠,٣٩	٦٨,٣
١٩٩٨	٠,٥٧٦	٣,١٥٢٧	٧١,٣٧	٨٠,٣
١٩٩٩	٠,٦٣٩	٧,١٧٥٠	٤٩,٣٦	٩١,٣
٢٠٠٠	٠,٧٠٩	٣,١٦٩٢	٨٩,٤١	٩٥,٣
٢٠٠١	٠,٧٨٧	٢,١٦٨٥	٧٠,٤٦	١٢,٣
٢٠٠٢	٠,٨٧٤	٠,١٧٦٠	٦٥,٤٩	٠٥,٤
٢٠٠٣	٠,٩٧١	٠,٢٠٥٩	١٥,٤٧	١٦,٤
٢٠٠٤	١٠٧٨	٠,٢٣٧٣	٤٢,٤٥	٢٤,٤
متوسط الفترة الأولى	**٣,٧٠٤**	**٧,١٦٢٢**	**٤٢,٨٧***	**٧٩,٣**
٢٠٠٥	١١٩٧	٠,٢٤٥٥	٧٥,٤٨	١٣,٤
٢٠٠٦	١٣٣٠	٠,٢٦٥٨	٠٣,٥٠	١٥,٤
٢٠٠٧	١٤٧٧	٠,٢٢٠٦	٩٥,٦٦	٢٠,٤
٢٠٠٨	١٦٤١	٠,٢٩٩٧	٧٥,٥٤	٣٣,٤
٢٠٠٩	١٨٢٣	٠,٣٧٨٨	١٢,٤٨	٢٦,٤
٢٠١٠	٢٠٢٥	٠,٤٠٧٣	٧١,٤٩	٢٤,٤
٢٠١١	٢٢٥٠	٠,٤٤٢٣	٨٧,٥٠	٢٤,٤
٢٠١٢	٢٥٠٠	٠,٤٥١٤	٣٨,٥٥	٢٦,٤
٢٠١٣	٢٧٥٠	٠,٥٢٠٥	٨٣,٥٢	٠٥,٤
٢٠١٤	٣٠٢٥	٠,٥٨٩٦	٣٠,٥١	٢٩,٤
متوسط الفترة الثانية	**٨,٢٠٠١**	**٥,٣٨٢١**	***٥٢,٦٤**	**٢١,٤**
المتوسط العام	**٠٥,١٣٥٣**	**١,٢٧٢٢**	***٤٧,٥٠**	**٠٠,٤**

***المتوسط الهندسى**

المصدر: (١) وزارة الزراعة وإستصلاح الأراضى ، قطاع الشئون الإقتصادية ، الإدارة المركزية للإقتصاد الزراعى ، نشرة الإقتصاد، أعداد متفرقة.

(٢) البنك الرئيسى للتنمية والإئتمان الزراعى، الإدارة العامة للإحصاء، سجلات قسم الإحصاء، بيانات غير منشورة.

(٣) موقع البنك الرئيسى http://www.pbd.eg.

جدول رقم (١٢). العلاقات بين أهم المؤشرات الإئتمانية لمحصول الأرز خلال الفترة (١٩٩٥- ٢٠١٤)

No.	Equation*	R^2	F	P-Value
١	$\ln \hat{y}_1 = 40.652 + 0.001 X_1$ (20.216) (3.639)	0.42	13.24	0.001
٢	$\ln \hat{y}_2 = 3.604 + 7.049 X_2$ (33.106) (3.650)	0.42	13.32	0.001
٣	$\ln \hat{y}_3 = 2.896 + 0.006 X_3$ (8.207) (2.602)	0.27	6.77	0.018

* القيم بين الأقواس تمثل قيمة (t) المحسوبة، وتمثل y_1 نسبة تغطية القرض الفدانى للتكاليف المتغيرة ، X_1 تمثل القرض الفدانى ، وتمثل y_2 الإنتاجية الفدانية ، X_2 تمثل القرض الفدانى ، وتمثل y_3 الإنتاجية الفدانية ، X_3 تمثل نسبة تغطية القرض الفدانى للتكاليف المتغيرة خلال الفترة (١٩٩٥– ٢٠١٤).

المصدر: حسبت من بيانات الجدول رقم (١١) باستخدام البرنامج الإحصائى SPSS.

٢-٢- المؤشرات الائتمانية لمحصول الأرز:

تتمثل أهم المؤشرات الائتمانية لمحصول الأرز فى الأتى:

٢-٢-١- قيمة القرض الفدانى ونسبة تغطية القرض الفدانى للتكاليف المتغيرة لمحصول الأرز:

بدراسة تطور قيمة القرض الفدانى ونسبة تغطية القرض الفدانى للتكاليف المتغيرة لمحصول الأرز خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤)، (٢٠٠٥ – ٢٠١٤)، يتضح أن قيمة القرض الفدانى لمحصول الأرز قد زاد من حوالي ٧٠٤,٣ جنيه بنسبة ٢٦,٠٢% كمتوسط للفترة الأولى إلى حوالي ٢٠٠١,٨ جنيه بنسبة ٧٣,٩٧% كمتوسط للفترة الثانية، كما هو موضح بالجدول رقم (١١)، كما تبين أنها قد تراوحت بين حد أدنى بلغ حوالى ٤٢٢ جنيه فى عام ١٩٩٥، وحد أقصى بلغ حوالى ٣٠٢٥ جنيه في عام ٢٠١٤ ، فى حين بلغ المتوسط السنوى لها خلال نفس الفترة حوالى ١٣٥٣,٠٥ جنيه. وبتقدير العلاقة بين القرض الفدانى ونسبة تغطية القرض الفدانى للتكاليف المتغيرة لمحصول الأرز خلال تلك الفترة، تبين من المعادلة رقم (١) بالجدول رقم (١٢) أنها أخذت إتجاهاً عاماً تصاعدياً بمعدل نمو سنوى بلغ حوالى ٠,١%

٢-٢-٢- بعض معايير الكفاءة الإئتمانية لمحصول الأرز:

تتمثل أهم معايير الكفاءة الائتمانية لمحصول الأرز فى العلاقة بين الانتاجية الفدانية والقرض الفدانى، والعلاقة بين الإنتاجية الفدانية ونسبة تغطية القرض الفدانى للتكاليف المتغيرة كما يلى:

٢-٢-٢-١- العلاقة بين الإنتاجية الفدانية والقرض الفدانى لمحصول الأرز:

بدراسة العلاقة بين الإنتاجية الفدانية للأرز كعامل تابع والقرض الفدانى كعامل مستقل خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤)، (٢٠٠٥ – ٢٠١٤) كما هو موضح فى الجدول رقم (١١)، يتضح أن قيمة الإنتاجية الفدانية زادت من حوالي ٣,٧٩ طن/الفدان بنسبة ٤٧,٠٤ كمتوسط للفترة الأولى إلى حوالي ٤,٢١ طن/الفدان بنسبة ٥٢,٩٥% كمتوسط للفترة الثانية، وتبين أنها قد تراوحت بين حد أدنى بلغ حوالى ٣,١٢ طن/فدان فى عام ٢٠٠١ ، وحد أقصى بلغ ٤,٣٣ طن/الفدان في عام ٢٠٠٨ ، فى حين بلغ المتوسط السنوى لها خلال نفس الفترة حوالى ٤ طن/الفدان. وبتقدير العلاقة بين الانتاجية الفدانية والقرض الفدانى لمجصول الأرز خلال تلك الفترة، تبين من المعادلة رقم (٢) بالجدول رقم (١٢) أنها أخذت إتجاهاً عاماً تصاعدياً بمعدل نمو سنوى بلغ حوالى ٧٠٤,٩%.

٢-٢-٢-٢- العلاقة بين الإنتاجية الفدانية ونسبة تغطية القرض الفدانى للتكاليف المتغيرة لمحصول الأرز:

بدراسة العلاقة بين الإنتاجية الفدانية للأرز كعامل تابع ونسبة تغطية القرض الفدانى للتكاليف المتغيرة كعامل مستقل خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤) ، (٢٠٠٥ – ٢٠١٤) كما هو موضح فى الجدول رقم (١١) ، يتضح أن قيمة نسبة تغطية القرض الفدانى للتكاليف المتغيرة زادت من حوالي ٤٢,٨٧% بنسبة ٤٤,٨٨% كمتوسط للفترة الأولى إلى حوالي٥٢,٦٤% بنسبة ٥٥,١١% كمتوسط للفترة الثانية ، وتبين أنها قد تراوحت بين حد أدنى بلغ حوالى ٣٦,٥٠% فى عام ١٩٩٩ ، وحد أقصى بلغ حوالى ٦٦,٩٥% في عام ٢٠٠٧ ، فى حين بلغ المتوسط السنوى لها خلال نفس الفترة حوالى ٤٧,٥٠%. وبتقدير العلاقة بين الإنتاجية الفدانية ونسبة تغطية القرض الفدانى للتكاليف المتغيرة لمحصول الأرز خلال تلك الفترة ، تبين من المعادلة رقم (٣) بالجدول رقم (١٢) أنها أخذت إتجاهاً تصاعدياً بمعدل نمو سنوى بلغ حوالى ٠,٦٥% .

جدول رقم (٩). المؤشرات الائتمانية لمحصول القمح خلال الفترة (١٩٩٥ - ٢٠١٤).

السنوات	القروض الفدانية (بالجنبه)	التكاليف المتغيرة (بالجنبه)	نسبة التغطية%	الإنتاجية الفدانية(طن/الفدان)
١٩٩٥	٠,٥٨٧	٣٥,٩٤٨	٨٩,٦١	٩٨,١
١٩٩٦	٠,٦٥٢	٩٦,٩٨٨	٩٢,٦٥	١٨,٢
١٩٩٧	٠,٧٢٤	٧,١٠٥٠	٩٠,٦٨	٣٧,٢
١٩٩٨	٠,٨٠٤	٧,١٣٤٢	٨٧,٥٩	٥٥,٢
١٩٩٩	٠,٨٩٣	٩,١٤٠٥	٥١,٦٣	٧٣,٢
٢٠٠٠	٠,٩٩٢	٤,١٥١٠	٦٧,٦٥	٧٤,٢
٢٠٠١	١١٠٢	٦,١٥٢٢	٣٧,٧٢	٧٤,٢
٢٠٠٢	١٢٢٤	٤,١٥٥٨	٥٤,٧٨	٨٠,٢
٢٠٠٣	١٣٥٩	٠,١٧١٥	٢٤,٧٩	٧٧,٢
٢٠٠٤	١٥٠٩	٠,١٩٠٤	٢٥,٧٩	٨٦,٢
متوسط الفترة الأولى	**٦,٩٨٤**	**٧,١٣٩٤**	**٦٩,١٧***	**٥٧,٢**
٢٠٠٥	١٦٧٦	٠,١٩٨١	٦٠,٨٤	٩٩,٢
٢٠٠٦	١٨٦٢	٠,٢١٤٣	٨٨,٨٦	٩٠,٢
٢٠٠٧	٢٠٦٨	٠,٢٦٤٤	٢١,٧٨	٩٧,٢
٢٠٠٨	٢٢٩٧	٠,٣١٤٥	٠٣,٧٣	٠٥,٣
٢٠٠٩	٢٥٥٢	٠,٣٤٥٩	٧٧,٧٣	٨٤,٢
٢٠١٠	٢٨٣٥	٠,٣٦٨٠	٠٣,٧٧	٦١,٢
٢٠١١	٣١٥٠	٠,٤٠٦٩	٤١,٧٧	٨٢,٢
٢٠١٢	٣٥٠٠	٠,٤٣٥٥	٣٦,٨٠	٨٧,٢
٢٠١٣	٣٨٥٠	٠,٤٨٠٨	٠٧,٨٠	٩٢,٢
٢٠١٤	٤٢٣٥	٠,٤٦١٩	٦٨,٩١	٩٤,٢
متوسط الفترة الثانية	**٥,٢٨٠٢**	**٣,٣٤٩٠**	***٨٠,١٢**	**٨٩,٢**
المتوسط العام	**٠٥,١٣٥٣**	**٥,٢٤٤٢**	***٧٤,٤٤**	**٧٣,٢**

*** المتوسط الهندسي**

المصدر: (١) وزارة الزراعة وإستصلاح الأراضى ، قطاع الشئون الإقتصادية ، الإدارة المركزية للإقتصاد الزراعى ، نشرة الإقتصاد، أعداد متفرقة. (٢) البنك الرئيسى للتنمية والائتمان الزراعى، الإدارة العامة للإحصاء ، سجلات قسم الإحصاء ، بيانات غير منشورة

جدول رقم (١٠). العلاقات بين أهم المؤشرات الائتمانية لمحصول القمح خلال الفترة (١٩٩٥- ٢٠١٤)

No.	Equation*	R^2	F	P-Value
١	$\text{Ln}\ \hat{y}_1 = 65.068 + 7.109\ X_1$ (26.126) (4.067)	0.47	16.53	0.000
٢	$\text{Ln}\ \hat{y}_2 = 2.450 + 5.536\ X_2$ (24.159) (2.929)	0.32	8.57	0.009
٣	$\text{Ln}\ \hat{y}_3 = 1.433 + 0.008\ X_3$ (5.856) (3.775)	0.44	14.25	0.001

*القيم بين الأقواس تمثل قيمة (t) المحسوبة، وتمثل y_1 نسبة تغطية القرض الفدانى للتكاليف المتغيرة ، X_1 تمثل القرض الفدانى ، وتمثل y_2 الإنتاجية الفدانية ، X_2 تمثل القرض الفدانى ، وتمثل y_3 الإنتاجية الفدانية ، X_3 تمثل نسبة تغطية القرض الفدانى للتكاليف المتغيرة خلال الفترة (١٩٩٥- ٢٠١٤).

المصدر: حسبت من بيانات الجدول رقم (٩) باستخدام البرنامج الإحصائى SPSS.

العلاقة بين القرض الفدانى ونسبة تغطية القرض الفدانى للتكاليف المتغيرة خلال تلك الفترة، تبين من المعادلة رقم (١) بالجدول رقم (١٠) أنها أخذت إتجاهاً تصاعدياً بمعدل نمو سنوى بلغ حوالى ٧١٠,٩.

٢-١-٢- بعض معايير الكفاءة الائتمانية للقمح:

تتمثل معايير الكفاءة الائتمانية لمحصول القمح فى العلاقة بين الانتاجية الفدانية والقرض الفدانى والعلاقة بين الإنتاجية الفدانية ونسبة تغطية القرض الفدانى للتكاليف المتغيرة كما يلى:

٢-١-٢-١- العلاقة بين الإنتاجية الفدانية والقرض الفدانى:

بدراسة العلاقة بين الإنتاجية الفدانية للقمح كعامل تابع والقرض الفدانى كعامل مستقل خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤) ، (٢٠٠٥ – ٢٠١٤) كما هو موضح فى الجدول رقم (٩) يتضح أن الإنتاجية الفدانية زادت من ٢,٥٨ طن/الفدان بنسبة ٤٧,٠٧% كمتوسط للفترة الأولى إلى ٢,٩٠ طن/الفدان بنسبة ٥٢,٩١% كمتوسط للفترة الثانية، وتبين أن الإنتاجية الفدانية لمحصول القمح قد تراوحت بين حد أدنى بلغ حوالى 1,99 طن/الفدان فى عام ١٩٩٥، وحد أقصى بلغ حوالى ٣,٠٥ طن/الفدان في عام ٢٠٠٨ ، فى حين بلغ المتوسط السنوى لها خلال نفس الفترة حوالى ٢,٧٤ طن/الفدان. وبتقدير العلاقة بين الانتاجية الفدانية والقرض الفدانى لمحصول القمح خلال تلك الفترة، تبين من المعادلة رقم (٢) بالجدول رقم (١٠) أنها أخذت إتجاهاً تصاعدياً بمعدل نمو سنوى بلغ حوالى ٥٥٣,٦% .

٢-١-٢-٢- العلاقة بين الانتاجية الفدانية ونسبة تغطية القرض الفدانى للتكاليف المتغيرة:

بدراسة العلاقة بين الانتاجية الفدانية للقمح كعامل تابع ونسبة تغطية القرض الفدانى للتكاليف المتغيرة كعامل مستقل خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤) ، (٢٠٠٥ – ٢٠١٤) كماهو موضح فى الجدول رقم (٩) ، يتضح أن قيمة نسبة تغطية القرض الفدانى للتكاليف المتغيرة لمحصول القمح زادت من حوالي ٦٩,١٧% كمتوسط للفترة الأولى بنسبة ٤٦,٣٩% إلى حوالي ٨٠,١٢ % بنسبة ٥٣,٦٠% كمتوسط للفترة الثانية، وتبين أنها قد تراوحت بين حد أدنى بلغ حوالى ٦١,٨٩% فى عام ١٩٩٥، وحد أقصى بلغ حوالى ٦٨,٩١ % في عام ٢٠١٤، فى حين بلغ المتوسط السنوى لها خلال نفس الفترة حوالى ٧٤,٤٤%. وبتقدير العلاقة بين الإنتاجية الفدانية ونسبة تغطية القرض الفدانى للتكاليف المتغيرة لمحصول القمح خلال تلك الفترة، تبين من المعادلة رقم (٣) بالجدول رقم (١٠) أنها أخذت إتجاهاً تصاعدياً بمعدل نمو سنوى بلغ حوالى ٠,٨٥% .

رقم (٧) ، وتبين أنها قد تراوح بين حد أدنى بلغ حوالى ٠,٠٤% فى عام ١٩٩٦، وحد أقصى بلغ حوالى ١٠,٤٦% في عام ٢٠١٤ ، فى حين بلغ المتوسط الهندسي لها خلال نفس الفترة حوالى ٠,٢٣%. وبتقدير معادلة الإتجاه العام الزمنية لمعدل العائد إلى إجمالى القروض خلال تلك الفترة ، تبين عدم ثبوت معنوية معامل الاتجاه العام الزمني عند مستويات المعنوية المألوفة.

جدول رقم (٨). معادلات القيم الإتجاهية لتطور معدلات الربحية خلال الفترة (١٩٩٥- ٢٠١٤).

Item	Equation*	R^2	F	P-Value
معدل العائد على رأس المال	$\text{Ln } \hat{y}_1 = 0.417 + 0.234 \text{ Ln } X$ (0.467) (0.592)	0.01	0.35	0.561
معدل العائد على حق الملكية	$\text{Ln } \hat{y}_2 = -1.192 + 0.775 \text{ Ln } X$ (−1.557) (2.288)	0.22	5.233	0.034
معدل العائد على الودائع	$\text{Ln } \hat{y}_3 = -1.768 + 0.191 \text{ Ln } X$ (−2.490) (0.609)	0.02	0.371	0.550
معدل العائد على الموارد	$\text{Ln } \hat{y}_4 = -2.119 + 0.277 \text{ Ln } X$ (−2.971) (0.879)	0.04	0.773	0.390
معدل العائد على إجمالى الأصول	$\text{Ln } \hat{y}_5 = -2.587 + 0.379 \text{ Ln } X$ (−3.572) (1.185)	0.07	1.403	0.251
معدل العائد على الأصول الإيرادية	$\text{Ln } \hat{y}_6 = -1.787 + 0.139 \text{ Ln } X$ (−2.439) (0.430)	0.01	0.184	0.672
معدل العائد إلى إجمالى القروض	$\text{Ln } \hat{y}_7 = -2.820 + 0.541 \text{ Ln } X$ (−3.732) (1.620)	0.12	2.624	0.122

*القيم بين الأقواس تمثل قيمة (t) المحسوبة، وتمثل X الزمن خلال الفترة (١٩٩٥– ٢٠١٤).

المصدر: حسبت من بيانات الجدول رقم (٧) بإستخدام البرنامج الإحصائى SPSS.

٢- أهم المؤشرات الائتمانية لأهم المحاصيل الزراعية فى محافظة البحيرة:

٢-١- المؤشرات الائتمانية لمحصول القمح : تتمثل أهم المؤشرات الائتمانية لمحصول القمح(**شرين ، ٢٠٠٨**) ، (**Mir Kalan *et al.*, 2008**) فى الأتى:

٢-١-١- قيمة القرض الفدانى ونسبة تغطية القرض الفدانى للتكاليف المتغيرة لمحصول القمح:

بدراسة تطور قيمة القرض الفدانى ونسبة تغطية القرض الفدانى للتكاليف المتغيرة لمحصول القمح خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤) ، (٢٠٠٥ – ٢٠١٤)، يتضح أن قيمة القرض الفدانى لمحصول القمح زاد من ٩٨٤,٦ جنيه بنسبة ٢٥,٩٩% كمتوسط للفترة الأولى إلى ٢٨٠٢,٥ جنيه بنسبة ٧٤% كمتوسط للفترة الثانية كما هو موضح بالجدول رقم (٩)، وتبين أنها قد تراوحت بين حد أدنى بلغ حوالى ٥٨٧جنيه فى عام ١٩٩٥ ، وحد أقصى بلغ حوالى ٤٢٣٥ جنيه في عام ٢٠١٤، فى حين بلغ المتوسط السنوى لها خلال نفس الفترة حوالى ١٣٥٣,٠٥ جنيه. وبتقدير

١-٤-٦- معدل العائد على الأصول الإيرادية:

بدراسة تطور معدل العائد على الأصول الإيرادية لقياس الكفاءة الداخلية لبنك التنمية والائتمان الزراعى المصري خلال فترتى الدراسة (١٩٩٥ - ٢٠٠٤) ، (٢٠٠٥ - ٢٠١٤) يتضح أن معدل العائد على الأصول الإيرادية قد زاد من حوالي ٠,١٦% كمتوسط للفترة الأولى إلي حوالي ٠,٤٣% كمتوسط للفترة الثانية كما هو موضح بالجدول رقم (٧) ، وتبين أنها قد تراوح بين حد أدنى بلغ حوالى ٠,٠٥% فى عام ٢٠٠٤ ، وحد أقصى بلغ حوالى ٨,٤٩ % في عام ٢٠١٤ ، فى حين بلغ المتوسط الهندسى لها خلال نفس الفترة حوالى ٠,٢٦%. وبتقدير معادلة الإتجاه العام الزمنية لمعدل العائد على الأصول الإيرادية خلال تلك الفترة ، تبين عدم ثبوت معنوية معامل الاتجاه العام الزمني عند مستويات المعنوية المألوفة.

جدول رقم (٧). تطور معدلات الربحية خلال فترتى الدراسة (١٩٩٥- ٢٠٠٤) ، (٢٠٠٥- ٢٠١٤)

السنوات	معدل العائد على رأس المال%	معدل العائد على حق الملكية%	معدل العائد على الودائع%	مدل العائد على الموارد%	معدل العائد على إجمالى الأصول%	معدل العائدعلى الإيرادات%	معدل العائد إلى إجمالى القروض%
١٩٩٥	٦,٧٠	١٩,١	٣٩,٠	٠,٢٩	٠,١٩	٠,٤١	٠,٢٠
١٩٩٦	٠,٤٢	٢٨,٠	٠٨,٠	٠,٠٦	٠,٠٤	٠,٠٩	٠,٠٤
١٩٩٧	٠,٥٤	٤٥,٠	١٢,٠	٠,١٠	٠,٠٧	٠,١١	٠,٠٦
١٩٩٨	٨,١٢	٦٧,٠	١٧,٠	٠,١٣	٠,١٠	٠,١٦	٠,٠٩
١٩٩٩	١,١٨	٩٨,٠	٢٢,٠	٠,١٨	٠,١٤	٠,٢١	٠,١٣
٢٠٠٠	١,٣٠	٠٧,١	٢٢,٠	٠,١٨	٠,١٤	٠,٢١	٠,١٢
٢٠٠١	٠,٨٠	٦٧,٠	١٧,٠	٠,١٣	٠,٠٩	٠,١٠	٠,٠٩
٢٠٠٢	١,١٨	٩٨,٠	٢٢,٠	٠,١٨	٠,١٣	٠,١٤	٠,١٣
٢٠٠٣	٣,٣٠	٦٧,٢	٥٨,٠	٠,٤٧	٠,٣٣	٠,٣٦	٠,٣٢
٢٠٠٤	٠,٥١	٤٤,٠	٠٧,٠	٠,٠٦	٠,٠٤	٠,٠٥	٠,٠٤
متوسط الفترة الأولى	**١,٤١**	**٠,٧٨**	**٠,١٩**	**٠,١٥**	**٠,١١**	**٠,١٦**	**٠,١١**
٢٠٠٥	٦٤,٣	٠٩,٣	٤٥,٠	٠,٣٩	٠,٣٠	٠,٣٧	٠,٣٤
٢٠٠٦	٨٢,٥	٩١,٤	٧٠,٠	٠,٦١	٠,٤٩	٠,٥٢	٠,٥٣
٢٠٠٧	٩٠,٠	٧٤,٠	٠٩,٠	٠,٠٨	٠,٠٦	٠,٠٧	٠,٠٧
٢٠٠٨	٠٥,١	٨٧,٠	٠٩,٠	٠,٠٨	٠,٠٧	٠,٠٨	٠,٠٨
٢٠٠٩	٣٣,١	١٠,١	٠٨,٠	٠,٠٧	٠,٠٦	٠,٠٩	٠,٠٩
٢٠١٠	١٩,٢	٨٠,١	١٤,٠	٠,٠١٣	٠,١٢	٠,١٤	٠,١٧
٢٠١١	٢,٣٦	٩٣,١	١٢,٠	٠,١١	٠,١٠	١٣,٠	٠,٢١
٢٠١٢	٧١,٤٤	٦٨,٣٦	٧١,٢	٥٣,٢	٢,٣٦	٨٧,٢	٣,٦٧
٢٠١٣	٥٦,٦٣	١٥,٥٢	٩٣,٣	٦٦,٣	٣,٣٠	٧٨,٣	٥٣,٤
٢٠١٤	٢,١٤١	٦,١١٥	٧٣,٧	٢٥,٧	٧,١٢	٤٩,٨	٤٦,١٠
متوسط الفترة الثانية	**٥,٩٥**	**٤,٩٣**	**٠,٤٥**	**٠,٤٢**	**٠,٣٦**	**٠,٤٣**	**٠,٤٨**
المتوسط الهندسى	**٢,٩٠**	**١,٩٦**	**٠,٢٩**	**٠,٢٥**	**٠,٢٠**	**٠,٢٦**	**٠,٢٣**

المصدر: جمعت وحسبت من بيانات: البنك الرئيسي للتنمية والائتمان الزراعى المصري، سجلات الميزانية، القاهرة ، بيانات غير منشورة.

١-٤-٧- معدل العائد إلى إجمالى القروض :

بدراسة تطور معدل العائد إلى إجمالى القروض لقياس الكفاءة الداخلية لبنك التنمية والائتمان الزراعى المصري خلال فترتى الدراسة (١٩٩٥ - ٢٠٠٤) ، (٢٠٠٥ - ٢٠١٤) يتضح أن معدل العائد إلى إجمالى القروض قد زاد من حوالي ٠,١١% كمتوسط للفترة الأولى إلى حوالي ٠,٤٩% كمتوسط للفترة الثانية كما هو موضح بالجدول

١–٤–٢– معدل العائد على حق الملكية:

بدراسة تطور العائد على حق الملكية لقياس الكفاءة الداخلية لبنك التنمية والائتمان الزراعى المصري خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤) ، (٢٠٠٥ – ٢٠١٤) يتضح أن معدل العائد على حق الملكية قد زاد من حوالي ٠,٧٨% كمتوسط للفترة الأولى إلى حوالي 4.94% كمتوسط للفترة الثانية كما هو موضح بالجدول رقم (٧) ، وتبين أنها قد تراوح بين حد أدنى بلغ حوالى ٠,٢٩% فى عام ١٩٩٦، وحد أقصى بلغ حوالى ١١٥,٦٨% في عام ٢٠١٤ ، فى حين بلغ المتوسط الهنسي لها خلال نفس الفترة حوالى ١,٩٧% وبتقدير معادلة الإتجاه العام الزمنية لمعدل العائد على حق الملكية خلال تلك الفترة ، تبين من المعادلة رقم (٢) بالجدول رقم (٨) أنها أخذت إتجاهاً تصاعدياً بنسبة تبلغ حوالى ٧٧,٥% سنويًا.

١–٤–٣– معدل العائد على الودائع:

بدراسة تطور معدل الودائع لقياس الكفاءة الداخلية لبنك التنمية والائتمان الزراعى المصري خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤) ، (٢٠٠٥ – ٢٠١٤) يتضح أن معدل العائد على الودائع قد زاد من حوالي ٠,١٩% كمتوسط للفترة الأولى إلى حوالي ٠,٤٦% كمتوسط للفترة الثانية كما هو موضح بالجدول رقم (٧) ، وتبين أنها قد تراوح بين حد أدنى بلغ حوالى ٠,٠٧% فى عام ٢٠٠٤، وحد أقصى بلغ حوالى ٧,٧٤% في عام ٢٠١٤ ، فى حين بلغ المتوسط الهندسي لها خلال نفس الفترة حوالى ٠,٣٠%. وبتقدير معادلة الإتجاه العام الزمنية لمعدل العائد على الودائع خلال تلك الفترة ، تبين عدم ثبوت معنوية معامل الاتجاه العام الزمني عند مستويات المعنوية المألوفة.

١–٤–٤– معدل العائد على الموارد:

وبدراسة تطور معدل العائد على الموارد لقياس الكفاءة الداخلية لبنك التنمية والائتمان الزراعى المصري خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤) ، (٢٠٠٥ – ٢٠١٤) يتضح أن معدل العائدعلى الموارد قد زاد من حوالي ٠,١٥% كمتوسط للفترة الأولى إلى حوالي 0,42% كمتوسط للفترة الثانية كما هو موضح بالجدول رقم (٧) ، وتبين أنها قد تراوح بين حد أدنى بلغ حوالى ٠,٠٦% فى عام ١٩٩٦ ، وحد أقصى بلغ حوالى ٧,٢٥% في عام ٢٠١٤ ، فى حين بلغ المتوسط الهندسي لها خلال نفس الفترة حوالى ٠,٢٥%. وبتقدير معادلة الإتجاه العام الزمنية لمعدل العائد على الموارد خلال تلك الفترة ، تبين عدم ثبوت معنوية معامل الاتجاه العام الزمني عند مستويات المعنوية المألوفة.

١–٤–٥– معدل العائد على إجمالى الأصول:

بدراسة تطور معدل العائد على إجمالى الأصول لقياس الكفاءة الداخلية لبنك التنمية والائتمان الزراعى المصري خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤) ، (٢٠٠٥ – ٢٠١٤) يتضح أن معدل العائد على إجمالى الأصول قد زاد من حوالي ٠,١١% كمتوسط للفترة الأولى إلى حوالي 0,36% كمتوسط للفترة الثانية كما هو موضح بالجدول رقم (٧) ، وتبين أنها قد تراوح بين حد أدنى بلغ حوالى ٠,٠٥% فى عام ٢٠٠٤ ، وحد أقصى بلغ حوالي ٧,١٣% في عام ٢٠١٤ ، فى حين بلغ المتوسط الهندسي لها خلال نفس الفترة حوالى ٠,٢٠%. وبتقدير معادلة الإتجاه العام الزمنية لمعدل إجمالى الأصول خلال تلك الفترة ، تبين عدم ثبوت معنوية معامل الاتجاه العام الزمني عند مستويات المعنوية المألوفة.

جدول رقم (٥). معدلات توظيف الأموال خلال فترتى الدراسة (١٩٩٥- ٢٠٠٤) ، (٢٠٠٥- ٢٠١٤)

السنوات	معدل إقراض الودائع%	معدل إقراض الموارد%	معدل توظيف الموارد%	معدل السحب على المكشوف%
١٩٩٥	١٩٤,٥٨	١٤٦,٣١	١٤٧,٠٨	٨,٣٦
١٩٩٦	١٩٩,٥٠	١٥٢,٠٦	١٥٢,٧٨	٧,٩٣
١٩٩٧	١٩١,١٠	١٤٨,٨٥	١٤٩,٥١	٥,٨٤
١٩٩٨	١٧٩,٧٥	١٤٣,٤٥	١٤٤,٠٦	١,٢٨
١٩٩٩	١٧٤,٢٩	١٤١,٨٠	١٤٢,٣٧	٠,٢٨
٢٠٠٠	١٧٦,٢١	١٤٥,٢٤	١٤٥,٨٤	٠,٨٨
٢٠٠١	١٨٠,١١	١٤٣,٥٩	١٤٤,٢٠	٠,٥٢
٢٠٠٢	١٧٤,٨٠	١٤٢,١٤	١٤٢,٧١	٠,١٩
٢٠٠٣	١٧٧,٣٨	١٤٥,٧٨	١٤٦,٣٨	٠,٠٨
٢٠٠٤	١٤٩,٤٣	١٢٧,٧٥	١٢٨,٣٠	٠,٠٢
متوسط الفترة الأولى	**١٧٩,١١**	**١٤٣,٥٧**	**١٤٤,١٩**	**٠,٦٩**
٢٠٠٥	١٣٠,٣٨	١١٣,٦٤	١١٥,٠٥	٠,٠١
٢٠٠٦	١٣١,٦١	١١٥,٠٣	١١٧,٠٤	٠,٠١
٢٠٠٧	١٢٦,٢٢	١١١,٩٠	١١٤,٠٥	٠,٠٢
٢٠٠٨	١٢٣,٥٣	١١٠,٨٧	١١٢,٨٧	٠,٠١
٢٠٠٩	٨٧,٨٥	٨١,٥٦	٨٢,٩١	٠,٠٤
٢٠١٠	٨٣,٨١	٧٧,٤١	٧٩,٩٣	٠,٠٥
٢٠١١	٥٨,٧٩	٥٥,٢٥	٦٨,٨٦	٠,٠٠٤
٢٠١٢	٧٣,٩٨	٦٨,٨٧	٨٣,٦٨	٠,٠٠١
٢٠١٣	٨٦,٩٠	٨٠,٧٩	٩٤,٠٥	٠,٠٠١
٢٠١٤	٧٣,٩٢	٦٩,٢٨	٧٨,٣١	٠,٠٠٠
متوسط الفترة الثانية	**٩٤,٢٠**	**٨٥,٨٨**	**٩٣,١٣**	**٠,٠٠٠٨**
المتوسط الهندسى	**١٢٩,٩٣**	**١١١,٠٣**	**١١٥,٨٤**	**٠,٠٩٤١**

المصدر: جمعت وحسبت من بيانات: البنك الرئيسي للتنمية والائتمان الزراعى المصري، سجلات الميزانية، القاهرة ، بيانات غير منشورة.

جدول رقم (٦). معادلات القيم الإتجاهية لتطور معدلات توظيف الأموال خلال الفترة (١٩٩٥- ٢٠١٤).

Item	Equation*	R2	F	P-Value
معدل إقراض الودائع	$\text{Ln}\ \hat{y}1 = 5.667 - 0.378\ \text{Ln}\ X$ (36.388) (−5.486)	0.62	30.10	0.000
معدل معدل إقراض الموارد	$\text{Ln}\ \hat{y}2 = 5.330 - 0.293\ \text{Ln}\ X$ (38.058) (−4.729)	0.55	22.36	0.000
معدل معدل توظيف الموارد	$\text{Ln}\ \hat{y}3 = 5.276 - 0.247\ \text{Ln}\ X$ (47.168) (−5.001)	0.58	25.01	0.001
معدل معدل السحب على المكشوف	$\text{Ln}\ \hat{y}4 = 4.275 - 3.136\ \text{Ln}\ X$ (4.615) (−7.651)	0.76	58.53	0.000

*القيم بين الأقواس تمثل قيمة (t) المحسوبة، وتمثل X الزمن خلال الفترة (١٩٩٥– ٢٠١٤).

المصدر: حسبت من بيانات الجدول رقم (٥) باستخدام البرنامج الإحصائى SPSS.

١-٣-٤- معدل السحب على المكشوف:

بدراسة تطور معدل السحب على المكشوف لقياس الكفاءة الداخلية لبنك التنمية والائتمان الزراعى المصري خلال فترتى الدراسة (١٩٩٥ - ٢٠٠٤) ، (٢٠٠٥ - ٢٠١٤) يتضح أن معدل السحب على المكشوف قد نقص من حوالي ٠,٦٩% كمتوسط للفترة الأولى إلي حوالي ٠,٠٠٠٨% كمتوسط للفترة الثانية كما هو موضح بالجدول رقم (٥) ، وتبين أنها قد تراوح بين حد أدنى بلغ حوالى صفر فى عام ٢٠١٤ ، وحد أقصى بلغ حوالى ٨,٣٧% في عام ١٩٩٥، فى حين بلغ المتوسط الهندسي لها خلال نفس الفترة حوالى ٠,٠٩٤% وبتقدير معادلة الإتجاه العام الزمنية لمعدل السحب على المكشوف خلال تلك الفترة ، تبين من المعادلة رقم (٤) بالجدول رقم (٦) أنها أخذت إتجاهاً تنازلياً بنسبة تبلغ حوالى ٣١٣,٦ سنويًا.

١-٤- معدلات الربحية:

١-٤-١- معدل العائد على رأس المال:

تشير البيانات بالجدول رقم (٧) إلي تطور معدل العائد على رأس المال لقياس الكفاءة الداخلية لبنك التنمية والائتمان الزراعى المصري خلال فترتى الدراسة (١٩٩٥ - ٢٠٠٤) ، (٢٠٠٥ - ٢٠١٤) ، ويتضح منها أن معدل العائد على رأس المال قد زاد من حوالي ١,٤١% كمتوسط للفترة الأولى إلى حوالي 5,95% كمتوسط للفترة الثانية، كما تبين أنها قد تراوح بين حد أدنى بلغ حوالى ٠,٤٢% فى عام ١٩٩٦ ، وحد أقصى بلغ حوالى ١٤١,٢٥% في عام ٢٠١٤ ، فى حين بلغ المتوسط الهندسي لها خلال نفس الفترة حوالى ٢,٩٠ ، وبتقدير معادلة الإتجاه العام الزمنية لمعدل العائد على رأس المال خلال تلك الفترة تبين وبتقدير معادلة الإتجاه العام الزمنية لمعدل العائد على رأس المال خلال تلك الفترة ، تبين عدم ثبوت معنوية معامل الاتجاه العام الزمني لمعدل العائد على رأس المال عند مستويات المعنوية المألوفة.

جدول رقم (٤). معادلات القيم الإتجاهية لتطور معدلات كفاية أو ملائمة رأس المال خلال الفترة (١٩٩٥-٢٠١٤).

Item	Equation*	R^2	F	P–Value
معدل حق الملكية إلى الودائع	$\ln \hat{Y}1 = 3.990 - 0.603 \ln X$ (22.260) (-7.610)	0.76	57.91	0.000
معدل حق الملكية إلى الاصول الخطرة	$\ln \hat{Y}2 = 3.158 - 0.334 \ln X$ (39.718) (-9.493)	0.83	90.11	0.000
هامش الأمان	$\ln \hat{Y}3 = 9.841 - 1.480 \ln X$ (13.754) (-4.678)	0.54	21.88	0.002
معدل حق الملكية إلى القروض	$\ln \hat{Y}4 = 2.928 - 0.225 \ln X$ (56.989) (-9.923)	0.84	98.47	0.000

*القيم بين الأقواس تمثل قيمة (t) المحسوبة، وتمثل X الزمن خلال الفترة (١٩٩٥- ٢٠١٤).

المصدر: حسبت من بيانات الجدول رقم (٣) باستخدام البرنامج الإحصائى SPSS.

١-٣-٢- معدل إقراض الموارد:

بدراسة تطور معدل إقراض الموارد لقياس الكفاءة الداخلية لبنك التنمية والائتمان الزراعى المصري خلال فترتى الدراسة (١٩٩٥ -٢٠٠٤) ، (٢٠٠٥- ٢٠١٤) يتضح أن معدل إقراض الموارد قد نقص من حوالي ١٤٣,٥٧% كمتوسط للفترة الأولى إلى حوالي ٨٥,٨٨% كمتوسط للفترة الثانية كما هو موضح بالجدول رقم (٥) ، وتبين أنها قد تراوح بين حد أدنى بلغ حوالى ٥٥,٢٥% فى عام ٢٠١١ ، وحد أقصى بلغ حوالى١٥٢,٠٦% في عام ١٩٩٦ ، فى حين بلغ المتوسط الهندسي لها خلال نفس الفترة حوالى ١٤٤,١٩%. وبتقدير معادلة الإتجاه العام الزمنية لمعدل إقراض الموارد خلال تلك الفترة ، تبين من المعادلة رقم (٢) بالجدول رقم (٦) أنها أخذت إتجاهاً تنازلياً بنسبة تبلغ حوالى ٢٩,٣% سنويًا.

١-٣-٣- معدل توظيف الموارد:

بدراسة تطور معدل توظيف الموارد لقياس الكفاءة الداخلية لبنك التنمية والائتمان الزراعى المصري خلال فترتى الدراسة (١٩٩٥ - ٢٠٠٤) ، (٢٠٠٥ - ٢٠١٤) يتضح أن معدل توظيف الموارد قد نقص من حوالي ١٤٤,١٩% كمتوسط للفترة الأولى إلى حوالي ٩٣,٠٧% كمتوسط للفترة الثانية كما هو موضح بالجدول رقم (٥) ، وتبين أنها قد تراوح بين حد أدنى بلغ حوالى ٦٨,٨٦% فى عام ٢٠١١، وحد أقصى بلغ حوالى ١٥٢,٧٩% في عام ١٩٩٦ ، فى حين بلغ المتوسط الهندسي لها خلال نفس الفترة حوالى ٨٥,١١%. وبتقدير معادلة الإتجاه العام الزمنية لمعدل توظيف الموارد خلال تلك الفترة ، تبين من المعادلة رقم (٣) بالجدول رقم (٦) أنها أخذت إتجاهاً تنازلياً بنسبة تبلغ حوالى ٢٤,٧% سنويًا.

١-٣- معدلات توظيف الأموال:

١-٣-١- معدل إقراض الودائع:

تشير البيانات الواردة بالجدول رقم (٥) إلي تطور معدل إقراض الودائع لقياس الكفاءة الداخلية لبنك التنمية والائتمان الزراعى المصري خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤) ، (٢٠٠٥ – ٢٠١٤) ، ويتضح أن معدل إقراض الودائع قد نقص من ١٧٩,١١% كمتوسط للفترة الأولى إلى ٩٤,٢٠% كمتوسط للفترة الثانية، كما تبين أنها قد تراوح بين حد أدنى بلغ حوالى ٨٠,٥٨% فى عام ٢٠١١، وحد أقصى بلغ حوالى ١٩٩,٥١ % في عام ١٩٩٦ ، فى حين بلغ المتوسط السنوى لها خلال نفس الفترة حوالى ١٢٩,٩٤% وبتقدير معادلة الإتجاه العام الزمنية لمعدل إقراض الودائع خلال تلك الفترة ، تبين من المعادلة رقم (١) بالجدول رقم (٦) أنها أخذت إتجاهاً تنازلياً بنسبة تبلغ حوالى ٣٧,٨% سنويًا.

جدول رقم (٣). معدلات كفاية أو ملائمة رأس المال خلال فترتى الدراسة (١٩٩٥- ٢٠٠٤) ، (٢٠٠٥- ٢٠١٤).

السنوات	معدل حق الملكية إلى الودائع %	معدل حق الملكية للأصول الخطرة %	هامش الأمان %	معدل حق الملكية إلى القروض%
١٩٩٥	٣٢,٩٩	١٨,٣٦	٣٢٢٨,٤٧	١٦,٩٥
١٩٩٦	٣١,١٩	١٨,٧٨	٣٢٩٥,٨١	١٥,٦٣
١٩٩٧	٢٨,٣٨	١٦,٢٤	٣٣٥٣,٦٧	١٤,٨٥
١٩٩٨	٢٥,٣٠	١٥,٠١	٣٣١٢,٣٤	١٤,٠٧
١٩٩٩	٢٢,٩١	١٤,٨٣	٣٢٣٤,٨٩	١٣,١٤
٢٠٠٠	٢١,٣١	١٣,٧٨	٢٩٤٩,٣٤	١٢,٠٩
٢٠٠١	٢٥,٣٤	١٤,٨٥	٣٣٢٣,١٢	١٤,١٢
٢٠٠٢	٢٢,٨٩	١٤,٣١	٣٢٣٤,٨٨	١٣,١٤
٢٠٠٣	٢١,٦٧	١٣,٢٤	٢٩٧٨,٧٣	١٢,٢١
٢٠٠٤	١٦,٩٧	١٢,١٦	٢٦٤٣,٨٠	١١,٣٥
متوسط الفترة الأولى	**٢٤,٤٩**	**١٥,٠٤**	**٣١٤٧,٦٦**	**١٣,٦٦**
٢٠٠٥	١٤,٧٢	١١,٦٩	٩١١,٣٨	١١,٢٩
٢٠٠٦	١٤,٤١	١٠,٦٠	٦٢٦,٦٠	١٠,٩٥
٢٠٠٧	١٢,٧٩	٩,٧٧	٥٢٨,٦١	١٠,١٣
٢٠٠٨	١١,٤١	٩,٠٧	٥١٤,١٠	٩,٢٣
٢٠٠٩	٧,٧٠	٨,٤٩	٥٢٩,٧٢	٨,٧٧
٢٠١٠	٨,٢٦	٧,٧١	٣٠٢,٨٤	٩,٨٦
٢٠١١	٦,٤٢	٨,٢٧	٤٤,٣١	١٠,٩١
٢٠١٢	٧,٤٠	٨,٩٠	٤٦,٥٦	١٠,٠١
٢٠١٣	٧,٥٥	٨,٠٠	٥٢,٩٨	٨,٦٩
٢٠١٤	٦,٦٨	٧,٨٠	٦٩,٤٣	٩,٠٤
متوسط الفترة الثانية	**٩,٢٨**	**٨,٩٥**	**٢١٢,٦٤**	**٩,٨٥**
المتوسط الهندسى	**١٥,٠٧**	**١,٦٠**	**١٢,٨١٨**	**١١,٦٠**

المصدر: جمعت وحسبت من بيانات: البنك الرئيسي للتنمية والائتمان الزراعى المصري، سجلات الميزانية، القاهرة ، بيانات غير منشورة.

١-٢-٢- معدل حق الملكية إلى الأصول الخطرة

بدراسة تطور معدل حق الملكية إلى الأصول الخطرة لقياس الكفاءة الداخلية لبنك التنمية والائتمان الزراعى المصري خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤) ، (٢٠٠٥ – ٢٠١٤) يتضح أن معدل حق الملكية إلى الأصول الخطرة قد نقص من حوالي ١٥,٠٤% كمتوسط للفترة الأولى إلى حوالي ٨,٦٩% كمتوسط للفترة الثانية كما هو موضح بالجدول رقم (٣) ، وتبين أنها قد تراوح بين حد أدنى بلغ حوالى ٧,٧٢% فى عام ٢٠١٠ ، وحد أقصى بلغ حوالى ١٨,٧٩% في عام ١٩٩٦ ، فى حين بلغ المتوسط الهندسي لها خلال نفس الفترة حوالى ١١,٦١% وبتقدير معادلة الإتجاه العام الزمنية لمعدل حق الملكية إلى الأصول الخطرة خلال تلك الفترة ، تبين من المعادلة رقم (٢) بالجدول رقم (٤) أنها أخذت إتجاهاً تنازلياً بنسبة تبلغ حوالى ٣٣,٤% سنويًا.

١-٢-٣- معدل حق الملكية إلى الاستثمارات فى أوراق مالية غير حكومية أو مضمونة (هامش الأمان)

بدراسة تطور معدل حق الملكية إلى الإستثمارات فى أوراق مالية غير حكومية أو مضمونة (هامش الأمان) لقياس الكفاءة الداخلية لبنك التنمية والائتمان الزراعى المصري خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤) ، (٢٠٠٥ – ٢٠١٤) يتضح أن معدل حق الملكية إلى الاستثمارات فى أوراق مالية غير حكومية أو مضمونة (هامش الأمان) قد نقص من حوالي ٣١٤٧,٦٦% كمتوسط للفترة الأولى إلى حوالي ٢١٢,٦٤% كمتوسط للفترة الثانية كما هو موضح بالجدول رقم (٣) ، وتبين أنها قد تراوح بين حد أدنى بلغ حوالى ٤٤,٣١% فى عام ٢٠١١ ، وحد أقصى بلغ حوالى ٣٣٥٣,٦٧% في عام ١٩٩٧ ، فى حين بلغ المتوسط الهندسي لها خلال نفس الفترة حوالى ٨١٨,١٢% وبتقدير معادلة الإتجاه العام الزمنية لمعدل حق الملكية إلى الاستثمارات فى أوراق مالية غير حكومية أو مضمونة (هامش الأمان) خلال تلك الفترة ، تبين من المعادلة رقم (٣) بالجدول رقم (٤) أنها أخذت إتجاهاً تنازلياً بنسبة تبلغ حوالى ١٤٨% سنويًا.

١-٢-٤- معدل حق الملكية إلى القروض

بدراسة تطور معدل حق الملكية إلى القروض لقياس الكفاءة الداخلية لبنك التنمية والائتمان الزراعى المصري خلال فترتى الدراسة (١٩٩٥-٢٠٠٤) ، (٢٠٠٥-٢٠١٤) يتضح أن معدل حق الملكية إلى القروض قد نقص من حوالي ١٣,٦٧% كمتوسط للفترة الأولى إلى حوالي 9,85% كمتوسط للفترة الثانية كما هو موضح بالجدول رقم (٣) ، وتبين أنها قد تراوح بين حد أدنى بلغ حوالى ٨,٦٩% فى عام ٢٠١٣ ، وحد أقصى بلغ حوالى ١٦,٩٦% في عام ١٩٩٥ ، فى حين بلغ المتوسط الهندسى لها خلال نفس الفترة حوالى ٦٠,١١%. وبتقدير معادلة الإتجاه العام الزمنية لمعدل حق الملكية إلى إجمالى القروض خلال تلك الفترة ، تبين من المعادلة رقم (٤) بالجدول رقم (٤) أنها أخذت إتجاهاً تنازلياً بنسبة تبلغ حوالى ٢٢,٥% سنويًا.

جدول رقم (١). تطور معدلات السيولة خلال فترتى الدراسة (١٩٩٥- ٢٠٠٤) ، (٢٠٠٥– ٢٠١٤)

السنوات	معدل السيولة السريع%	معدل السيولة النقدية%	معدل الاحتياطى القانونى%
١٩٩٥	٤٩,٥٥	١٧,٨٥	١٧,٤٥
١٩٩٦	٨٢,٢٣	١٧,٤٣	١٧,٤٢
١٩٩٧	٨٤,٢٨	١,٤٠	١,٤٣
١٩٩٨	٨٨,٩٩	١,٥٨	١,٦٠
١٩٩٩	٩٣,٦٤	٤,٩٧	٤,٩٣
٢٠٠٠	٨٩,٧٢	٨,٣١	٨,٢٢
٢٠٠١	٦٥٨,٧٩	١,٥٨	١,٦٠
٢٠٠٢	٦٩٨,٨٨	٤,٨٩	٤,٩٥
٢٠٠٣	٧٧٩,١٤	٨,٣١	٨,٢٧
٢٠٠٤	٨٥٢,٦٧	١٨,٩٦	١٦,١٢
متوسط الفترة الأولى	**١٩٤,٧٧**	**٥,٦٨**	**٥,٥٩**
٢٠٠٥	٩٣٥,٦٨	٢٧,٣٢	٢٠,٤٦
٢٠٠٦	٩٧٥,١٠	٧,٧٩	٦,٠١
٢٠٠٧	١٠٥٩,٥٧	٨,٠٧	٥,٧٠
٢٠٠٨	١١٤٦,١٤	٩,٢٤	٦,٠٧
٢٠٠٩	١٦٤٢,٠٣	٧٩,٥٦	٣٦,٤٨
٢٠١٠	١٤٦١,١١	٣٠,٧٩	١٤,٠١
٢٠١١	١٧٨٧,٦٥	٧٥,٦٤	٢٤,٦٥
٢٠١٢	١٤٩٤,٢٣	٣٨,٧٩	١٥,٦٤
٢٠١٣	١٥٢٤,٥٨	٢١,٤٤	١٠,٥٩
٢٠١٤	١٥٦٧,٨٦	٣١,٣٠	١٣,٢٦
متوسط الفترة الثانية	**١٣٢٧,٣٣**	**٢٤,٤٦**	**١٢,٧٩**
المتوسط الهندسى	**٥٠٨,٤٥**	**١١,٧٩**	**٨,٤٦**

المصدر: جمعت وحسبت من بيانات: البنك الرئيسي للتنمية والائتمان الزراعى المصري، سجلات الميزانية، القاهرة ، بيانات غير منشورة.

جدول رقم (٢). معادلات القيم الإتجاهية لتطور معدلات السيولة خلال الفترة (١٩٩٥- ٢٠١٤).

Item	Equation*	R^2	F	P-Value
معدل السيولة السريع	$\ln \hat{y}_1 = 3.143 + 1.458 \ln X$ (9.858) (10.337)	0.85	106.85	0.000
معدل السيولة النقدى	$\ln \hat{y}_2 = 1.059 + 0.664 \ln X$ (1.531) (2.171)	0.20	4.71	0.043
معدل الأحتياطى القانونى	$\ln \hat{y}_3 = 1.468 + 0.315 \ln X$ (2.539) (1.231)	0.07	1.52	0.234

*القيم بين الأقواس تمثل قيمة (t) المحسوبة ، وتمثل X الزمن خلال الفترة (١٩٩٥– ٢٠١٤).

المصدر: حسبت من بيانات الجدول رقم (١) باستخدام البرنامج الإحصائى SPSS.

السيولة السريع خلال تلك الفترة ، تبين من المعادلة رقم (١) بالجدول رقم (٢) أنها أخذت إتجاهاً تصاعدياً بنسبة تبلغ حوالى ١٤٥,٨% سنويًا.

١-١-٢- معدل السيولة النقدية

بدراسة تطور معدل السيولة النقدية لقياس الكفاءة الداخلية لبنك التنمية والائتمان الزراعى المصري خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤) ، (٢٠٠٥ – ٢٠١٤) يتضح أن معدل السيولة النقدية قد زاد من حوالي ٥,٦٨% كمتوسط للفترة الأولى إلى حوالي 24,46% كمتوسط للفترة الثانية كما هو موضح بالجدول رقم (١) ، وتبين أنها قد تراوح بين حد أدنى بلغ حوالى ١,٣٩% فى عام ١٩٩٧، وحد أقصى بلغ حوالى ٧٩,٥٦% في عام ٢٠٠٩ ، فى حين بلغ المتوسط الهندسي لها خلال نفس الفترة حوالى ١١,٧٩% وبتقدير معادلة الإتجاه العام الزمنية لمعدل السيولة النقدية خلال تلك الفترة ، تبين من المعادلة رقم (٢) بالجدول رقم (٢) أنها أخذت إتجاهاً تصاعدياً بنسبة تبلغ حوالى ٦٦,٤٩% سنويًا.

١-١-٣- معدل الإحتياطى القانونى

بدراسة تطور معدل الاحتياطى القانونى لقياس الكفاءة الداخلية لبنك التنمية والائتمان الزراعى المصري خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤) ، (٢٠٠٥ – ٢٠١٤) يتضح أن معدل الأحتياطى القانونى قد زاد من حوالي ٥,٦٠% كمتوسط للفترة الأولى إلى حوالي ١٢,٨٠% كمتوسط للفترة الثانية كما هو موضح بالجدول رقم (١) ، وتبين أنها قد تراوح بين حد أدنى بلغ حوالى ١,٤٣% فى عام ١٩٩٧، وحد أقصى بلغ حوالى ٣٦,٤٩% في عام ٢٠٠٩ ، فى حين بلغ المتوسط الهندسي لها خلال نفس الفترة حوالى ٨,٤٦% ، وبتقدير معادلة الإتجاه العام الزمنية لمعدل الأحتياطى القانونى خلال تلك الفترة ، تبين عدم ثبوت معنوية معامل الاتجاه العام الزمني لمعدل الاحتياطي القانوني عند مستويات المعنوية المألوفة.

١-٢- معدلات كفاية أو ملائمة رأس المال:

١-٢-١- معدل حق الملكية إلى الودائع:

تشير البيانات بالجدول رقم (٣) إلي تطور معدل حق الملكية إلى الودائع لقياس الكفاءة الداخلية لبنك التنمية والائتمان الزراعى المصري خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤) ، (٢٠٠٥ – ٢٠١٤) ، ويتضح منها أن معدل حق الملكية قد نقص من حوالي ٢٤,٤٩% كمتوسط للفترة الأولى إلى حوالي ٩,٢٨% كمتوسط للفترة الثانية ، كما تبين أنها قد تراوح بين حد أدنى بلغ حوالى ٦,٤٢% فى عام ٢٠١١ ، وحد أقصى بلغ حوالى ٣٢,٩٩% في عام ١٩٩٥ ، فى حين بلغ المتوسط الهندسي لها خلال نفس الفترة حوالى ١٥,٠٨%. وبتقدير معادلة الإتجاه العام الزمنية لمعدل حق الملكية إلى الودائع خلال تلك الفترة ، تبين من المعادلة رقم (١) بالجدول رقم (٤) أنها أخذت إتجاهاً تنازلياً بنسبة تبلغ حوالى ٦٠,٣% سنويًا.

الأمر الذى يشير إلى أهمية دراسة كفاءة وفاعلية الأداء لبنك التنمية والائتمان الزراعى المصري ، وكذلك دور بنك التنمية والائتمان الزراعى فى القطاع الزراعى والتعرف على مدى مناسبة القروض المقدمة من بنك التنمية والائتمان الزراعى من حيث مدى مساهمة هذه القروض فى تغطية التكاليف المتغيرة، ودرجة كفاءة استخدام هذه القروض مع التركيز على أكثر العوامل تأثيراً على طلب هذه القروض، ومن حيث قيمة القروض الفدانية الممنوحة لأهم المحاصيل فى محافظة البحيرة.

الأهداف البحثية

تستهدف الدراسة التعرف على كفاءة وفاعلية الأداء لبنك التنمية والائتمان الزراعى المصري بالإضافة إلي دوره فى تحقيق التنمية الزراعية بمحافظة البحيرة، ويمكن أن يتحقق هذا الهدف من خلال دراسة الأهداف الوسيلية التالية: (١) تقييم الأداء المصرفى لبنك التنمية والائتمان الزراعي المصري. (٢) التعرف علي أهم المؤشرات الائتمانية لأهم المحاصيل الزراعية فى محافظة البحيرة. (٣) تقييم مستويات كفاءة الائتمان الزراعى ومدى مساهمة القروض الزراعية فى تغطية التكاليف الإنتاجية الفدائية لأهم المحاصيل بمحافظة البحيرة. (٤) دراسة محددات الطلب على القروض الفدانية لأهم المحاصيل الزراعية بمحافظة البحيرة. (٥) التوصل إلى مجموعة من التوصيات النابعة من النتائج المتحصل عليها والتى يمكن أن تفيد واضعى السياسة الإقتصادية فى هذا المجال.

الأسلوب البحثى ومصادر البيانات

لتحقيق الأهداف المنشودة من البحث إعتمدت الدراسة على أسلوب التحليل الإقتصادى الوصفى والكمي ، مثل: إستخدام المقاييس الوصفية والمتوسطات والنسب المئوية والجداول وأسلوب الإنحدار البسيط والمتعدد (الشهاوى ،٢٠١٦)، فضلاً عن معدلات النمو والتكاليف ومؤشرات الكفاءة الإنتاجية والإقتصادية (شافعى، ٢٠٠٤)، (Coelli *et al.*, 2005) وكذلك تم الاستعانة بكافة الإختبارات اللازمة للتأكد من صحة النتائج المتحصل عليها من الناحية الإحصائية والاقتصادية (Wooldridge, 2012). كما إعتمدت الدراسة على البيانات الثانوية المنشورة وغير المنشورة لكل من البنك الرئيسى للتنمية والائتمان الزراعى ، والإدارة المركزية للإقتصاد الزراعى بوزارة الزراعة وإستصلاح الأراضى.

النتائج البحثية ومناقشاتها

١- الأداء المصرفى لبنك التنمية والائتمان الزراعى المصري

١-١- معدلات السيولة

١-١-١- معدل السيولة السريع

تشير البيانات الواردة بالجدول رقم (١) إلي تطور معدل السيولة السريع لقياس الكفاءة الداخلية لبنك التنمية والائتمان الزراعى المصري خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤) ، (٢٠٠٥ – ٢٠١٤)، ويتبين أن معدل السيولة السريع قد زاد من حوالي ١٩٤,٧٧% كمتوسط للفترة الأولى إلى حوالي ١٣٢٧,٣٣%كمتوسط للفترة الثانية، كما تبين أنه قد تراوح بين حد أدنى بلغ حوالى ٥٦,٤٩% فى عام ١٩٩٥، وحد أقصى بلغ حوالى ١٧٨٧,٦٦% في عام ٢٠١١ ، فى حين بلغ المتوسط الهندسي لها خلال نفس الفترة حوالى ٥٠٨,٤٥% وبتقدير معادلة الإتجاه العام الزمنية لمعدل

(٥) بدراسة بعض معايير الكفاءة الائتمانية لكل من محصول القمح والأرز والقطن والذرة الشامية بمحافظة البحيرة من خلال العلاقة بين الإنتاجية الفدانية والقرض الفدانى خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤) ، (٢٠٠٥ – ٢٠١٤) تأكد معنوية النموذج المستخدم عند مستوى ٠,٠١ لكل من محصول القمح والأرز والذرة الشامية ، وكما تأكد عدم معنوية محصول القطن ، وبدراسة العلاقة بين الإنتاجية الفدانية كعامل تابع ونسبة تغطية القرض الفدانى للتكاليف المتغيرة كعامل مستقل خلال فترتى الدراسة (١٩٩٥ – ٢٠٠٤) ، (٢٠٠٥ – ٢٠١٤) لهذه المحاصيل تأكد معنوية النموذج المستخدم عند مستوى٠,٠١ للقمح والأرز والقطن ، كما تأكد عدم معنوية محصول الذرة الشامية. (٦) بدراسة محددات الطلب على القروض الفدانية لكل من محصول القمح والأرز والقطن والذرة الشامية بمحافظة البحيرة تبين أن كل من نسبة تغطية القرض الفداني للتكاليف المتغيرة وصافي العائد الفداني تفسر حوالى ٣٥,٧% ،٦٦,٨% من التغيرات فى القروض الفدانية الممنوحة لمحصول القمح على الترتيب ، في حين يفسر صافي العائد الفداني حوالى 90% من التغيرات فى القروض الفدانية الممنوحة لمحصول الأرز على الترتيب، وتفسر كل من نسبة تغطية القرض الفداني للتكاليف المتغيرة وصافي العائد الفداني تفسر حوالى ٣٠,٠٥% ، ٧٧,٢% من التغيرات فى القروض الفدانية الممنوحة لمحصول القطن لفترة الدراسة (١٩٩٥– ٢٠١٤) على الترتيب ، وتفسر حوالى ٦٥% ،٣٦,٦% من التغيرات فى القروض الفدانية الممنوحة لمحصول الذرة الشامية على الترتيب.

الكلمات الدلالية: بنك التنمية والائتمان الزراعي ، تقييم الأداء، معدلات السيولة، كفاءة الائتمان ، الودائع ، القروض المتوسطة والقصيرة الاجل، القروض الزراعية.

المقدمة والمشكلة البحثية

يعانى البنيان الاقتصادى الزراعى المصري بصفة عامة ومحافظة البحيرة بصفة خاصة من بعض المشكلات الاقتصادية أهمها: ضآلة الدخول الفردية، وضعف القدرة الإدخارية، وقصور التمويل الذاتى وهذا يؤدى إلى ضرورة الإقتراض لمواجهة الاحتياجات الزراعية، والإرتقاء بمستوى الإنتاج الزراعى ، ورفع مستوى معيشة الزراع. ويعد بنك التنمية والائتمان الزراعى هو المصدر المتخصص فى تمويل العمليات الإنتاجية الزراعية فى مصر، ويضع على عاتقه مهمة تقديم التسهيلات الائتمانية اللازمة والضرورية لتنمية القطاع الزراعى حيث من الأهمية تأويل ذلك الدور الحيوى والهام الذى يقوم به هذا البنك فى تنمية القطاع الزراعى المصرى.

ولذا من الضرورى التعرف على المركز المالى الحالى لبنك التنمية والائتمان الزراعى قبل التفكير فى وضع الخطط المستقبلية ، وبالتالي فإنه يعتبر أداة للكشف عن مواطن القوة والضعف فى المركز المالى وفى السياسات المختلفة التى تؤثر على الربحية ، ويتيح الكشف عن مواطن القوة للإدارة فرص يتم استغلالها ، كما أن الكشف عن مواطن الضعف يتيح فرصة التعرف على أسباب هذا الضعف ومحاولة القضاء عليها مبكراً حتى لا تعوق الخطط المستقبلية لتطوير البنك ، والعمل علي رفع كفاءة وفاعلية أداء البنك والرقابة المسبقة على الأنشطة والتى يسعى البنك من خلالها لتحقيق أقصى عائد مع تجنب أو تقليل مخاطر نقص السيولة ومخاطر الإفلاس.

كفاءة وفاعلية الأداء لبنك التنمية والائتمان الزراعى المصري: دراسة حالة محافظة البحيرة

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الملخص: يستهدف هذا البحث بصفة عامة التعرف على كفاءة وفاعلية الأداء لبنك التنمية والائتمان الزراعى المصري بالإضافة إلي دوره فى تحقيق التنمية الزراعية بمحافظة البحيرة، ويمكن أن يتحقق هذا الهدف من خلال دراسة الأهداف التالية: (١) تقييم الأداء المصرفى لبنك التنمية والائتمان الزراعى. (٢) التعرف علي أهم المؤشرات الائتمانية لأهم المحاصيل الزراعية فى محافظة البحيرة. (٣) تقييم مستويات كفاءة الائتمان الزراعى ومدى مساهمة القروض الزراعية فى تغطية التكاليف الإنتاجية الفدانية لأهم المحاصيل بمحافظة البحيرة. (٤) دراسة محددات الطلب على القروض الفدانية لأهم المحاصيل الزراعية بمحافظة البحيرة. (٥) التوصل إلى مجموعة من التوصيات النابعة من النتائج المتحصل عليها والتى يمكن أن تفيد واضعى السياسة الإقتصادية فى هذا المجال.

توصلت الدراسة إلي النتائج التالية: (١) أن معدلات السيولة قد أخذت إتجاهاً عامًا تصاعدياً خلال الفترة (١٩٩٥– ٢٠١٤) وأن متوسطات الفترة الأخيرة قد بلغت نحو١٣٢٧,٣٣% ، ٢٤,٤٦%، ١٢,٨٠% بنفس الترتيب مما يشير إلى أنها فى صالح تحسن الأداء المصرفى لبنك التنمية والائتمان الزراعى. (٢) أن كل من معدل حق الملكية إلى الودائع ومعدل حق الملكية إلى الأصول الخطرة ومعدل حق الملكية إلى الإستثمارات فى أوراق مالية غير حكومية أو مضمونة (هامش الأمان) ومعدل حق الملكية إلى القروض قد أخذت إتجاهاً عامًا تنازلياً خلال الدراسة وأن متوسطات الفترة الأخيرة قد بلغت نحو ٩,٢٨% ، ٨,٩٦% ، ٢١٢,٦٤% ،٩,٨٥% بنفس الترتيب مما يشير إلى أنها فى صالح تحسن الأداء المصرفى للبنك. (٣) أن كل من معدل إقراض الودائع ومعدل إقراض الموارد ومعدل توظيف الموارد ومعدل السحب على المكشوف قد أخذت إتجاهاً تنازلياً خلال فترة الدراسة وأن متوسطات الفترة الأخيرة قد بلغت نحو ٩٤,٢٠% ، ٨٥,٨٣%، ٩٣,٠٧% ،٠,٠٠٨% بنفس الترتيب مما يشير إلى أن المعدل الأول والثاني والثالث فى غير صالح الأداء المصرفى لبنك التنمية والائتمان الزراعى المصري، بينما المعدل الرابع إتجه إلي أن يكون في صالح تحسن الأداء المصرفي للبنك في الفترة الأخيرة. (٤) أن كل من معدل العائد على رأس المال ومعدل العائد على حق الملكية ومعدل العائد على الودائع ومعدل العائد على الموارد ومعدل العائد على إجمالى الأصول ومعدل العائد على الأصول الإيرادية ومعدل العائد إلى إجمالى القروض قد أخذت إتجاهاً تصاعدياً خلال فترة الدراسة ، وأن متوسطات الفترة الأخيرة قد بلغت نحو ٥,٩٦% ، ٤,٩٤%، ٠,٤٦%،% ٠,٤٢% ، ٠,٣٦%، ٠,٤٣% ، ٠,٤٩% بنفس الترتيب مما يشير إلى أنها فى صالح تحسن الأداء المصرفى لبنك التنمية والائتمان الزراعى في الفترة الثانية.

Third: The most important problems facing the respondents in marketing some strategic crops were : Low prices of crops sales comparison with costing (100%) and the manipulate of prices by traders (100%),along with other problems.

Fourth: The most important suggestions to overcome the most important problems facing respondents when buy their some crops were : support the supplies (100%) and increase the supervision on the traders and the markets (79.27%), as well as other suggestions.

The Farmers' Opinions Towards the Best Marketing Systems of Some Strategic Crops in Kafer El- Dawar and Abou Homos Districts , El- Beheira Governorate

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ABSTRACT: The main objective of this research was to investigate farmers' opinions towards the best marketing systems of some strategic crops in Kafer El- Dawar and Abou Homos districts in El- Beheira Governorate. This entail the fulfillment of the following objectives:

1-determine the best marketing systems of some strategic crop at their respondents vision.
2-determine the reasons of chose marketing system on the other at their respondents vision.
3-determine the most important problems facing the respondents when they buy some strategic crops at their vision.
4-determine the most important suggestions to overcome these problems at their respondents vision.

The research was conducted at the villages of El- Bedah El Balad and Boline in Kafer El-Dawar district, and Dosones El- Helfaya and El- Ghaba in Abou Homos district El- Beheira Governate, where it was taken a random sample of (10%) from (2679) farmers. Data was collected using the personal interview questionnaire, Percentage and frequency, were used to present and discuss results .

The main results of the study were as follows:

First: The results showed that (52.99%) of respondents chose the cooperation marketing system, (38.81%) chose contractuall marketing system and (8.20%) chose direct sales to traders system.

Second: Reasons for chosing the cooperation marketing system were : the trust at agricultural cooperation association (100%) and having a guarantee to obtain the crop price (100%), as well as other reasons. Reasons for chose contractual marketing system were: Being informed with the crops price before selling them (100%) and having a guarantee sale the crops (100%) , as well as other reasons. Reasons for chosing direct sale to traders system were: The farmers has adventage to sell his production to any trader freely and any time (100%) and the farmers can take a loan in advance of the crop price from the trader (77.27%).

جدول رقم (٦). أهم الحلول المقترحة من وجهة نظر المبحوثين للتغلب على بعض المشكلات التسويقية التي تواجههم عند تسويق بعض محاصيلهم الإستراتيجية

الحلول المقترحة	التكرار	%
ضرورة دعم مستلزمات الإنتاج لتقليل التكاليف على الزراع	٢٤٦	١٠٠
الرقابة المشددة على التجار والأسواق من الجهات المسئولة	١٩٥	٧٩,٢٧
توعية الزراع بأسعار السوق بصفة دائمة	١٨٢	٧٣,١٧
الإعلان مسبقا عن سعر بيع المحاصيل	١٧٥	٧١,١٤
إعادة نظام التسويق التعاوني عن طريق الجمعيات التعاونية الزراعية	١٣١	٥٣,٢٥

حسبت النسبة المئوية على إجمالي عدد الزراع المبحوثين الذين تقابلهم بعض المشكلات عند تسويق بعض محاصيلهم الاستراتيجية (٢٤٦) مبحوث

التوصيات

استناداً لنتائج هذا البحث يمكن استخلاص مجموعة من التوصيات يجب أخذها في الاعتبار والتي منها ما يلي :

١- ضرورة دعم مستلزمات الإنتاج لتقليل تكاليف المنتج الزراعي .

٢-الرقابة الجادة على التجار لضمان عدم التلاعب بالأسعار واستغلال الزراع .

٣- الإعلان مسبقا عن سعر بيع المحاصيل الزراعية بالسعر المناسب لتشجيع الزراع .

٤-أن يكون هناك قاعدة بيانات تسويقية متجددة باستمرار ومتاحة لجميع أطراف العملية التسويقية.

٥-توعية الزراع بمزايا وقصور الأنظمة التسويقية المختلفة بما يضمن اختيار الزراع للنظام التسويقي المناسب لتسويق محاصيلهم الزراعية.

٦-تفعيل دور الجمعيات التعاونية الزراعية بصفة عامة ولا سيما في مجال تسويق المحاصيل الزراعية بما يحقق أعلى ربحية للزراع (الإرشاد الزراعي التسويقي)

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مشكلات في تسويق بعض محاصيلهم الإستراتيجية تمثل الواقع الميداني الحالي في القطاع الزراعي الذي يعانى فيه الزراع أشد المعاناة في عملية التسويق لمحاصيلهم ، حيث أنهم أصبحوا في حالة من الحيرة وعدم الاستقرار في ظل حرية التسويق التي ظهرت في هذه الآونة.

وقد أظهرت النتائج البحثية أن المشكلات التي تقابل الزراع المبحوثين والبالغ عددهم (٢٤٦) مبحوثا من إجمالي المبحوثين قد بلغت (ثمان) مشكلات تم ترتيبها تنازليا حسب تكراراتها . وتمثلت هذه المشكلات : في انخفاض أسعار بيع المحاصيل مقارنة بالتكاليف (١٠٠%) ، وتلاعب التجار بالأسعار (١٠٠%) ، ومماطلة التجار في سداد ثمن المحصول (٩٣,٩٠ %) ، وعدم ضمان بيع المحصول (٩٢,٢٨ %) ، والنزاعات والخلافات بين الزراع والتجار على سداد ثمن المحصول (٨٣,٣٣%) ، وعدم معرفة الزراع بأسعار السوق (٧٧,٦٤ %)، وعدم وجود رقابة جادة على التجار والأسواق (٧٥,٢٠ %)، وأخيرا عدم الإعلان عن سعر بيع المحاصيل مسبقا (٦٩,١٩ %).جدول رقم (٥)

جدول رقم (٥). المشكلات التي تواجه الزراع المبحوثين عند تسويق بعض محاصيلهم الإستراتيجية من وجهة نظرهم

المشكلات	التكرار	%
انخفاض أسعار بيع المحاصيل مقارنة بالتكاليف	٢٤٦	١٠٠
تلاعب التجار بالأسعار	٢٤٦	١٠٠
مماطلة التجار في سداد ثمن المحصول	٢٣١	٩٣,٩٠
عدم ضمان بيع المحصول	٢٢٧	٩٢,٢٨
النزاعات والخلافات بين الزراع والتجار على سداد ثمن المحصول	٢٠٥	٨٣,٣٣
عدم معرفة الزراع بأسعار السوق	١٩١	٧٧,٦٤
عدم وجود رقابة جادة على التجار والأسواق	١٨٥	٧٥,٢٠
عدم الإعلان عن سعر بيع المحاصيل مسبقا	١٢٧	٦٩,١٩

حُسبت النسبة المئوية من إجمالي عدد الزراع المبحوثين الذين تواجههم مشكلات في التسويق (٢٤٦) مبحوثا

و يجب النظر بعين الاعتبار إلى هذه المشكلات التي ذكرها المبحوثون، ويجب وضعها في الحسبان والسعي في حلها من الجهات المنوطة بذلك ، حيث يذكر الموجي واخرون (٢٠٠٤ ، ص :١١٧) أن أولى مراحل اتخاذ القرار هو التحديد الدقيق والواضح للمشكلة والتعرف على أسبابها ، ومن ثم سهولة حلها والتعامل معها .

رابعاً الحلول المقترحة للتغلب على بعض المشكلات التسويقية التي تواجه الزراع المبحوثين عند تسويق بعض محاصيلهم الإستراتيجية من وجهة نظرهم :

أوضحت النتائج البحثية أن أهم الحلول المقترحة التي ذكرها المبحوثون من أجل التغلب علي بعض المشكلات التسويقية التي تواجههم عند تسويق بعض محاصيلهم الإستراتيجية قد اشتملت على خمسة حلول مقترحه تم ترتيبها تنازليا حسب تكرارها والتي تمثلت في: ضرورة دعم مستلزمات الإنتاج لتقليل التكاليف على الزراع (١٠٠%)، والرقابة المشددة على التجار والأسواق من الجهات المسئولة (٢٧, ٧٩%)، وتوعية للزراع بأسعار السوق بصفة دائمة (١٧, ٧٣%)، والإعلان مسبقا عن سعر بيع المحاصيل (١٤, ٧١%) ، وأخيرا إعادة نظام التسويق التعاوني عن طريق الجمعيات التعاونية الزراعية (٥٣,٢٥ %). جدول رقم (٦) .

وأما بالنسبة للزراع المبحوثين الذين يفضلون نظام التسويق التعاقدي فقد بلغت نسبتهم (٣٨,٨١%) جدول رقم (١) السابق، وكانت أسباب التفضيل تنحصر في خمسة أسباب تم ترتيبها تنازلياً حسب تكراراتها، وهي معرفة المبحوثين بثمن بيع المحصول مسبقا (١٠٠%) ، وضمان بيع المحصول من خلال التعاقد ، وتشجيع المبحوثين على زراعة المحصول مستقبلا (١٠٠%)، والالتزام بشروط التعاقد بين الطرفين (٩٥,١٩%) ، وأخيراً حصول المبحوثين على بعض الخدمات من الطرف المشتري المتعاقد(٧٨,٨٥%). جدول رقم (٣) .

جدول رقم (٣) أسباب تفضيل الزراع المبحوثين لنظام التسويق التعاقدي

أسباب التفضيل	التكرار	%
معرفة المبحوثين بثمن بيع المحصول مسبقاً	١٠٤	١٠٠
ضمان بيع المحصول من خلال التعاقد	١٠٤	١٠٠
تشجيع المبحوثين على زراعة المحصول مستقبلاً	١٠٤	١٠٠
الالتزام بشروط التعاقد بين الطرفين	٩٩	٩٥,١٩
حصول المبحوثين على بعض الخدمات من الطرف المشتري المتعاقد	٨٢	٧٨,٨٥

حُسبت النسبة المئوية من إجمالي عدد الزراع المبحوثين الذين يفضلون نظام التسويق التعاقدي (١٠٤) مبحوث.

ومن المعروف أن نظام التسويق التعاقدي من أنظمة التسويق المتعارف عليها لدى زراع قصب السكر وبنجر السكر وأحيانا بين زراع البطاطس ، وإذا كانت النتائج البحثية تشير إلى رغبة (٣٨,٨١%) من إجمالي المبحوثين في هذا النظام ، فيجب النظر له بعين الاعتبار وتطبيقه فعلياً كأحد الأنظمة التسويقية. وأخيراً أظهرت النتائج البحثية جدول (١) السابق أن عدد الزراع المبحوثين الذين يفضلون نظام التسويق الحر المباشر للتجار قد بلغ (٢٢) مبحوثاً من إجمالي عدد الزراع المبحوثين ، وبنسبة (٨,٢٠%) ، وكانت أسباب تفضيلهم لهذا النظام في سببين هما: الأول حرية المزارع في البيع لأي تاجر في أي مكان وأي وقت (١٠٠ %). والثاني هو : حصول المزارع على سلفة مقدماً من ثمن المحصول من التاجر(٧٧,٢٧ %) . جدول رقم (٤)

جدول رقم (٤). أسباب تفضيل الزراع المبحوثين لنظام التسويق الحر المباشر للتجار

أسباب التفضيل	**التكرار**	**%**
حرية المزارع في البيع لأي تاجر في أي مكان وأي وقت .	٢٢	١٠٠
حصول المزارع على سلفة مقدماً من ثمن المحصول من التاجر .	١٧	٧٧,٢٧

حسبت النسبة المئوية من إجمالي عدد الزراع المبحوثين الذين يفضلون نظام التسويق الحر المباشر للتجار (٢٢) مبحوث

ثالثا المشكلات التي تواجه الزراع المبحوثين في تسويق بعض محاصيلهم الإستراتيجية :

لا شك أن وجود بعض المشكلات في بيئة العمل من شأنها أن تؤثر تأثيراً سلبياً على جميع من هو كائن في هذه البيئة ، حيث يذكر (Dillon and Hug , 1990) أن تحسين ظروف بيئة العمل من شانها تأدية الإعمال المطلوبة بكفاءة عالية.

وقد أظهرت النتائج البحثية أن عدد الزراع المبحوثين الذين تواجههم مشكلات عند تسويق بعض محاصيلهم الإستراتيجية قد بلغ عددهم (٢٤٦) مبحوثا من أجمالي المبحوثين بنسبة(٩١,٧٩%) في حين تبين أن هناك (٢٢) مبحوثا من إجمالي المبحوثين ذكروا بأنهم ليس لديهم أي مشكلات تقابلهم عند تسويق محاصيلهم ، حيث بلغت نسبتهم (٨,٢١ %) من اجمالى المبحوثين ، وهذه النسبة المرتفعة من عدد الزراع المبحوثين الذين تواجههم

جدول رقم (١) . توزيع الزراع المبحوثين وفقا لآرائهم حول أفضل النظم التسويقية لبعض المحاصيل الإستراتيجية من وجهة نظرهم

النظام التسويقي المفضل	العدد	%
التسويق التعاوني عن طريق الجمعيةالتعاونية الزراعية	١٤٢	٥٢,٩٩
التسويق التعاقدي	١٠٤	٣٨,٨١
التسويق الحر المباشر للتجار	٢٢	٨,٢٠
المجمــوع	٢٦٨	١٠٠

يتضح من الجدول رقم (١) السابق ارتفاع نسبة الزراع المبحوثين الذين يفضلون نظام التسويق التعاوني عن طريق الجمعية الزراعية حيث بلغت ما يقرب من (٥٣%) ، وقد يعزى سبب ارتفاع هذه النسبة إلي تعود المزارع المصري على هذا النظام من التسويق لفترة طويلة ، حيث أنه كان هو النظام السائد في الريف المصري ، كما أن هذه النتيجة تعكس مدى ارتباط المزارع بالجمعية الزراعية حيث كانت تقدم له كل ما يحتاجه من مستلزمات انتاج مدعمة وإرشادات لتوعيته ، ولكن الواقع الميداني الحالي الآن يشير إلى ضعف الدور التي تقوم به الجمعيات الزراعية بصورة كبيرة في القطاع الزراعي وبشكل ملحوظ.

ثانيا أسباب تفضيل المبحوثين لنظام تسويقي معين :

أظهرت النتائج البحثية أن عدد المبحوثين الذين يفضلون نظام التسويق التعاوني عن طريق الجمعيات التعاونية الزراعية قد بلغ (١٤٢) مبحوثاً بنسبة (٥٢,٩٩%).جدول رقم (١). وكانت أسباب التفضيل من وجهة نظرهم تنحصر في خمسة أسباب تم ترتيبها تنازلياً حسب تكرارها من المبحوثين كما يلي : الثقة والشعور بالأمان لتسويق الجمعية التعاونية الزراعية (١٠٠%)، وضمان الحصول على ثمن بيع المحصول مهما تأخرالثمن (١٠٠%) والبعد عن تلاعب التجار بالاسعار (٩٥,٠٧ %) ، ودعم رأس مال الجمعية التعاونية الزراعية (٧٦,٠٦ %)، وأخيراً الحصول على فوائد غير مباشرة من الجمعية التعاونية الزراعية في صورة أرباح (٥٩,٨٦%). جدول رقم (٢).

جدول رقم (٢). أسباب تفضيل المبحوثين لنظام التسويق التعاوني للجمعيات التعاونية الزراعية

أسباب التفضيل	التكرار	%
الثقة والشعور بالأمان لتسويق الجمعية التعاونية الزراعية	١٤٢	١٠٠
ضمان الحصول على ثمن بيع المحصول مهما تأخر الثمن	١٤٢	١٠٠
البعد عن تلاعب التجار بالأسعار	١٣٥	٩٥,٠٧
دعم رأس مال الجمعية التعاونية الزراعية	١٠٨	٧٦,٠٦
الحصول على فوائد غير مباشرة من الجمعية التعاونية الزراعية في صور أرباح	٨٥	٥٩,٨٦

حُسبت النسبة المئوية من إجمالي عدد الزراع المبحوثين الذين يفضلون نظام التسويق التعاوني (١٤٢) مبحوث

وتشير النتائج البحثية بالجدول رقم (٢) السابق إلى مدى الإرتباط بين المزارع والجمعية التعاونية الزراعية الذي كان موجودا في الفترة السابقة ، ولذا يجب على جميع الجهات المسئولة أن تبذل قصارى جهدها لإعادة الدور الفعال للجمعيات الزراعية مرة أخرى في ربوع الريف المصري ، وهذا لا يتم إلا بتوفير مستلزمات الإنتاج الجيدة والمدعمة ، وكذلك الاهتمام بالكوادر الفنية العاملة بها من حيث تدريبهم على كل ما هو جديد في القطاع الزراعي حتى يتسنى لهم القيام بأعمالهم على أكمل وجه للنهوض بالزراعة المصرية٠

الطريقة البحثية

أولا منطقة الدراسة:

تم إجراء هذا البحث في محافظة البحيرة، حيث تم اختيار مركزي كفر الدوار وأبو حمص من بين مراكز المحافظة بطريقة عشوائية ، ومن بين قرى هذين المركزين تم اختيار قريتين من كل مركز على حده بطريقة عشوائية أيضاً ، فكانت القرى المختارة هي قريتي البيضا البلد وبولين من مركز كفر الدوار ، وقريتي دسونس الحلفاية والغابة من مركز أبو حمص٠

ثانيا الشاملة والعينة:

بلغت شاملة هذا البحث (٢٦٧٩) مبحوثاً في القرى المختارة محل الدراسة وهم أجمالي الزراع الحائزين بهذه القرى من واقع سجل ٢ خدمات للزراع الحائزين بالجمعية الزراعية بكل قرية على حده ، وتم أخذ عينة عشوائية منتظمة بنسبة (١٠%) من شاملة الزراع الحائزين بكل جمعية زراعية ، ومن ثم بلغت عينة البحث (٢٦٨) مبحوثا موزعة كالتالي : قرية البيضا البلد (٤٨) مبحوثا ، وقرية بولين (٨٥) مبحوثا ، وقرية دسونس الحلفاية (١٠٠) مبحوثا ، وقرية الغابة (٣٥) مبحوثاً٠

ثالثا جمع البيانات وتحليلها :

تم تجميع البيانات الميدانية بالمقابلة الشخصية للمبحوثين باستخدام استمارة استبيان تم إعدادها بالأسلوب الذي يحقق أهداف البحث ، وقد تم إجراء الاختبار المبدئي عليها وذلك للتأكد من صلاحيتها بشكل نهائي وإجراء التعديلات اللازمة٠ وقد تم استخدام كلا من النسب المئوية والتكرارات لتحليل البيانات البحثية.

رابعا بعض التعريفات الإجرائية:

١–آراء الزراع المبحوثين حول أفضل النظم التسويقية لبعض المحاصيل الإستراتيجية :

يقصد بها في هذا البحث معرفة رأي المبحوث في المفاضلة بين ثلاثة أنظمة من أنظمة التسويق تعرض عليه وهي النظام التسويقي التعاوني ونظام التسويق التعاقدي ونظام التسويق الحر المباشر للتجار مباشرة وأسباب تفضيله لنظام عن الآخر.

٢–بعض المحاصيل الإستراتيجية :

يقصد بها في هذا البحث المحاصيل الهامة التي يزرعها الزراع المبحوثون وهي كل من محصول القمح والأرز والذرة الشامية والبطاطس.

النتائج البحثية

أولاً آراء الزراع المبحوثين حول أفضل النظم التسويقية لبعض المحاصيل الإستراتيجية :

أظهرت النتائج البحثية أن عدد الزراع المبحوثين الذين يفضلون نظام التسويق التعاوني عن طريق الجمعية التعاونية الزراعية قد بلغ (١٤٢) مبحوثاً من إجمالي عدد المبحوثين وبنسبة (٥٢,٩٩%) ، وعدد (١٠٤) مبحوثاً من إجمالي المبحوثين يفضلون نظام التسويق التعاقدي وبنسبة (٣٨,٨١ %) ، وأخيراً عدد (٢٢) مبحوثاً يفضلون نظام التسويق الحر المباشر للتجار وبنسبة (٨,٢٠ %)٠ جدول رقم (١).

من الأهمية بمكان نظراً لأن الغالبية العظمي من السكان المصريين يمارسون النشاط الزراعي ، وبالتالي فأي سياسات زراعية خاطئة سوف تنعكس آثارها على أغلب أفراد المجتمع المصري.

ومن المهم هنا هنا التغير الذي حدث في نظام التسويق ، حيث هو محور الاهتمام في هذه الدراسة ، حيث يمكن القول بأن التسويق أصبح متروكا بالكامل لقوى السوق (العرض والطلب) ، ومن هذا المنطلق أصبح للمزارع الحرية الكاملة في التصرف في بيع محصوله دون أي تدخل من جانب الحكومة أو غيرها ، ولكن تبين أن المزارع أصبح في ظل هذه الحرية في حالة من الحيرة من ناحية تذبذب أسعار المحاصيل الزراعية التي لم تعد تستقر إلى حد ما على نمط سعري محدد يحقق له التسويق الأمثل ، والعائد المرضي لمنتجاته الزراعية ، بل أصبحت الأسعار تقفز بطريقة عشوائية صعوداً وهبوطاً ، وفي هذا الصدد يذكر ميخائيل (٢٠٠٧ ، ص: ٢) بأنه إذا كان أمر التسويق للحاصلات الزراعية أصبح متروكا لقوى السوق (العرض والطلب) فإن هذا لا يعني عشوائية السوق إلى هذه الدرجة التي يبدو عليها ، ولكن لابد من توافر أو وجود قاعدة من البيانات والمعلومات عن السوق والمستهلكين ، حيث أن ذلك يعتبر من الأمور الهامة في مجال اقتصاد السوق الحر حالياً.

وفي سبيل السعى إلى تحقيق تنمية حقيقية وشاملة للقطاع الزراعي فلابد من حل كلي لكافة المشكلات التي تواجهه ، وليس من المعقول والأمثل حل كل مشكلة على حدة ، حيث ذكر محمود (٢٠٠٢، ص:١٤٧) أن القطاع الزراعي له دورٌ بالغ الأهمية في الناتج القومي المصري ، حيث أنه يساهم في خمس الناتج القومي الإجمالي ، ويساهم بنحو ثلث حصيلة الصادرات ، فضلاً عن كونه القطاع الهام في توفير متطلبات ومستلزمات الصناعة المصرية وتشغيل العمالة.

ومع التسليم بأهمية مسايرة التغيرات التي تحدث في العالم فهذا لا يعني عدم الإدراك لأثر هذه التغيرات والإلمام بآثارها الإيجابية وتشجيعها وتلافي آثارها السلبية إن وجدت بقدر الإمكان للنهوض بالمجتمع وأفراده .
ومن خلال معايشة الباحث للواقع الميداني ومعايشة الزراع بصفة مستمرة فقد اتضح وجود عديد من المشكلات التي تجابه الزراع عند تسويق محاصيلهم الزراعية وتلاعب التجار بالأسعار واستغلالهم ، مما دفعه لإجراء هذا البحث بهدف تحقيق الأهداف التالية :

الأهداف البحثية

١-التعرف على آراء الزراع المبحوثين حول أفضل النظم التسويقية لبعض المحاصيل الإستراتيجية من وجهة نظرهم.
٢-التعرف على أسباب تفضيل الزراع المبحوثين لنظام تسويقي معين عن الآخر .
٣-التعرف على أهم المشكلات التي تواجه الزراع المبحوثين عند تسويق بعض محاصيلهم الإستراتيجية من وجهة نظرهم.
٤-التعرف على بعض الحلول المقترحة لمواجهة المشكلات التسويقية التي تقابل الزراع المبحوثين عند تسويق بعض محاصيلهم الإستراتيجية من وجهة نظرهم.

المقدمة والمشكلة البحثية

تُعد عملية تسويق السلعة أو المحصول من الأمور الهامة التي تشغل بال أي منتج بصورة كبيرة ، حيث أن نجاح تلك العملية بما يحقق عائد مرضي منها يكون بمثابة دافعاً قوياً في أن يبذل هذا المنتج الكثير من الجهد لزيادة إنتاجه.

وفي هذا السياق يذكر طلبة (غير مبين سنة النشر ، ص:١) أن عملية التسويق تعد أحد الركائز الأساسية التي يبنى عليها أي بنيان اقتصادي ، فهي جزء مكمل لعملية الإنتاج ، بل هي جزء من الإنتاج نفسه ، وأضاف قائلاً أن مشكلة التسويق وبيع المنتجات تعد من أهم التحديات التي تواجه المنتج الزراعي في الوقت الحالي ، ويرجع ذلك إلى عدم دراية غالبية المنتجين من الزراع بظروف السوق ، وكذلك عدم توافر الكثير من المعلومات عن الأسواق والمستهلكين.

واستنادا إلى أهمية الإرشاد الزراعي التسويقي في تعظيم ربحية الزراع ، لذا فإن ذلك يتطلب إمداد الزراع بالمعلومات الكافية عن الأسواق والمستهلكين ، وظروف السوق ، وأن تكون هناك قاعدة بيانات متجددة متاحة لهم لكل هذه الأمور التي من شأنها تساعد في نجاح عملية التسويق.

ويعرف صادومة (٢٠٠٤ ، ص : ١٦) التسويق للسلعة بأنه هو " الأنشطة التي تتعلق بتدفق المنتجات من المنتج إلى المستهلك " ، وذكر أن المزيج التسويقي يتكون من المنتج والتسعير والترويج والتوزيع المادي ، ويعرف التسويق أيضا بأنه " عملية تبادلية بين طرفين أحدهما المنتج والآخر المستهلك للسلعة ".

والنظم التسويقية كثيرة ومتعددة منها على سبيل المثال لا الحصر التسويق التعاوني ، والتسويق التعاقدي (نظام الزراعة التعاقدية) والتسويق الحر المباشر للتجار مباشرة.

ولقد شهد العالم في الفترة الأخيرة العديد من التغيرات لا سيما التغيرات الاقتصادية التي سادت معظم دول العالم وانتهاج نظام التحرر الاقتصادي ونظام التسويق الحر وترك الأسواق والأسعار لقوى السوق (العرض والطلب) ، وقد اتبعت مصر هذه السياسات لمسايرة دول العالم حيث ذكر حمد (٢٠٠٤ ، ص : ١) أن السياسة الزراعية في مصر بدأت تأخذ هذا الاتجاه كسائر الدول ، وكانت من أهم التغيرات هي : إلغاء الدعم على مستلزمات الإنتاج الزراعي ، وإلغاء نظام الدورة الزراعية ، والتحرر من نظام التسويق الإجباري (التسوق التعاوني) ، وأخيراً تحرر عقود الإيجار للأراضي الزراعية وقد تم تنفيذ كل هذه التغيرات بداية من عام ١٩٨٦.

وفي هذا الصدد يذكر شريف وآخرون (٢٠٠٤ ، ص : ٧٧) أنه مما لا شك فيه أن لأي تغير يطرأ على السياسة المتبعة في القطاع الزراعي بعض الآثار والتي يمكن أن تكون إيجابية ، بما يعني أن تلك السياسات قد حققت أهدافها المرجوة منها من ناحية ، أو أن تكون سلبية بما يعنى هنا ضرورة تعديل تلك السياسات بما يساعد على تحقيق الأهداف المرجوة في القطاع الزراعي المصري ، ويعتبر تقييم آثار السياسات المتبعة في القطاع الزراعي

ثانيا: أسباب تفضيل الزراع المبحوثين لنظام تسويقي معين عن الآخر:

أوضحت النتائج البحثية أن الزراع المبحوثين الذين يفضلون نظام التسويق التعاوني للجمعيات التعاونية الزراعية كانت أسباب التفضيل هي : الثقة والشعور بالأمان لتسويق الجمعية التعاونية الزراعية (١٠٠%) ، وضمان حصولهم على ثمن المحصول مهما تأخر الثمن (١٠٠%) ، والبعد عن تلاعب التجار بالأسعار (٩٥,٠٧ %) ، ودعم رأس مال الجمعية التعاونية الزراعية (٧٦,١٠%) ، وأخيراً حصولهم على فوائد غير مباشرة من الجمعية التعاونية الزراعية في صورة أرباح آخر العام (٥٩,٩٠%).

وأما بالنسبة للزراع المبحوثين الذين يفضلون نظام التسويق التعاقدي فكانت أسباب التفضيل هي: معرفتهم بثمن بيع المحصول مسبقاً (١٠٠%) ، وضمان بيع المحصول من خلال التعاقد (١٠٠%) وتشجيعهم على زراعة المحصول مستقبلا (١٠٠%) والالتزام بشروط التعاقد بين الطرفين (٩٥,١٩%) ، وأخيراً حصول الزراع على بعض الخدمات من الطرف المشتري المتعاقد (٧٨,٨٥%).

وأما بالنسبة للمبحوثين الذين يفضلون نظام التسويق الحر المباشر للتجار فكانت الأسباب هي : حرية المزارع في البيع لأي تاجر في أي مكان وأي وقت (١٠٠%) ، و حصول المزارع على سلفة مقدماً من ثمن المحصول من التاجر (٧٧,٢٧%) .

ثالثا: المشكلات التي تواجه المبحوثين عند تسويق بعض المحاصيل الاستراتيجية :

أبرزت نتائج هذه الدراسة أن هناك ثماني مشكلات ذكرها المبحوثون تواجههم عند التسويق ، وقد تم ترتيبها تنازلياً حسب تكراراتها ، حيث تمثلت تلك المشكلات في : انخفاض أسعار بيع المحاصيل مقارنة بالتكاليف (١٠٠%) ، وتلاعب التجار بالأسعار (١٠٠%) ، ومماطلة التجار في سداد ثمن المحصول (٩٣,٩٠ %) ، وعدم ضمان بيع المحصول (٩٢,٢٨%) ، والنزاعات والخلافات بين الزراع والتجار على سداد ثمن المحصول (٨٣,٣٣%) ، وعدم معرفة الزراع بأسعار السوق (٧٧,٦٤%) ، وعدم وجود رقابة جادة على التجار والأسواق (٧٥,٢٠%) ، وأخيراً عدم الإعلان عن سعر بيع المحاصيل مسبقا (٦٩,٩٤%)٠

رابعا: أهم الحلول المقترحة من وجهة نظر الزراع المبحوثين للتغلب على مشكلاتهم التسويقية لبعض محاصيلهم الإستراتيجية :

أظهرت النتائج البحثية أن الزراع المبحوثين قد ذكروا مجموعة من الحلول المقترحة والتي من شأنها قد تساهم في حل مشكلاتهم التسويقية ، وقد تم ترتيبها تنازلياً حسب تكراراتها حيث تمثلت في الآتي : ضرورة دعم مستلزمات الإنتاج لتقليل التكاليف على الزراع (١٠٠%) ، والرقابة المشددة على التجار والأسواق من الجهات المسئولة (٧٩,٢٧%) ، وتوعية الزراع بأسعار السوق بصورة دائمة (٧٣,١٧%) ، والإعلان مسبقاً عن سعر بيع المحاصيل (٧١,١٤%) ، وأخيراً إعادة نظام التسويق التعاوني عن طريق الجمعيات الزراعية (٥٣,٢٥%).

آراء الزراع حول أفضل النظم التسويقية لبعض المحاصيل الإستراتيجية بمركزي كفر الدوار وأبو حمص بمحافظة البحيرة

صبحي عوض عيسى الأحمر

معهد بحوث الإرشاد الزراعي والتنمية الريفية _ مركز البحوث الزراعية

الملخص: استهدف هذا البحث بصفة رئيسية التعرف على آراء الزراع المبحوثين حول أفضل النظم التسويقية لبعض المحاصيل الإستراتيجية بمركزي كفر الدوار وأبو حمص بمحافظة البحيرة ، وذلك من خلال تحقيق الأهداف الفرعية التالية :

١- التعرف على آراء الزراع المبحوثين حول أفضل النظم التسويقية لبعض المحاصيل الإستراتيجية من وجهة نظرهم.

٢- التعرف على أسباب تفضيل الزراع المبحوثين لنظام تسويقي معين عن الآخر.

٣- التعرف على أهم المشكلات التي تواجه الزراع المبحوثين في تسويق بعض محاصيلهم الإستراتيجية من وجهة نظرهم.

٤- التعرف على بعض الحلول المقترحة لمواجهة المشكلات التي تقابل الزراع المبحوثين عند تسويق بعض محاصيلهم الإستراتيجية من وجهة نظرهم.

وقد تم إجراء هذا البحث بمحافظة البحيرة ، حيث تم اختيار مركزين من بين مراكز المحافظة بطريقة عشوائية وهما كفر الدوار وأبو حمص ، ومن بين قرى هذين المركزين تم اختيار أربع قرى بطريقة عشوائية أيضا ، فكانت القرى المختارة هي قريتي البيضا البلد وبولين من مركز كفر الدوار ، وقريتي دسونس الحلفاية والغابة من مركز أبو حمص.

وأما بالنسبة لشاملة البحث وعينته ، فقط تمثلت شاملة هذا البحث في إجمالي عدد الزراع الحائزين بسجل ٢ خدمات بكل جمعية زراعية في القرى الأربع محل الدراسة ، ومن ثم بلغت الشاملة (٢٦٧٩) مبحوثاً ، وقد تم أخذ عينة عشوائية منتظمة بنسبة (١٠%) من شاملة كل قرية فكانت موزعة كالتالي : قرية البيضا البلد(٤٨) مبحوثاً ، وقرية بولين (٨٥) مبحوثاً ، وقرية دسونس الحلفاية(١٠٠) مبحوثاً ، وقرية الغابة (٣٥) مبحوثاً. وقد تم تجميع البيانات باستخدام استمارة استبيان بالمقابلة الشخصية مع المبحوثين بعد إجراء الاختبار المبدئي مسبقا على هذه الاستمارة على عينة من المبحوثين للتأكد من سلامتها وإجراء التعديلات اللازمة عليها. وقد استخدم كلاً من النسب المئوية والتكرارات لتحليل البيانات البحثية هذا ولقد تمثلت أهم النتائج فيما يلي:

أولا: آراء الزراع نحو أفضل النظم التسويقية لبعض المحاصيل الاستراتيجية :

أظهرت النتائج البحثية أن نسبة (٥٢,٩٩%) من إجمالي الزراع المبحوثين يفضلون نظام التسويق التعاوني للجمعية التعاونية الزراعية ، و(٣٨,٨١%) يفضلون نظام التسويق التعاقدي ، وأخيراً (٨,٢٠%) يفضلون نظام التسويق الحر للتجار مباشرة.

pounds, 10.5 billion pounds, 120 workers, respectively, by an annual growth rate reached about 12.7%, 9.9%, 2.2%, respectively.

With respect to the assessment of the efficiency of agricultural investments, the results confirmed that the rate of investment, return on investment, the investment multiplier, the coefficient of endemism, and the coefficient of capital intensive have reached about 0.10, 14,2,1,4,0,51,1,34 respectively. And investment rate and coefficient of endemism decreases by a statistically significant value was about 0.01, 0.024, respectively, And on the other hand, the return on investment is increasing by a significant value amounted to about 1.13.

With respect to the most important variables affecting the volume of agricultural investments in Egypt by real prices in the linear form. The results indicated that the most important factors affecting the agricultural investment volume are the value of agricultural savings, the value of Interest rate of deposits in the banking system. But in the semi-logarithmic form, the results confirmed that the value of agricultural Savings, and Agricultural wages are increasing by 1% would increase agricultural investment volume of about 0.27%, 0.02% respectively. In the double logarithmic form, results showed that increasing the value of agricultural savings of about 1% leads to increase agricultural investment volume of about 1.4%.

The research was reported that the main causes of decline in the volume and efficiency of investment on the national level and within the Egyptian agricultural sector due to the complexity and slow pace of investment procedures, a weak institutional framework, the weakness of the stock market efficient and very influenced by current events, the unequal distribution of investments between sectors of the economy, the lower the efficiency of workers of different sectors in Egypt's economy, and the low of Egyptian competitive position, the lack of agricultural investment, the weakness of technology in the agricultural sector, and reduced the relative importance of agricultural land from the total area.

The research recommends an increase in investment directed to infrastructure projects and economic services, which contributes to reducing the cost to investors, thereby increasing private investment, as well as limiting the use of agricultural loans and agricultural savings to finance the agricultural investments.

موقع البنك المركزي المصري WWW.cba.org.eg

موقع وزارة التخطيط WWW.moP.gov.eg

موقع وزارة المالية WWW.mof.gova.ag

وزارة الزراعة واستصلاح الأراضي– قطاع الشئون الاقتصادية– الإدارة المركزية للاقتصاد الزراعي– نشرات الدخل الزراعي– القاهرة – أعداد متفرقة.

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An economic study of the efficiency and determinants of agricultural investment in Egypt

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ABSTRACT: Egyptian agricultural sector represents one of the basic pillars in the national economic structure. Agriculture sector employs a large part of labor, which is about 27.2% of the total number of workers in economic activities. The value of agricultural domestic product has reached about 106 billion pounds, represents about 12.6٪ of the GDP value which reached about 844.5 billion pounds. The value of investments directed to the agriculture sector is around 7.43 billion pounds; represent about 5.5% of the total national investments, amounting to about 136.1 billion pounds during the period (1995-2015).

The research problem is the decline in the share of the agricultural sector of the national investments, which decreased the relative importance of the agricultural investments volume in the total national investment from about 8.6% in 1995, to about 4% in 2015.

The research aims to study agricultural investment efficiency and its determinants in Egypt, The research was based on descriptive analysis and quantitative analysis to characterize the economic variables, as well as the use of statistical analysis tools.

The results showed that gross domestic product (GDP), agriculture domestic product, and agricultural employment amounted to about 844.5 billion pounds, 106.0 billion pounds, 6 000 workers, respectively, and they are growing annually by growing annually by statistically value amounted to about 107.6 billion

ج- وضع خرائط للاستثمار الزراعي يوضح فيها مجالات الاستثمار ومواقعه وترتيب أولوياته، والأراضي القابلة للاستصلاح والمرافق المتاحة بها.

د- الاهتمام بالترويج للفرص الاستثمارية المتاحة بالقطاع الزراعي داخلياً وخارجياً من خلال إرسال البعثات الترويجية للاستثمار، والاهتمام بالأعلام الاستثماري في المجالات الاستثمارية ومواقعها.

ه- تدعيم مراكز الاستثمار المتخصصة مثل مكتب الاستثمار الزراعي التابع لوزارة الزراعة ليساهم في توفير البيانات والمعلومات عن المجالات الاستثمارية الزراعية المتاحة، وإعداد دراسات الجدوى الأولية لها، وعقد لقاءات مع المستثمرين ورجال الأعمال الزراعيين للعمل علي حل مشاكلهم وتسهيل أعمالهم.

و- التوسع في إقامة المعارض لعرض منتجات الشركات الزراعية في الداخل والخارج، إلي جانب عقد الندوات والمؤتمرات المهتمة بالاستثمار الزراعي، وحل مشاكل المستثمرين.

ز- تسهيل عمليات الائتمان اللازمة لمشروعات الاستثمار الزراعي.

٣- قصر استخدام القروض الزراعية، الادخار الزراعي علي تمويل الاستثمارات الزراعية. وليس استخدامها في أغراض أخري.

٤- أن يتم تحديد سعر الفائدة علي القروض الزراعية في ضوء حجم الاستثمارات اللازمة لإقامة المشروعات، مع العمل علي إيجاد سعر فائدة مناسب علي القروض الزراعية.

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سابعاً: أسباب انخفاض حجم الاستثمارات الزراعية:

(٧-١) تدني نسبة الاستثمارات المخصصة للقطاع الزراعي حيث انخفضت نسبة الاستثمارات المخصصة للقطاع الزراعي من نحو ٨,٦٪عام ١٩٩٥، إلي نحو ٤٪ عام ٢٠١٥ (نشرات الدخل ، وزارة الزراعة، أعداد متفرقة).

(٧-٢) انخفاض القيمة المضافة للعامل الزراعي أشارت أحد المصادر أن متوسط القيمة المضافة للعامل الزراعي في مصر بلغت حوالي ١,٢ دولار، بينما بلغت في دولتي سنغافورا، والأرجنتين إلي حوالي ٤٢,٩، ١٣,٧ دولار علي الترتيب، وبذلك يتبين انخفاض القيمة المضافة للعامل الزراعي في مصر بالمقارنة ببعض الدول وهو ما ينعكس علي انخفاض الاستثمار في القطاع الزراعي، ويعزي انخفاض القيمة المضافة للعامل الزراعي إلي انخفاض المستوي التكنولوجي، وصغر حجم الحيازات الزراعية، إلي جانب ارتفاع نسبة الأمية بين العمال الزراعيين.

(٧-٣) ضعف التكنولوجيا بالقطاع الزراعي مازال القطاع الزراعي المصري يعتمد علي الأساليب التقليدية وعدم استخدام الأساليب الحديثة بسبب ضعف المخصص للبحث العلمي من الناتج المحلي الإجمالي، مما ترتب عليه ضعف كفاءة الإنتاج الزراعي، كذلك انخفاض مؤشر الميكنة الزراعية في القطاع الزراعي بالمقارنة بالدول النامية مثل سنغافورا، مما أدي إلي انخفاض الإنتاجية الفدانية، وانخفاض كفاءة القطاع الزراعي.

(٧-٤) انخفاض الأهمية النسبية للأراضي الزراعية في جملة المساحة الكلية أشارت أحدي المصادر أن نسبة الأراضي الزراعية إلي المساحة الكلية في مصر قد بلغت نحو ٣,٣٪، في حين بلغت هذه النسبة في تونس وتركيا والأرجنتين نحو ١٧٪، ٣٢٪، ٨٪ علي الترتيب.

(٧-٥) معوقات استصلاح الأراضي يتسم القطاع الزراعي بانخفاض العائد علي الاستثمار في مشروعات استصلاح الأراضي الجديدة، مقارنة بغيرها من المشروعات الصناعية، والخدمية، والتجارية حيث يتراوح العائد علي الاستثمار في مشروعات استصلاح الأراضي ما بين (٥٪- ١١٪) جنيه للفدان ويعزي ذلك إلي ارتفاع التكلفة الاستثمارية للاستصلاح والاستزراع وكذلك ارتفاع درجة المخاطرة في نشاط الاستصلاح والاستزراع، وعدم كفاءة الخدمات التسويقية إلي جانب ضعف الخدمات الاجتماعية في المناطق الجديدة، بالإضافة إلي المعوقات الإدارية (الأهرام الإقتصادي، العدد ١٨٧، نوفمبر ٢٠٠٤).

(٧-٦) قزمية الحيازات وكثرة عدد القطع بالحيازة الواحدة.

التوصيات

١- زيادة الاستثمارات العامة الموجهة لمشروعات البنية التحتية والخدمات الاقتصادية والاجتماعية الهامة، مما يساهم في خفض التكلفة للمستثمرين، ومن ثم زيادة الاستثمارات الخاصة.

٢- تحسين المناخ الاستثماري في مصر من خلال:

أ- توجيه الاستثمارات العامة نحو تطوير البنية الأساسية خاصة المناطق الجديدة لتشجيع الاستثمار الزراعي الخاص.

ب- إزالة المحددات الخاصة بالتسويق والتجارة الخارجية وتوفير الحماية للمنتجات المحلية خاصة الناشئة منها.

لسنة ٢٠٠٤، ثم قوانين أخري، أي تم صدور قانون كل عدة سنوات وهو ما يعكس تعدد القوانين والتشريعات أمام المستثمرين، مما أدي إلي عدم الاستقرار داخل المناخ الاستثماري.

(٦-٢) تعقد وبطء إجراءات الاستثمار أشارت إحدى التقارير أن تسجيل أي عمل استثماري جديد يتطلب ١٣ إجراء وقرابة شهرين، وتكلفة توازي ٦١٪من متوسط نصيب الفرد من الناتج المحلي الإجمالي، كما بلغ عدد الإجراءات المطلوبة لوضع العقود حوالي (١٧) إجراء يستغرق في المتوسط سبعة أشهر وبالنظر إلي العديد من الدول النامية وعلي رأسها المغرب والتي خفضت إجراءات التسجيل من ١١ إجراء إلي ٥ إجراءات مقابل حوالي ١٣ إجراء لمصر ووفقاً لهذا فإن مصر تعتبر من الدول ذات الإجراءات الكثيرة المعوقة للاستثمار (إبراهيم، ٢٠١٤).

(٦-٣) قصور وبطء أليات فض المنازعات يصل متوسط طول فترة التقاضي إلي نحو أربعة سنوات ونصف، إلي جانب غياب وقصور مستويات الخدمات المساعدة مثل مراكز التدريب والمعامل الخاصة بمنح شهادات الجودة والمنشأ، وعدم توفر قاعدة معلومات تمكن من اتخاذ القرار الاستثماري الرشيد، إلي جانب ارتفاع تكاليف التمويل وتكلفة المعاملات. هذا وقد بلغ معامل الإقراض في مصر نحو ١٣٪، مقابل نحو ٢,٢٪ في دولة مثل اليابان (World bank, 2001).

(٦-٤) ضعف الإطار المؤسسي وضعف كفاءة البورصة وتأثرها الشديد بالأحداث الجارية مما لاشك فيه أن ما يحدث فيمصر من اعتداءات علي المرافق العامة للدولة وحوادث الإرهاب في سيناء وبعض محافظات مصر أدي إلي انخفاض حجم التعامل في البورصة، وأثر علي الدور الرئيسي لها والمتمثل في التخصيص الأمثل للموارد.

(٦-٥) التوزيع غير العادل للاستثمارات بين القطاعات الاقتصادية يعاني الاقتصاد المصري عدم التوزيع الأمثل للاستثمارات بين القطاعات الاقتصادية وفي داخل كل قطاع فمثلاً يستحوذ قطاعي الصناعة والتعدين علي نحو١٤٪، ١٦٪ علي الترتيب من جملة الاستثمارات، في حين يستحوذ القطاع الزراعي علي نحو ٤٪فقط من جملة الاستثمارات القومية خلال الفترة (١٩٩٥– ٢٠١٥) (الأهرام الإقتصادي، العدد ١٩٢٥، نوفمبر ٢٠٠٥).

(٦-٦) انخفاض كفاءة العاملين بالقطاعات الاقتصادية المختلفة تبلغ نسبة الأجر إلي الإنتاجية في مصر حوالي ١,٣ جنيه، بمعني أن كل ١٠٠ جنيه إنتاجية يقابلها حوالي ١٣٠ جنيه أجر وهذا يعني أن الأجر أعلي من الإنتاجية بنحو ٣٠٪، وهذا المعدل أعلي بكثير من نظيره في معظم دول العالم، حيث بلغت نسبة الأجر إلي الإنتاجية في دولة مثل تايلاند إلي نحو ٠,٣ دولار، وهذا يعني أن تحديد العلاقة بين الأجر والإنتاجية في مصر يسير بشكل غير اقتصادي (مصطفي وآخرون، ٢٠٠٤).

(٦-٧) تدني المركز التنافسي المصري يبني تقرير التنافسية علي ثلاثة مؤشرات وهي مؤشر التكنولوجيا ومؤشر المؤسسات العامة، ومؤشر البيئة الاقتصادية الكلية، وقد أصدر المنتدى الاقتصادي العالمي تنافسية العالم العربي عام ٢٠٠٥ وجاءت مصر في المرتبة التاسعة، وقد ارجع التقرير الترتيب المتدني لمصر إلي عدة أمور منها أوجه القصور علي مستوي الاقتصاد الكلي، وتواضع الأداء فيما يتعلق بانتشار التكنولوجيا.

جدول رقم (٩). القياس الاحصائي لأهم المتغيرات الاقتصادية المؤثرة علي حجم الاستثمار الزراعي المصري بالأسعارالحقيقية باستخدام الانحدار المرحلي خلال الفترة (١٩٩٥-٢٠١٥)

رقم المعادلة	النموذج المستخدم	معادلة الاتجاه الزمني العام	$R^{/2}$	F المحسوبة
٣٢	الصورة الخطية	$Y_i = -2.42 + 1.11X_7 + 0.15X_9$ $(-5.7)^{**}\ (7.0)^{**}\ (4.5)^{**}$	0.79	38.2**
٣٣	الصورة نصف اللوغاريتمية	$\log Y_i = -0.43 - 0.28X_4 + 0.27X_7 + 0.02X_5$ $(-2.4)^{*}\ (-4.4)^{**}\ (4.2)^{**}\ (2.2)^{*}$	0.80	27.5**
٣٤	الصورة اللوغاريتمية المزدوجة	$\log Y_i = -0.43 - 0.37 \log X_4 + 1.4 \log X_7$ $(-3.9)^{**}\ (-4.3)^{**}\ (4.2)^{**}$	0.78	35.4**

حيث أن:

Y_i =قيمة الاستثمارات الزراعية الحقيقية بالمليار جنيه في المشاهدة i. X_4 =قيمة الصادرات الزراعية الحقيقية بالمليار جنيه في المشاهدة ا.

X_5 =قيمة الأجور الزراعية الحقيقية بالمليار جنيه في المشاهدة ا. X_7 =قيمة المدخرات الزراعية الحقيقية بالمليار جنيه في المشاهدة ا.

X_9 =سعر الفائدة علي الودائع بالجهاز المصرفي بالمليار جنيه في المشاهدة ا. i =١،٢،...........،٢١.

المصدر: نتائج الحاسب الآلي للأرقام الواردة بالجدول رقم (٦) بالبحث.

(٥-٢-٣) **الصورة اللوغاريتمية المزدوجة** تشير نتائج المعادلة رقم (٣٤) أن العلاقة معنوية احصائياً عند مستوي ١٪، حيث بلغت قيمة ف المحسوبة حوالي (٣٥,٤) وهي أكبر من نظيرتها الجدولية. كما تشير قيمة معامل التحديد المعدل أن نحو ٧٨٪ من التغيرات في حجم الاستثمارات الزراعية ترجع إلي التغير في قيمة كلاً من الصادرات الزراعية(X_4)، المدخرات الزراعية (X_7)، وقد احتلت قيمة الصادرات الزراعية المرتبة الأولي من حيث التأثير علي حجم الاستثمارات الزراعية الحقيقية، وقد ثبتت معنوية تأثير هذين المتغيرين، كما تشير النتائج أن زيادة قيمة المدخرات الزراعية بنحو ١٪ يؤدي إلي زيادة حجم الاستثمارات الزراعية بنحو ١,٤٪، كما أن نقص قيمة الصادرات الزراعية بنحو١٪ يؤدي إلي زيادة الاستثمارات الزراعية بنحو ٠,٣٧٪.

مما سبق يتبين أن الصورة الخطية هي أفضل الصور في قياس العلاقة تأثير أهم المتغيرات الاقتصادية علي الاستثمار الزراعي المصري بالأسعار الجارية والحقيقية خلال الفترة (١٩٩٥-٢٠١٥).

سادساً: أسباب انخفاض حجم وكفاءة الاستثمار القومي في مصر:

علي الرغم من الحوافز التي منحتها الدولة تشجيعاً للاستثمار علي المستوي القومي إلا أنه مازال هناك الكثير من المشاكل والعقبات التي تحول دون زيادة حجم الاستثمارات القومية وانخفاض كفاءتها. ويمكن توضيح أهم الأسباب التي أدت إلي انخفاض حجم الاستثمارات المحلية والأجنبية في الآتي:

(٦-١) **تعدد القوانين والتشريعات** شهد المناخ الاستثماري في مصر تعدد القوانين والتشريعات أمام المستثمرين بداية من صدور القانون رقم ٤٣ لسنة ١٩٧٤ لاستثمار رأس المال العربي والأجنبي، والذي أعقبه صدور قانون رقم ٢٢ سنة ١٩٧٧، وتم إلغائه بالقانون رقم ٢٣٠ لسنة ١٩٨٩، ثم صدور القانون رقم ٨ لسنة ١٩٩٧، ثم صدور القانون رقم ١٣

٠,٠٧٪. وهذا ما يؤكد أهمية تخفيض سعر الفائدة علي القروض الزراعية في المدي القصير إذا ما كان الهدف هو زيادة حجم الاستثمارات الزراعية.

(٥-١-٣) الصورة اللوغاريتمية المزدوجة أوضحت نتائج المعادلة رقم (٣١) أن الدالة المقدرة معنوية احصائياً عند مستوي ١٪، حيث بلغت نسبة(ف) المحسوبة حوالي (١٤,٢) وهي أكبر من نظيرتها الجدولية. كما أشارت قيمة معامل التحديد المعدل أن نحو ٤٠٪ من التغيرات في حجم الاستثمارات الزراعية في مصر ترجع إلي تأثير نسبة سعر الفائدة علي القروض الزراعية (X_8) علي الاستثمارات الزراعية، حيث ثبتت معنوية تأثير هذا المتغير عند مستوي معنوية ١٪، وتشير النتائج أن تخفيض نسبة الفائدة علي القروض الزراعية بنحو ١٪ يؤدي إلي زيادة الاستثمارات الزراعية بنحو ١,٩٩٪.

(٥-٢) التقدير الاحصائي لأهم العوامل المؤثرة علي الاستثمار الزراعي بالأسعار الحقيقية:

(٥-٢-١) الصورة الخطية أشارت المعادلة رقم (٣٢) بالجدول رقم (٩) إلي القياس الاحصائي لأهم العوامل المؤثرة علي قيمة الاستثمار الزراعي بالأسعار الحقيقية. حيث أكدت النتائج أن الدالة المقدرة معنوية احصائياً عند مستوي١٪، وقد بلغت نسبة ف المحسوبة حوالي (٣٨,٢) وهي أكبر من نظيرتها الجدولية. كما أشارت قيمة معامل التحديد المعدل أن نحو ٧٩٪ من التغيرات في حجم الاستثمارات الزراعية في مصر ترجع إلي التغير في العوامل المستقلة المتضمنة بالدالة. كما أشارت النتائج إلي أهمية تأثير كل من قيمة المدخرات الزراعية (X_7)، سعر الفائدة علي الودائع بالجهاز المصرفي(X_9)علي حجم الاستثمارات الزراعية، وتحتل قيمة المدخرات الزراعية المرتبة الأولي من حيث التأثير علي حجم الاستثمارات الزراعية، ثم تأتي سعر الفائدة علي الودائع بالجهاز المصرفي في المرتبة الثانية، حيث ثبتت معنوية تأثير هذين المتغيرين عند مستويات المعنوية المألوفة. كما تشير النتائج أن زيادة قيمة المدخرات الزراعية بحوالي مليار جنيه يؤدي إلي زيادة حجم الاستثمارات الزراعية بحوالي١,١١ مليار جنيه، كذلك تؤدي زيادة سعر الفائدة علي الودائع بالجهاز المصرفي بحوالي مليار جنيه إلي زيادة الاستثمارات الزراعية بحوالي ٠,١٥ مليار جنيه.

(٥-٢-٢) الصورة نصف اللوغاريتمية أوضحت النتائج أن الدالة معنوية احصائياً عند مستوي١٪، حيث بلغت نسبة (ف) المحسوبة حوالي (٢٧,٥) وهي أكبر من نظيرتها الجدولية. كما تشير قيمة معامل التحديد المعدل أن نحو ٨٠٪ من التغيرات في حجم الاستثمارات الزراعية ترجع إلي التغير في العوامل المستقلة التي تضمنتها الدالة. كذلك يتبين أهمية تأثير كل من قيمة الصادرات الزراعية (X_4)، قيمة المدخرات الزراعية (X_7)، قيمة الأجور الزراعية(X_5)علي حجم الاستثمارات الزراعية، وقد احتلت قيمة الصادرات الزراعية المرتبة الأولي من حيث التأثير علي حجم الاستثمارات الزراعية، ثم تأتي قيمة المدخرات الزراعية في المرتبة الثانية، وأخيراً تأتي قيمة الأجور الزراعية في المرتبة الثالثة، حيث ثبتت معنوية تأثير تلك المتغيرات عند مستوي معنوية ١٪، كما تشير النتائج أن زيادة قيمة المدخرات الزراعية بنسبة ١٪ يؤدي إلي زيادة حجم الاستثمارات الزراعية بنحو ٠,٢٧٪، كذلك تؤدي زيادة قيمة الأجور الزراعية بنسبة ١٪ إلي زيادة الاستثمارات الزراعية بنحو ٠,٠٢٪، أما نقص قيمة الصادرات الزراعية بنسبة ١٪ يؤدي إلي انخفاض الاستثمارات الزراعية بنحو ٠,٢٨٪.

نحو ٧٣٪ من التغيرات في حجم الاستثمارات الزراعية ترجع إلي التغير في العوامل المستقلة التي تضمنتها الدالة. كما أشارت النتائج إلي مدي تأثير كلاً من قيمة الأجور الزراعية(X_5)، قيمة الواردات الزراعية(X_3)، قيمة القروض الزراعية (X_6)، قيمة الصادرات الزراعية(X_4)علي حجم الاستثمارات الزراعية، وقد احتلت قيمة الأجور الزراعية المرتبة الأولي من حيث التأثير علي حجم الاستثمارات الزراعية، ثم تأتي قيمة القروض الزراعية في المرتبة الثانية، كما تأتي قيمة الواردات الزراعية في المرتبة الثالثة، وأخيراً تأتي قيمة الصادرات الزراعية في المرتبة الرابعة، حيث ثبتت معنوية تأثير تلك المتغيرات عند مستويات المعنوية المألوفة، كما تشير النتائج أن زيادة قيمة الأجور الزراعية بحوالي مليار جنيه يؤدي إلي زيادة الاستثمارات الزراعية بحوالي ٠,١٢ مليار جنيه، كما أن انخفاض قيمة الواردات الزراعية بحوالي مليار جنيه يؤدي إلي زيادة حجم الاستثمارات الزراعية بحوالي ٠,١٧ مليار جنيه، كما يؤدي زيادة قيمة القروض الزراعية بحوالي مليار جنيه إلي زيادة الاستثمارات الزراعية بحوالي٠,٣ مليار جنيه، كذلك فإن نقص قيمة الصادرات الزراعية بحوالي مليار جنيه يؤدي إلي زيادة الاستثمارات الزراعية بحوالي ٠,٣٦ مليار جنيه والقيمة الأخيرة قد لا تتفق مع المنطق الاقتصادي.

جدول رقم (٨). القياس الاحصائي لأهم المتغيرات الاقتصادية المؤثرة علي حجم الاستثمار الزراعي المصري بالأسعار الجارية باستخدام الانحدار المرحلي خلال الفترة (١٩٩٥-٢٠١٥)

رقم المعادلة	النموذج المستخدم	معادلة الاتجاه الزمني العام	R'^2	F المحسوبة
٢٩	**الصورة الخطية**	$\mathbf{Y_i} = 4.21 + 0.12\ \mathbf{X_5} - 0.17\ \mathbf{X_3} + 0.3\ \mathbf{X_6} - 0.36\ \mathbf{X_4}$ $(5.7)^{**}\ (6.1)^{**}\ (-2.3)^{*}(3.8)^{**}\ (-2.29)^{*}$	0.73	14.18**
٣٠	**الصورة نصف اللوغاريتمية**	$\mathbf{log Y_i} = 1.72 - 0.07\ \mathbf{X_8}$ $(7.9)^{**}\ (-4.0)^{**}$	0.43	16.3**
٣١	**الصورة اللوغاريتمية المزدوجة**	$\mathbf{log Y_i} = 3.06 - 1.99 \log \mathbf{X_8}$ $(5.2)^{**}\ (-3.8)^{**}$	0.40	14.2**

حيث أن:

$\mathbf{Y_i}$ = قيمة الاستثمارات الزراعية الجارية بالمليار جنيه في المشاهدة i. $\mathbf{X_3}$ = قيمة الواردات الزراعية الجارية بالمليار جنيه في المشاهدة I.

$\mathbf{X_4}$ = قيمة الصادرات الزراعية الجارية بالمليار جنيه في المشاهدة I. $\mathbf{X_5}$ = قيمة الأجور الزراعية الجارية بالمليار جنيه في المشاهدة I.

$\mathbf{X_6}$ = قيمة القروض الزراعية الجارية بالمليار جنيه في المشاهدة I. $\mathbf{X_8}$ = سعر الفائدة علي القروض الزراعية في المشاهدة I.

$\mathbf{i}$ = ا،٢،..........،٢١.

المصدر: نتائج الحاسب الآلي للأرقام الواردة بالجدول رقم (٦) بالبحث.

(٥-١-٢) الصورة نصف اللوغاريتمية أكدت نتائج المعادلة رقم (٣٠) أن الدالة المقدرة معنوية احصائياً عند مستوي ١٪، حيث بلغت نسبة(ف) المحسوبة حوالي (١٦,٣) وهي أكبر من نظيرتها الجدولية. كما تشير قيمة معامل التحديد المعدل أن نحو ٤٣٪ من التغيرات في حجم الاستثمارات الزراعية في مصر ترجع إلي تأثير نسبة سعر الفائدة علي القروض الزراعية (X_8) علي الاستثمارات الزراعية، حيث ثبتت معنوية تأثير هذا المتغير عند مستوي معنوية ١٪، كما تشير النتائج أن تخفيض نسبة الفائدة علي القروض الزراعية بنسبة ١٪ يؤدي إلي زيادة الاستثمارات الزراعية بنسبة

وتشير تقديرات المعادلة رقم (٢٤) أن قيمة المدخرات الزراعية تتزايد سنوياً بمقدار معنوي احصائياً بلغ حوالي ٠,٨٥ مليار جنيه بالأسعار الجارية (بما يوازي حوالي -٠,٠٢ مليار جنيه بالأسعار الحقيقية)، وبمعدل نمو سنوي بلغ نحو ٥,٩٪ وفقاً للأسعار الجارية. وتشير قيمة معامل التحديد أن نحو ٩٨٪ من التغيرات في قيمة المدخرات الزراعية ترجع إلي تغيرات يعكس أثرها عامل الزمن.

(٤- ٨) سعر الفائدة علي القروض الزراعية أشارت نتائج البحث إلي أن سعر الفائدة علي القروض الزراعية قد بلغ أدني قيمة له نحو ١١,٠١٪ عام ٢٠١٠، في حين بلغ أقصي قيمة له نحو ١٦,٤٧٪ عام ١٩٩٥، بمتوسط بلغ نحو ١٢,٩٪. وتشير تقديرات المعادلة رقم (٢٦) أن سعر الفائدة علي القروض الزراعية يتناقص سنوياً بمقدار معنوي احصائياً بلغ نحو ٠,١٨ ٪، وبمعدل نمو سنوي بلغ نحو (١,٤) ٪. وتشير قيمة معامل التحديد أن نحو ٧١٪ من التغيرات في سعر الفائدة علي القروض الزراعية ترجع إلي تغيرات يعكس أثرها عامل الزمن.

(٤-٩) سعر الفائدة علي الودائع بالجهاز المصرفي أوضحت النتائج بالجدول رقم (٦) أن سعر الفائدة علي الودائع بالجهاز المصرفي قد بلغ أدني قيمة له نحو ٦,٠٢٪ عام ٢٠٠٦، في حين بلغ أقصي قيمة له نحو ١٠,٩٢٪ عام ١٩٩٥، بمتوسط بلغ نحو ٧,٩٪. وتشير تقديرات المعادلة رقم (٢٧) أن سعر الفائدة علي الودائع بالجهاز المصرفي يتناقص سنوياً بمقدار معنوي احصائياً بلغ نحو ٠,٢١ ٪، وبمعدل نمو سنوي بلغ نحو (٢,٧)٪. وتشير قيمة معامل التحديد أن نحو ٦٩٪ من التغيرات في سعر الفائدة علي الودائع بالجهاز المصرفي ترجع إلي تغيرات يعكس أثرها عامل الزمن.

(٤-١٠) سعر صرف الجنيه بالدولار أكدت نتائج البحث أن سعر صرف الجنيه بالدولار قد بلغ أدني قيمة له حوالي ٣,٣٩جنيه/ دولار عام ١٩٩٥، في حين بلغ أقصي قيمة له حوالي ٧,٦جنيه/ دولار عام ٢٠١٥، بمتوسط بلغ حوالي ٥,٢جنيه/ دولار. وتشير المعادلة رقم (٢٨) أن سعر صرف الجنيه بالدولار تتزايد سنوياً بمقدار معنوي احصائياً بلغ حوالي ٠,١٩ جنيه/ دولار، وبمعدل نمو سنوي بلغ نحو ٣,٧٪. وتشير قيمة معامل التحديد أن نحو ٨٦٪ من التغيرات في سعر صرف الجنيه بالدولار ترجع إلي تغيرات يعكس أثرها عامل الزمن.

خامساً: تأثير المتغيرات الاقتصادية علي حجم الاستثمارات الزراعية في مصر:

تم استخدام أسلوب الانحدار المرحليregression stepwiseلدراسة أثر المتغيرات الاقتصادية علي الاستثمار الزراعي في صورها الخطية المتعددة ونصف اللوغاريتمية واللوغاريتمية المزدوجة بالأسعار الجارية والأسعار الحقيقية خلال الفترة (١٩٩٥- ٢٠١٥).

(٥-١) القياس الاحصائي لأهم العوامل المؤثرة علي الاستثمار الزراعي بالأسعار الجارية:

(٥-١-١) الصورة الخطية توضح المعادلة رقم (٢٩) بالجدول رقم (٨) نتائج القياس الاحصائي لأهم العوامل المؤثرة علي الاستثمار الزراعي الجاري. حيث أشارت النتائج أن الدالة المقدرة معنوية احصائياً عند مستوي معنوية ١٪، حيث بلغت قيمة (ف) المحسوبة حوالي (١٤,١٨) وهي أكبر من نظيرتها الجدولية. كما تشير قيمة معامل التحديد المعدل أن

جدول رقم (٧). الاتجاه الزمني العام لأهم المتغيرات الاقتصادية المؤثرة علي الاستثمارات الزراعية في مصر بالأسعار الجارية والحقيقية خلال الفترة (١٩٩٥- ٢٠١٥)

رقم المعادلة	المتغيرات الاقتصادية		معادلة الاتجاه الزمني العام	معدل النمو السنوي(٪)	R^2	F المحسوبة
١٢	قيمة الواردات القومية (مليار جنيه)	جاري	$Y_i = 126.5 + 50.0\, T_i$ $(3.1)^{**}$ $(15.1)^{**}$	7.4	0.92	228.9**
١٣		حقيقي	$Y_i = 3.9 + 1.8\, T_i$ $(1.9)^{N}$ $(10.7)^{**}$	7.6	0.86	115.2**
١٤	قيمة الصادرات القومية (مليار جنيه)	جاري	$Y_i = -37.9 + 11.2\, T_i$ $(-3.5)^{**}$ $(12.9)^{**}$	13.2	0.90	168.3**
١٥		حقيقي	$Y_i = 0.73 + 0.87\, T_i$ $(0.71)^{N}$ $(10.54)^{**}$	8.4	0.85	111.05**
١٦	قيمة الواردات الزراعية (مليار جنيه)	جاري	$Y_i = -5.4 + 2.4\, T_i$ $(-1.6)^{N}$ $(9.2)^{**}$	11.3	0.82	84.9**
١٧		حقيقي	$Y_i = 1.42 + 0.12\, T_i$ $(6.02)^{**}$ $(6.59)^{**}$	4.3	0.70	43.54**
١٨	قيمة صادرات الزراعية (مليار جنيه)	جاري	$Y_i = -4.07 + 1.13\, T_i$ $(-3.2)^{**}$ $(11.1)^{**}$	13.5	0.87	122.6**
١٩		حقيقي	$Y_i = 0.09 + 0.08\, T_i$ $(1.03)^{N}$ $(10.8)^{**}$	8.0	0.86	115.7**
٢٠	قيمة الأجور الزراعية (مليار جنيه)	جاري	$Y_i = -24.5 + 7.8\, T_i$ $(-2.2)^{*}$ $(8.7)^{**}$	12.7	0.80	74.9**
٢١		حقيقي	$Y_i = 2.7 + 0.46\, T_i$ $(3.8)^{**}$ $(8.1)^{**}$	5.9	0.78	65.7
٢٢	قيمة القروض الزراعية (مليار جنيه)	جاري	$Y_i = 5.2 + 0.29\, T_i$ $(3.4)^{**}$ $(2.3)^{*}$	3.5	0.22	5.4*
٢٣		حقيقي	$Y_i = 1.76 - 0.03\, T_i$ $(6.03)^{**}$ (-1.45)	(2.1)	0.09	2.09
٢٤	قيمة المدخرات الزراعية (مليار جنيه)	جاري	$Y_i = 4.9 + 0.85\, T_i$ $(14.4)^{**}$ $(31.7)^{**}$	5.9	0.98	1007.1**
٢٥		حقيقي	$Y_i = 2.45 - 0.02\, T_i$ $(17.4)^{**}$ $(-2.02)^{*}$	(0.9)	0.18	4.09**
٢٦	سعر الفائدة علي القروض الزراعية (٪)		$Y_i = 14.9 - 0.18\, T_i$ $(44.8)^{**}$ $(-6.8)^{**}$	(1.4)	0.71	46.3**
٢٧	سعر الفائدة علي الودائع بالجهاز المصرفي (٪)		$Y_i = 10.3 - 0.21\, T_i$ $(25.9)^{**}$ $(-6.5)^{**}$	(2.7)	0.69	42.5**
٢٨	سعر صرف الجنيه بالدولار (جنيه/ دولار)		$Y_i = 3.1 + 0.19\, T_i$ $(13.4)^{**}$ $(10.6)^{**}$	3.7	0.86	112.4**

** معنوية عند ١٪. **حيث أن:** Y_i= القيمة التقديرية للمتغير التابع موضع البحث. T_i= متغير يعبر عن الزمن. **i**= ١. ٢. ٣،.........٢١، سنة

المصدر: نتائج الحاسب الآلي للأرقام الواردة بالجدول رقم (٦).

(٤-٧) **قيمة المدخرات الزراعية** أكدت النتائج أن قيمة المدخرات الزراعية قد بلغت أدني قيمة لها حوالي ٥,٤٧ مليار جنيه بالأسعار الجارية (بما يوازي حوالي ١,٧٢ مليار جنيه بالأسعار الحقيقية) عام ١٩٩٥، في حين بلغت أقصي قيمة لها حوالي ٢٣,٠٢ مليار جنيه بالأسعار الجارية (بما يوازي حوالي ١,٨٨ مليار جنيه بالأسعار الحقيقية) عام ٢٠١٥، بمتوسط بلغ حوالي ١٤,٣ مليار جنيه بالأسعار الجارية (بما يوازي ٢,٢ مليار جنيه بالأسعار الحقيقية).

جدول رقم (٦). أهم المتغيرات الاقتصادية المؤثرة علي الاستثمارات الزراعية في مصر بالأسعار الجارية والحقيقية خلال الفترة (١٩٩٥- ٢٠١٥)

السنوات	الاستثمارات الزراعية (مليار جنيه) (Y)		جملة الأجور الزراعية (مليار جنيه)		قيمة القروض الزراعية (مليار جنيه)		المدخرات الزراعية (مليار جنيه)		قيمة الواردات الزراعية (مليار جنيه)		قيمة الصادرات الزراعية (مليار جنيه)		قيمة الواردات القومية (مليار جنيه)		قيمة الصادرات القومية (مليار جنيه)		سعر الفائدة علي القروض (٪)	سعر الفائدة علي الودائع بالجهاز المصرفي (٪)	سعر صرف الجنيه للدولار (جنيه/ دولار)
	أسعار جارية	أسعار حقيقية	أسعار جارية	أسعار حقيقية	أسعار جارية	أسعار حقيقية	أسعار جارية	أسعار حقيقية	أسعار جارية	أسعار حقيقية	أسعار جارية	أسعار حقيقية	أسعار جارية	أسعار حقيقية	أسعار جارية	أسعار حقيقية			
١٩٩٥	٣,٣٨	١,٠٧	١٤,٧٧	٤,٦٥	١,٢٨	٠,٤٠	٥,٤٧	١,٧٢	٦,١	١,٩٢	١,٦	٠,٥	٣١٧,٣	١٢,٥٧	١١,٩٥	٣,٧٧	١٦,٤٧	١٠,٩٢	٣,٣٩
١٩٩٦	٤,٤٨	١,٢٨	١٥,٤٤	٤,٤٢	١,٦٩	٠,٤٨	٦,٨٢	١,٩٥	٧,٧	٢,٢٠	١,٤	٠,٤	٣٤٩,٥	١٢,٦٥	١٢,٢٨	٣,٥١	١٥,٥٨	١٠,٥٤	٣,٤١
١٩٩٧	٥,١٩	١,٤٤	١٦,٧٧	٤,٦٥	٦,٢٥	١,٧٣	٧,٨٨	٢,١٩	٦,٠	١,٦٦	١,٢	٠,٣	٣٦٠,٦	١٢,٤٥	١٣,٥٣	٣,٧٥	١٣,٧٩	٩,٨٤	٣,٤٥
١٩٩٨	٨,١٦	٢,٢٠	٢٠,٥٢	٥,٥٢	٦,٩٢	١,٨٦	٨,٩٥	٢,٤١	٥,٩	١,٥٩	١,٦	٠,٤	٣٧١,٦	١٥,٠٨	١١,٠٤	٢,٩٧	١٣,٢	٩,٣٦	٣,٤٨
١٩٩٩	٨,٤٢	٢,٢٣	٢٢,٧٤	٦,٠١	٧,٥١	١,٩٩	١٠,١٣	٢,٦٨	٦,٤	١,٦٩	٢,٠	٠,٥	٣٧٨,٢	١٤,٣٨	١٢,١٧	٣,٢٢	١٢,٩٦	٩,٢٢	٣,٩٩
٢٠٠٠	٨,١٣	٢,١١	٢٢,٧٤	٥,٩١	٨,١٥	٢,١٢	١٠,٣٣	٢,٦٨	٩,٧	٢,٥٢	١,٨	٠,٥	٣٨٤,٩	١٢,٦٤	١٦,٤٠	٤,٢٦	١٣,٢٢	٩,٤٦	٣,٦٥
٢٠٠١	٨,٢٠	٢,١٢	٢٠,٣٤	٥,٢٦	٨,١٤	٢,١١	١٠,٤٢	٢,٧٠	٩,٣	٢,٤١	٢,١	٠,٥	٣٨٦,٦	١٣,١٠	١٦,٥٠	٤,٢٧	١٣,٢٩	٩,٤٦	٤,٠٧
٢٠٠٢	٥,٥٩	١,٣٠	٢٨,٧٢	٦,٧	٩,١٢	٢,١٣	١٠,٤٤	٢,٤٤	١٣,٠	٣,٠٣	٢,٦	٠,٦	٤٢٨,٧	١٣,١٧	٢١,١٥	٤,٩٣	١٣,٧٩	٩,٣٣	٤,٦٣
٢٠٠٣	٦,٤٠	١,٤٠	٢٩,٨٢	٦,٥٢	٨,٤٣	١,٨٤	١١,١٦	٢,٤٤	١٣,٥	٢,٩٥	٤,٩	١,١	٤٥٧,٦	١٤,٢٢	٣٦,٨١	٨,٠٤	١٣,٥٣	٨,٢٢	٥,٨٦
٢٠٠٤	٧,٥٦	١,٣٣	٣٠,٩١	٥,٤٦	٨,٤٧	١,٤٩	١١,٨٩	٢,١٠	١٣,٢	٢,٣٣	٣,٨	٠,٧	٥٦٦,٦	١٤,٠٧	٤٧,٦٨	٨,٤٢	١٣,٣٨	٧,٧٢	٦,١٩
٢٠٠٥	٧,٤٢	١,٣٠	٣٩,٧٩	٦,٩٦	٨,٩	١,٥٦	١٣,٥٦	٢,٣٧	١٣,٤	٢,٣٤	٤,٣	٠,٨	٥٧١,٥	٢٠,٠٧	٦١,٦٣	١٠,٧٨	١٣,١٤	٧,٢٢	٥,٧٨
٢٠٠٦	٨,٠٤	١,٢٣	٤٠,٢٦	٦,١٥	١٠,١٦	١,٥٥	١٥,٩١	٢,٤٣	١٢,٩	١,٩٧	٤,٩	٠,٧	٦٥٥	١٨,٠٧	٧٨,٨٦	١٢,٠٤	١٢,٦	٦,٠٢	٥,٧٣
٢٠٠٧	٧,٧٩	١,٢٤	٤٦,٤٦	٧,٣٨	١٠,٨	١,٧١	١٦,٦٦	٢,٦٥	١٥,٤	٢,٤٥	٥,٥	٠,٩	٦٢٩,٨	٢٤,٢٣	٩١,٢٦	١٤,٤٩	١٢,٥٤	٦,١	٥,٦٤
٢٠٠٨	٨,٠٧	٠,٩٨	٥٤,٠٩	٦,٥٥	١١,٠٢	١,٣٤	١٧,٤١	٢,١١	٢٠,٤	٢,٤٧	١٠,٩	١,٣	٨٢٥,٤	٣٤,٨٦	١٤٣,٠٩	١٧,٣٤	١٢,٣٢	٦,٥٨	٥,٤٣
٢٠٠٩	٦,٨٦	٠,٨٦	٥٨,٦٧	٧,٣٢	٢١,٠٤	٢,٦٣	١٨,١٧	٢,٢٧	٢٦,٤	٣,٢٩	١٣,٧	١,٧	٨٠١,٤	٣١,١٨	١٣٤,٥٨	١٦,٧٩	١١,٩٧	٦,٤٩	٥,٥٤
٢٠١٠	٦,٧٤	٠,٧١	٩٥,٨٦	١٠,٠٣	٦,٠٣	٠,٦٣	١٨,٩٢	١,٩٨	٢٦,٣	٢,٧٥	١٥,٨	١,٧	٩٥٥,٧	٣١,٤٣	١٥٤,٨٥	١٦,٢٠	١١,٠١	٦,٢٣	٥,٦٢
٢٠١١	٦,٨٤	٠,٦٢	١٠٥,١١	٩,٥٩	٨,٥٧	٠,٧٨	١٩,٤١	١,٧٧	٤١,٤	٣,٧٨	١٨,١	١,٧	١٠٩٦,١	٣٣,٨٩	١٨٨,٣٥	١٧,١٨	١١,٠٣	٦,٧٤	٥,٩٣
٢٠١٢	٥,٣٧	٠,٤٨	١٢٠,١٧	١٠,٧	٨,١٥	٠,٧٣	٢٠,٣٣	١,٨١	٥٢,٥	٤,٦٧	١٨,٢	١,٦	١١٢٣,١	٣٩,٣٥	١٨٦,٧٧	١٦,٦٣	١٢,٠٠	٧,٦٤	٦,٠٦
٢٠١٣	٨,٣٨	٠,٧٢	١٥٦,٠١	١٣,٤٤	٧,٢٤	٠,٦٢	٢٠,٥٤	١,٧٧	٤٨,٦	٤,١٩	٢٠,٢	١,٧	١١٦١,١	٣٩,٢٧	١٩٩,٨٧	١٧,٢١	١٢,٢٩	٧,٦٨	٦,٨٧
٢٠١٤	١١,٦٣	١,٠٠	١٦٧,٩٣	١٤,٤٣	٨,٩٩	٠,٧٧	٢١,٨٦	١,٨٨	٤٥,٣	٣,٨٩	١٩,١	١,٦	١١٦٤,٢	٤٤,٩٥	١٩٥,٢٨	١٦,٧٧	١١,٧١	٦,٩٢	٧,٠٨
٢٠١٥	١٣,٤١	١,١٠	١٨٥,٥	١٥,١٦	٩,٢١	٠,٧٥	٢٣,٠٢	١,٨٨	٥٣,٢	٤,٣٥	٢١,٨	١,٨	١٢٢٣,٦	٤٦,٥٠	١٦٨,٠٨	١٣,٧٤	١١,٦٣	٦,٩١	٧,٦
المتوسط	٧,٤٣	١,٣	٦١,٦	٧,٨	٨,٤	١,٤	١٤,٣	٢,٢	٢١,٣	٢,٨	٨,٤	١,٠	٦٧٦,٦	٢٣,٧	٨٥,٨	١٠,٣	١٢,٩	٧,٩	٥,٢

تم التحويل إلي قيم حقيقية باستخدام الرقم القياس لأسعار الجملة، سنة الأساس (١٩٨٦= ١٠٠)

المصدر:

١- الجهاز المركزي للتعبئة العامة والاحصاء، شبكة المعلومات (الموقع الالكتروني).

٢- موقع وزارة التخطيط WWW.moP.gov.eg

٣- موقع وزارة المالية WWW.mof.gova.ag

٤- موقع البنك المركزي المصري WWW.cba.org.eg

٥- وزارة الزراعة واستصلاح الأراضي- قطاع الشئون الاقتصادية- الإدارة المركزية للاقتصاد الزراعي- نشرات الدخل- أعداد متفرقة.

مليار جنيه بالأسعار الجارية (بما يوازي حوالي ١٥,١٦ مليار جنيه بالأسعار الحقيقية) عام ٢٠١٥، بمتوسط بلغ حوالي ٦١,٦ مليار جنيه بالأسعار الجارية (بما يوازي ٧,٨ مليار جنيه بالأسعار الحقيقية). وتشير المعادلة رقم (٢٠) أن جملة الأجور الزراعية تتزايد سنوياً بمقدار معنوي احصائياً بلغ حوالي ٧,٨ مليار جنيه بالأسعار الجارية (بما يوازي حوالي ٠,٤٦ مليار جنيه بالأسعار الحقيقية)، وبمعدل نمو سنوي بلغ نحو ١٢,٧٪ وفقاً للأسعار الجارية. وتشير قيمة معامل التحديد أن نحو ٨٠٪ من التغيرات في جملة الأجور الزراعية ترجع إلي تغيرات يعكس أثرها عامل الزمن.

(٤–٦) قيمة القروض الزراعية تشير الأرقام الواردة بالجدول رقم (٦) إلي أن قيمة القروض الزراعية قد بلغت أدني قيمة لها حوالي ١,٢٨ مليار جنيه بالأسعار الجارية (بما يوازي حوالي ٠,٤ مليار جنيه بالأسعار الحقيقية) عام ١٩٩٥، في حين بلغت أقصي قيمة لها حوالي ٢١,٠٤ مليار جنيه بالأسعار الجارية (بما يوازي حوالي ٢,٦٣ مليار جنيه بالأسعار الحقيقية) عام ٢٠٠٩، بمتوسط بلغ حوالي ٨,٤ مليار جنيه بالأسعار الجارية (بما يوازي ١,٤ مليار جنيه بالأسعار الحقيقية). وتشير المعادلة رقم (٢٢) أن قيمة القروض الزراعية تتزايد سنوياً بمقدار معنوي احصائياً بلغ حوالي ٠,٢٩ مليار جنيه بالأسعار الجارية (بما يوازي حوالي –٠,٠٣ مليار جنيه بالأسعار الحقيقية)، وبمعدل نمو سنوي بلغ نحو ٣,٥٪ وفقاً للأسعار الجارية. وتشير قيمة معامل التحديد أن نحو ٢٢٪ من التغيرات في قيمة القروض الزراعية ترجع إلي تغيرات يعكس أثرها عامل الزمن.

(١٢) بالجدول رقم (٧) أن قيمة الواردات القومية تتزايد سنوياً بمقدار معنوي إحصائيا بلغ حوالي ٥٠,٠ مليار جنيه بالأسعار الجارية (بما يوازي حوالي ١,٨ مليار جنيه بالأسعار الحقيقية)، وبمعدل نمو سنوي بلغ نحو ٧,٤٪ وفقاً للأسعار الجارية. وتشير قيمة معامل التحديد أن نحو ٩٢٪ من التغيرات في قيمة الواردات القومية ترجع إلي تغيرات يعكس أثرها عامل الزمن.

(٤–٢) قيمة الصادرات القومية أشارت النتائج إلي أن قيمة الصادرات القومية بلغت أدني قيمة لها حوالي ١١,٩٥ مليار جنيه بالأسعار الجارية (بما يوازي حوالي ٣,٧٧ مليار جنيه بالأسعار الحقيقية) عام ١٩٩٥، في حين بلغت أقصي قيمة لها حوالي ١٩٩,٨٧ مليار جنيه بالأسعار الجارية (بما يوازي حوالي ١٧,١٢ مليار جنيه بالأسعار الحقيقية) عام ٢٠١٣، بمتوسط بلغ حوالي ٨٥,٨ مليار جنيه بالأسعار الجارية (بما يوازي ١٠,٣ مليار جنيه بالأسعار الحقيقية). وتشير تقديرات المعادلة رقم (١٤) أن قيمة الصادرات القومية تتزايد سنوياً بمقدار معنوي إحصائيا بلغ حوالي ١١,٢ مليار جنيه بالأسعار الجارية (بما يوازي حوالي ٠,٨٧ مليار جنيه بالأسعار الحقيقية)، وبمعدل نمو سنوي بلغ نحو ١٣,٢٪ وفقاً للأسعار الجارية. وتشير قيمة معامل التحديد أن نحو ٩٠٪ من التغيرات في قيمة الصادرات القومية ترجع إلي تغيرات يعكس أثرها عامل الزمن.

(٤–٣) قيمة الواردات الزراعية بلغت قيمة الواردات الزراعية أدني قيمة لها حوالي ٥,٩ مليار جنيه بالأسعار الجارية (بما يوازي حوالي ١,٥٩ مليار جنيه بالأسعار الحقيقية) عام ١٩٩٨، في حين بلغت أقصي قيمة لها حوالي ٥٣,٢ مليار جنيه بالأسعار الجارية (بما يوازي حوالي ٤,٣٥ مليار جنيه بالأسعار الحقيقية) عام ٢٠١٥، بمتوسط بلغ حوالي ٢١,٣ مليار جنيه بالأسعار الجارية (بما يوازي ٢,٨ مليار جنيه بالأسعار الحقيقية)،وتشير تقديرات المعادلة رقم (١٦) أن قيمة الواردات الزراعية تتزايد سنوياً بمقدار معنوي احصائياً بلغ حوالي ٢,٤ مليار جنيه بالأسعار الجارية (بما يوازي حوالي ٠,١٢ مليار جنيه بالأسعار الحقيقية)، وبمعدل نمو سنوي بلغ نحو ١١,٣٪ وفقاً للأسعار الجارية. وتشير قيمة معامل التحديد أن نحو ٨٢٪ من التغيرات في قيمة الواردات الزراعية ترجع إلي تغيرات يعكس أثرها عامل الزمن.

(٤–٤) قيمة الصادرات الزراعية أوضحت النتائج أن قيمة الصادرات الزراعية بلغت أدني قيمة لها حوالي ١,٢ مليار جنيه بالأسعار الجارية (بما يوازي حوالي ٠,٣ مليار جنيه بالأسعار الحقيقية) عام ١٩٩٧، في حين بلغت أقصي قيمة لها حوالي ٢١,٨ مليار جنيه بالأسعار الجارية (بما يوازي حوالي ١,٨ مليار جنيه بالأسعار الحقيقية) عام ٢٠١٥، بمتوسط بلغ حوالي ٨,٤ مليار جنيه بالأسعار الجارية (بما يوازي ١,٠ مليار جنيه بالأسعار الحقيقية). وتشير تقديرات المعادلة رقم (١٨) أن قيمة الصادرات الزراعية تتزايد سنوياً بمقدار معنوي احصائياً بلغ حوالي ١,١٣ مليار جنيه بالأسعار الجارية (بما يوازي حوالي ٠,٠٨ مليار جنيه بالأسعار الحقيقية)، وبمعدل نمو سنوي بلغ نحو ٨,٠٪ وفقاً للأسعار الجارية. وتشير قيمة معامل التحديد أن نحو ١٣,٥٪ من التغيرات في قيمة الصادرات الزراعية ترجع إلي تغيرات يعكس أثرها عامل الزمن.

(٤–٥) جملة الأجور الزراعية بلغت جملة الأجور الزراعية أدني قيمة لها حوالي ١٤,٧٧ مليار جنيه بالأسعار الجارية (بما يوازي حوالي ٤,٦٥ مليار جنيه بالأسعار الحقيقية) عام ١٩٩٥، في حين بلغت أقصي قيمة لها حوالي ١٨٥,٥

الفترة، مما يدل علي كفاءة الاستثمار الموجه للقطاع الزراعي.وتشير المعادلة رقم (١١) أن قيمة معامل التكثيف الرأسمالي يتزايد بمقدار غير معنوي إحصائيا خلال تلك الفترة.

جدول رقم (٥). الاتجاه الزمني العام لتطور معايير قياس كفاءة الاستثمار الزراعي في مصر خلال الفترة (١٩٩٥-٢٠١٥)

رقم المعادلة	المعايير الاقتصادية	معادلة الاتجاه الزمني العام	R^2	F المحسوبة
٧	**معدل الاستثمار الزراعي**	$\mathbf{Y_i} = 0.18 - 0.01\ \mathbf{T_i}$ $(13.98)^{**}\ \ (-7.04)^{**}$	0.72	49.59**
٨	**العائد علي الاستثمار الزراعي**	$\mathbf{Y_i} = 1.87 + 1.13\ \mathbf{T_i}$ $(0.68)^{N}\ \ (5.16)^{**}$	0.58	26.7**
٩	**مضاعف الاستثمار الزراعي**	$\mathbf{Y_i} = -2.72 + 0.37\ \mathbf{T_i}$ $(-0.07)^{N}\ \ (0.11)^{N}$	0.001	0.013**
١٠	**معامل التوطن الزراعي**	$\mathbf{Y_i} = 0.78 - 0.024\ \mathbf{T_i}$ $(10.03)^{**}\ \ (-3.94)^{**}$	0.45	15.49**
١١	**معامل التكثيف الرأسمالي الزراعي (مليار جنيه/ ألف عامل)**	$\mathbf{Y_i} = 1.22 + 0.011\ \mathbf{T_i}$ $(8.05)^{**}\ (0.94)^{N}$	0.05	0.89

** معنوية عند مستوي ١٪. Nغير معنوي **حيث أن:** $\mathbf{Y_i}$= القيمة التقديرية للمتغير التابع موضع البحث.
$\mathbf{T_i}$= متغير يعبر عن الزمن. **i**= ١، ٢، ٣،............،٢١ سنة. القيمة ما بين القوسين تشير إلي قيمة **t** المحسوبة
المصدر: نتائج الحاسب الآلي للأرقام الواردة بالجدولين (١،٣).

رابعاً: تطور المتغيرات الاقتصادية المؤثرة علي حجم الاستثمارات الزراعية في مصر:

أدي الانخفاض المستمر في العوائد المحققة من الإنتاج الزراعي في مصر بالإضافة إلي بعض العوامل الأخرى مثل ضعف نمو الصناعات المحلية التي تعتمد علي الخامات الزراعية، وارتفاع قيمة الفائدة علي القروض المخصصة للإنتاج الزراعي، وانخفاض سعر صرف الجنيه المصري مقارنة بالعملات الأجنبية الرئيسية، وكبر حجم رأس المال الثابت، وغيرها من العوامل إلي ضعف إقبال المستثمرين علي المشاركة في النشاط الزراعي. وهناك مجموعة من العوامل التي تؤثر في الاستثمار الزراعي المصري من أهمها قيمة الواردات القومية بالمليار جنيه (X_1)، قيمة الصادرات القومية بالمليار جنيه (X_2)، قيمة الواردات الزراعية بالمليار جنيه (X_3)، قيمة الصادرات الزراعية بالمليار جنيه (X_4)، قيمة الأجور الزراعية بالمليار جنيه (X_5)، قيمة القروض الزراعية بالمليار جنيه (X_6)، قيمة المدخرات الزراعية(X_7)، سعر الفائدة علي القروض الزراعية (X_8)، وسعر الفائدة علي الودائع بالجهاز المصرفي (X_9)، وسعر صرف الجنيه للدولار (X_{10}).

(٤-١) قيمة الواردات القومية بلغت قيمة الواردات القومية أدني قيمة لها حوالي ٣١٧,٣ مليار جنيه بالأسعار الجارية (بما يوازي حوالي ١٢,٦ مليار جنيه بالأسعار الحقيقية) عام ١٩٩٥، في حين بلغت أقصي قيمة لها حوالي ١٢٢٣,٦ مليار جنيه بالأسعار الجارية (بما يوازي حوالي ٤٦,٥ مليار جنيه بالأسعار الحقيقية) عام ٢٠١٥، بمتوسط بلغ حوالي ٦٧٦,٦ مليار جنيه بالأسعار الجارية (بما يوازي ٢٣,٧ مليار جنيه بالأسعار الحقيقية). وتشير تقديرات المعادلة رقم

$$\text{معامل التوطن الزراعي} = \frac{\text{الاستثمارات الزراعية} \div \text{الاستثمار الكلي}}{\text{الناتج الزراعي المحلي} \div \text{الناتج المحلي الإجمالي}}$$

حيث يعبر انخفاض قيمة معامل التوطن عن الواحد الصحيح علي وجود كفاءة في الاستثمار الزراعي، بينما ارتفاع قيمة معامل التوطن عن الواحد الصحيح يدل علي أن قطاع الزراعة قد حصل علي استثمارات قد جاوزت قيمة الناتج المحلي الزراعي المتولد منه. وتوضح بيانات الجدول رقم (٣) أن قيمة معامل التوطن الزراعي في مصر خلال الفترة (١٩٩٥– ٢٠١٥) قد تباينت بين الارتفاع والانخفاض نظراً لتقلبات كلاً من إجمالي قيمة الناتج الزراعي المحلي، وإجمالي الناتج القومي وفقاً لتقلبات الظروف الاقتصادية التي مر بها الاقتصاد المصري خلال تلك الفترة. وقد كانت قيمة معامل التوطن الزراعي في مصر طوال سنوات تلك الفترة أقل من الواحد الصحيح، مما يدل علي عجز القطاع الزراعي عن تحقيق ناتج يفوق الاستثمارات الموجهة له في جميع تلك السنوات وبالتالي انخفاض كفاءة الاستثمارات الزراعية خلال تلك الفترة. وقد تبين أن معامل التوطن الزراعي قد بلغ حده الأدنى نحو ٠,٢ خلال عامي ٢٠١٠، ٢٠١٢، في حين بلغ حده الأقصى نحو ٠,٩٣ خلال عام ١٩٩٨، بمتوسط عام بلغ نحو ٠,٥١. وتشير المعادلة رقم (١٠) أن قيمة معامل التوطن تتناقص بمقدار معنوي إحصائيا بلغ نحو ٠,٠٢٤، كما قدر معامل التحديد بنحو ٠,٤٥، بما يعني أن نحو ٤٥٪ من التغيرات التي تنتاب معامل التوطن تعزي إلي العوامل التي يعكس أثرها عامل الزمن.

(٣–٥) معامل التكثيف الرأسمالي الزراعي يؤدي زيادة الدخل القومي إلي زيادة الإنفاق الزراعي في ألمدي القصير وفقاً لنظرية المضاعف وهو ما يعرف بأثر الدخل، كما يؤثر علي زيادة السعات الإنتاجية للمشاريع الزراعية وهو ما يعرف بأثر السعة. ويوضح معامل التكثيف الرأسمالي النسبة بين الاستثمار الزراعي وعدد العمال الزراعيين. ويوضح معامل التكثيف الرأسمالي النسبة بين قيمة الاستثمارات الموجهة لقطاع معين أو لمشروع معين وعدد العاملين في هذا القطاع أو المشروع، فإذا كانت قيمة هذا المعامل أكبر من الواحد الصحيح فإن ذلك يدل علي أن النشاط الاقتصادي يعتبر مكثفاً لاستخدام رأس المال، وأن هذا النشاط تزيد استثماراته بنسبة أكبر من نسبة زيادة عدد العمال فيه، أما إذا كانت قيمة هذا المعامل أقل من الواحد الصحيح دل ذلك علي زيادة عدد العمال بنسبة أكبر من زيادة حجم الاستثمارات الموجهة لهذا النشاط. ويتم حساب معامل التكثيف الرأسمالي كالتالي:

$$\textbf{معامل التكثيف الرأسمالي الزراعي} = \frac{\text{قيمة الاستثمارات الزراعية}}{\text{إجمالي عدد العمال الزراعين}}$$

وتوضح بيانات الجدول رقم (٣) أن معامل التكثيف الرأسمالي في القطاع الزراعي المصري خلال الفترة (١٩٩٥– ٢٠١٥) كان أكبر من الواحد الصحيح طوال سنوات هذه الفترة باستثناء أعوام (١٩٩٥، ١٩٩٦، ٢٠١٢)، الأمر الذي يدل علي زيادة التكثيف الرأسمالي في القطاع الزراعي المصري خلال تلك الفترة. حيث تبين أن معامل التكثيف الرأسمالي الزراعي قد بلغ حده الأدنى نحو ٠,٧ خلال عام١٩٩٥،في حين بلغ حده الأقصى نحو ٢,٠ خلال عام ٢٠١٥، بمتوسط عام بلغ نحو ١,٣٤. أي أن معامل التكثيف الرأسمالي كان أعلي من الواحد الصحيح خلال تلك

وتشير تقديرات المعادلة رقم (٧) بالجدول رقم (٥) أن معدل الاستثمار يتناقص سنوياً بمقدار معنوي إحصائيا بلغ نحو ٠,٠١، كما قدر معامل التحديد بنحو ٠,٧٢، الأمر الذي يشير إلي أن نحو ٧٢٪ من التغيرات في معدل الاستثمار إنما ترجع إلي عوامل أخري يعكس أثرها عامل الزمن.

(٣-٢) العائد علي الاستثمار الزراعي (إنتاجية الاستثمار) يوضح العائد علي الاستثمار قيمة الناتج المتولد من وحدة واحدة من الاستثمار. ويتم حسابه من خلال المعادلة التالية:

$$\textbf{العائد علي الاستثمار الزراعي} = \frac{\text{إجمالي الناتج المحلي الزراعي}}{\text{إجمالي الاستثمارات الزراعية}}$$

وارتفاع قيمة العائد علي الاستثمار عن الواحد الصحيح يشير إلي وجود كفاءة في الاستثمار الزراعي. وهو يعتبر معكوس معدل الاستثمار، وتشير النتائج أن العائد علي الاستثمار الزراعي قد بلغ أدنى قيمه له نحو ٥,٤ عام ١٩٩٨، في حين بلغ أقصي قيمة له نحو ٣٥,٢ عام ٢٠١٢، كما بلغ متوسط قيمة العائد علي الاستثمارات الزراعية في مصر نحو ١٤,٢ خلال متوسط الفترة (١٩٩٥– ٢٠١٥)، ويتضح من المعادلة رقم (٨) أن العائد علي الاستثمار يتزايد سنوياً بمقدارمعنوي احصائياً بلغ نحو ١,١٣، كما قدر معامل التحديد بنحو ٠,٥٨، الأمر الذي يشير إلي أن نحو ٥٨٪ من التغيرات في معدل العائد علي الاستثمار الزراعي إنما ترجع إلي عوامل أخري يعكس أثرها عامل الزمن.

(٣-٣) مضاعف الاستثمار يوضح مضاعف الاستثمار – كما وصفه العالم الاقتصادي (كينز) – مقدار التغير في قيمة الناتج المتولد من تغير الاستثمار بوحدة واحدة، أو هو الزيادة النهائية في الناتج الناشئ عن زيادة الاستثمار، حيث كل انفاق استثماري يولد دخل أكبر، كما أن الناتج الناشئ من الاستثمار يؤدي إلي زيادة الانفاق الاستهلاكي وفقاً للميل الحدي للاستهلاك، وبالتالي يؤدي إلي زيادة الناتج. ويتم حسابه من خلال المعادلة التالية:

$$\textbf{مضاعف الاستثمار الزراعي} = \frac{\text{التغير في الناتج المحلي الزراعي}}{\text{التغير في الاستثمار الزراعي}}$$

ويدل ارتفاع قيمة مضاعف الاستثمار عن الواحد الصحيح علي وجود كفاءة في الاستثمار الزراعي، وقد بلغ مضاعف الاستثمار الزراعي حده الأدنى نحو (٢٤٣,٣) عام ٢٠١٠، في حين بلغ حده الأقصى نحو ٢٨٠,٦ عام ٢٠١١، بمتوسط عام بلغ نحو ١,٤ خلال متوسط الفترة (١٩٩٥– ٢٠١٥)، أي أن مضاعف الاستثمار الزراعي كان أكبر من الواحد الصحيح خلال هذه الفترة، مما يدل علي كفاءة الاستثمار في القطاع الزراعي –جدول رقم (٣). وتشير المعادلة رقم (٩) بالجدول رقم (٥) إلي عدم معنوية الزيادة في قيمة مضاعف الاستثمار خلال هذه الفترة.

(٣-٤) معامل التوطن الزراعي يدل معامل التوطن الزراعيعلي مدي مساهمة القطاع الزراعي في توليد الناتج المحلي الإجمالي وفقاً للاستثمار الزراعي من خلال قياس كفاءة الاستثمار الزراعي. ويتم حسابه من خلال المعادلة التالية:

جدول رقم (٤). معادلات الاتجاه الزمني العام لتطور الناتج المحلي الزراعي والناتج المحلي القومي وعدد العمال الزراعين خلال الفترة (١٩٩٥-٢٠١٥)

رقم المعادلة	المتغيرات الاقتصادية	معادلة الاتجاه الزمني العام	معدل النمو السنوي (٪)	R^2	F المحسوبة
٤	**الناتج المحلي الإجمالي (مليار جنيه)**	$Y_i = -339.3 + 107.6\ T_i$ $(-2.7)^{**}$ $(10.76)^{**}$	12.7	0.86	115.8**
٥	**الناتج المحلي الزراعي (مليار جنيه)**	$Y_i = -9.68 + 10.51\ T_i$ (-0.9) $(12.21)^{**}$	9.9	0.89	149.0**
٦	**عدد العمال الزراعين (مليون عامل)**	$Y_i = 4.33 + 0.12\ T_i$ $(43.4)^{**}$ $(13.74)^{**}$	2.2	0.91	181.35**

** معنوية عند مستوي ١٪. **حيث أن:** Y_i = القيمة التقديرية للمتغير الاقتصادي موضع البحث.

T_i= متغير يعبر عن الزمن. **i** = ١، ٢، ٣،.............،٢١ سنة. القيمة ما بين القوسين تشير إلي قيمة t المحسوبة

المصدر: جمعت وحسبت من بيانات الجدول رقم (٣).

ثالثاً: تقييم كفاءة الاستثمارات الزراعية:

تعد عملية توزيع الاستثمارات علي القطاعات الاقتصادية المختلفة هي المحدد الرئيسي في المدي الطويل لإحداث النمو الاقتصادي في القطاع الاقتصادي وتحقيق استقراره من خلال زيادة إنتاجية عوامل الإنتاج، وارتفاع معدل نمو ناتجه المحلي وبالتالي الناتج المحلي الإجمالي. ويتوقف نجاح عملية التنمية الزراعية في قدرتها علي زيادة حجم الاستثمارات الزراعية وتوزيعها بين مختلف البرامج لتحقيق أعلي كفاءة إنتاجية ممكنة. ويعتبر الاستثمار الزراعي من أهم العوامل التي تؤدي إلي نجاح عملية التنمية الزراعية، حيث يعتبر مورداً أساسياً لزيادة الإنتاج والدخل الزراعي، وخلق فرص عمل جديدة، هذا ويتوقف نجاح عملية التنمية الزراعية في مدي قدرتها علي زيادة حجم الاستثمارات الزراعية المتاحة، وتوزيعها بين مختلف البرامج لتحقيق أعلي كفاءة إنتاجية ممكنة، ويمكن قياس كفاءة الاستثمار الزراعي للوقوف علي مدي كفاءة الاستثمار في القطاع الزراعي من خلال المعايير والمؤشرات الاقتصادية التالية (بسيوني وآخرون، ٢٠٠٩ ، دويدار، ٢٠٠٦).

(٣-١) معدل الاستثمار الزراعي يوضح معيار معدل الاستثمار حجم الاستثمار اللازم لإنتاج وحدة واحدة من الناتج المحلي، ويشير انخفاض قيمة هذا المعيار عن الواحد الصحيح إلي كفاءة الاستثمارات الموجهة للقطاع الذي تتم فيه قياس كفاءة الاستثمار، والعكس صحيح. ويتم حساب هذا المعيار كالتالي:

$$\text{معدل الاستثمار الزراعي} = \frac{\text{إجمالي الاستثمارات الزراعية}}{\text{إجمالي الناتج المحلي الزراعي}}$$

وبالنظر إلي الأرقام الواردة بالجدول رقم (٣) يتبين أن معدل الاستثمار في القطاع الزراعي أقل من الواحد الصحيح طوال سنوات الفترة (١٩٩٥– ٢٠١٥)، حيث بلغ أدنى قيمة له نحو ٠,٠٣ عامي ٢٠١١ ، ٢٠١٢، في حين بلغ أقصى قيمة له نحو ٠,١٩ عام ١٩٩٨، وقد بلغ متوسط قيمة معدل الاستثمارات الزراعية في مصر نحو ٠,١٠.

نحو ١٢,٧٪، كما قدر معامل التحديد بنحو ٠,٨٦، مما يعني أن نحو ٨٦٪ من التغيرات في الناتج المحلي الإجمالي ترجع لعوامل يعكس أثرها عامل الزمن.

(٢-٢) الناتج المحلي الزراعي أشارت النتائج أن الناتج المحلي الزراعي بلغ حده الأدنى حوالي ٢٤,٥ مليار جنيه عام ١٩٩٥، في حين بلغ حده الأقصى حوالي ٢٠٩,٨ مليار جنيه عام ٢٠١٣، بمتوسط عام بلغ حوالي ١٠٦,٠ مليار جنيه. وتشير نتائج المعادلة رقم (٥) إلي أن الناتج المحلي الزراعي يتزايد سنوياً بمقدار معنوي إحصائيا بلغ حوالي ١٠,٥ مليار جنيه، وبمعدل نمو سنوي بلغ نحو ٩,٩٪، كما قدر معامل التحديد بنحو ٠,٨٩، مما يعني أن نحو ٨٩٪ من التغيرات في الناتج المحلي الزراعي ترجع لعوامل يعكس أثرها عامل الزمن.

(٢-٣) عدد العمال الزراعيين أكدت النتائج أن عدد العمال الزراعين بلغ حده الأدنى حوالي خمسة آلاف عامل عام ١٩٩٦، في حين بلغ حده الأقصى حوالي سبعة آلاف عامل عام ٢٠١٣، بمتوسط عام بلغ حوالي ستة آلاف عامل. كما أوضحت النتائج أن عدد العمال الزراعين يتزايد سنوياً بمقدار معنوي احصائياً بلغ حوالي ١٢٠ عامل، وبمعدل نمو سنوي بلغ نحو ٢,٢٪، كما قدر معامل التحديد بنحو ٠,٩١، مما يعني أن نحو ٩١٪ من التغيرات في عدد العمال الزراعين ترجع لعوامل يعكس أثرها عامل الزمن.

جدول رقم (٣). تطور المتغيرات الاقتصادية ومعايير قياس كفاءة الاستثمار الزراعي في مصر خلال الفترة (١٩٩٥-٢٠١٥)

السنة	الناتج المحلي الزراعي(١) (مليار جنيه)	الاستثمار الزراعي(٢) (مليارجنيه)	الاستثمار القومي(٣) (مليار جنيه)	الناتج المحلي الإجمالي(٤) (مليار جنيه)	عدد العمال الزراعيين(٥) (مليون عامل)	حجم العمالة القومية (مليون عامل)	العائد علي الاستثمار (إنتاجية الاستثمار) (١)/(٢)	مضاعف الاستثمار (التغير١/ التغير٢)	معامل التوطن (٢/٣) / (١/٤)	معامل الاستثمار (٢)/(١)	معامل التوظيف (التكثيف الرأسمالي) مليار جنيه لكل ألف عامل (٢)/(٥)
١٩٩٥	٢٤,٤٧	٣,٣٨	٣٩,٤١	١٥٣,٤	٤,٨	١٥,٣٤	٧,٢٤	-	٠,٥٤	٠,١٤	٠,٧٠
١٩٩٦	٣٥,٣١	٤,٤٨	٤٤,١١	١٦١,٥	٤,٧	١٥,٨٣	٧,٨٨	٩,٨٥	٠,٤٦	٠,١٣	٠,٩٥
١٩٩٧	٤٢,٣٢	٥,١٩	٤٧,٨٥	٢٣٩,٥	٤,٨	١٦,٣٤	٨,١٥	٩,٨٧	٠,٦١	٠,١٢	١,٠٨
١٩٩٨	٤٣,٩٠	٨,١٦	٥٠,٧٧	٢٥٣,١	٤,٨	١٦,٨٧	٥,٣٨	٠,٥٣	٠,٩٣	٠,١٩	١,٧٠
١٩٩٩	٤٥,٥٣	٨,٤٢	٥٧,٢٢	٢٦٨,٤	٤,٩	١٧,٤٢	٥,٤١	٦,٢٧	٠,٨٧	٠,١٨	١,٧٢
٢٠٠٠	٤٧,٠٨	٨,١٣	٥٨,١٢	٢٨٢,٢	٤,٩	١٧,٩٨	٥,٧٩	- ٥,٣٤*	٠,٨٤	٠,١٧	١,٦٦
٢٠٠١	٤٩,٦٠	٨,٢٠	٥٨,٩٥	٢٩٩,٦	٥,٠	١٧,٩٥	٦,٠٥	٣٦,٠	٠,٨٤	٠,١٧	١,٦٤
٢٠٠٢	٥٨,٣٧	٥,٥٩	٥٩,٦٤	٣٥٤,٦	٥,١	١٨,٤٩	١٠,٤٤	- ٣,٣٦	٠,٥٧	٠,١٠	١,١٠
٢٠٠٣	٦٢,٥٨	٦,٤٠	٦٦,١٢	٣٨٨,١	٥,٢	١٨,٦٥	٩,٧٨	٥,٢٠	٠,٦٠	٠,١٠	١,٢٣
٢٠٠٤	٧٠,٣٢	٧,٥٦	٧٧,٥٦	٤٤٥,٢	٥,٢	١٩,١٦	٩,٣٠	٦,٦٧	٠,٦٢	٠,١١	١,٤٥
٢٠٠٥	٨١,٣٧	٧,٤٢	٧٩,٣١	٥٥٨,١	٥,٣	١٩,٧٦	١٠,٩٧	- ٧٨,٩٣	٠,٦٤	٠,٠٩	١,٤٠
٢٠٠٦	٨١,٧٧	٨,٠٤	١١٥,٧	٥٨١,١	٥,٤	٢٠,٤٤	١٠,١٧	٠,٦٥	٠,٤٩	٠,١٠	١,٤٩
٢٠٠٧	٩٤,٧٥	٧,٧٩	١٥٥,٧	٦٨٤,٤	٥,٥	٢١,٧٢	١٢,١٦	- ٥١,٩٢	٠,٣٦	٠,٠٨	١,٤٢
٢٠٠٨	١١٣,١	٨,٠٧	١٩٩,٥	٨٥٦,٣	٥,٧	٢٢,٥٠	١٤,٠١	٦٥,٥٤	٠,٣١	٠,٠٧	١,٤٢
٢٠٠٩	١٦٠,٩٧	٦,٨٦	١٩٧,١	١١٥٠,٦	٥,٨	٢٢,٩٧	٢٣,٤٧	- ٣٩,٥٦	٠,٢٥	٠,٠٤	١,١٨
٢٠١٠	١٩٠,١٦	٦,٧٤	٢٣١,٨	١٣٠٩,٩	٥,٨	٢٣,٨٣	٢٨,٢١	- ٢٤٣,٢٥	٠,٢٠	٠,٠٤	١,١٦
٢٠١١	٢١٨,٢٢	٦,٨٤	٢٢٩,١	١٥٠٨,٥	٦,٠	٢٣,٣٤	٣١,٩٠	٢٨٠,٦	٠,٢١	٠,٠٣	١,١٤
٢٠١٢	١٨٨,٧٩	٥,٣٧	٢٤٦,١	١٦٩٥,١	٦,٧	٢٣,٥٩	٣٥,١٦	٢٠,٠٢	٠,٢٠	٠,٠٣	٠,٨٠
٢٠١٣	٢٠٩,٧٥	٨,٣٨	٢٤١,٦	١٩٠٨,٣	٦,٨	٢٣,٩٧	٢٥,٠٣	٦,٩٦	٠,٣٢	٠,٠٤	١,٢٣
٢٠١٤	٢٠٠,٣٠	١١,٦٣	٢٦٥,١	٢١٧٧,٨	٦,٦	٢٤,٣٠	١٧,٢٢	- ٢,٠١	٠,٤٨	٠,٠٦	١,٧٦
٢٠١٥	٢٠٦,٣١	١٣,٤١	٣٣٧,٧	٢٤٥٩,٠	٦,٧	٢٤,٧٩	١٥,٣٨	٣,٣٨	٠,٤٧	٠,٠٦	٢,٠٠
المتوسط	١٠٥,٩٥	٧,٤٣	١٣٦,١٢	٨٤٤,٥١	٥,٥١	٢٠,٢٥	١٤,٢٤	١,٣٦	٠,٥١	٠,١٠	١,٣٤

*= تشير الإشارة السالبة في مضاعف الاستثمار إلي أن الاستثمار الزراعي في السنة الحالية أقل من الاستثمار الزراعي في السنة السابقة، أو أن الناتج المحلي الزراعي في السنة الحالية أقل من الناتج المحلي الزراعي في السنة السابقة.

المصدر: جمعت حسبت من الأرقام الواردة بالجدول رقم (١) بالملحق.

(١-٢) تطور الاستثمار الزراعي الجاري

تشير الأرقام الموضحة بالجدول رقم (١) أن الاستثمار الزراعي الجاري قد بلغ أدني قيمة له حوالي ٣,٣٨ مليار جنيه عام ١٩٩٥، في حين بلغ أقصي قيمة له حوالي ١٣,٤ مليار جنيه عام ٢٠١٥، بمتوسط عام بلغ حوالي ٧,٤ مليار جنيه. كما أشارت نتائج المعادلة رقم (٢) إلي أن الاستثمار الزراعي الجاري يتزايد سنوياً بمقدار معنوي إحصائيا بلغ حوالي ٠,٢١ مليار جنيه، وبمعدل نمو سنوي بلغ نحو ٢,٨٪، وقدر معامل التحديد بنحو ٠,٣٤، مما يعني أن نحو ٣٤٪ من التغيرات في إجمالي الاستثمار الزراعي الجاري ترجع لعوامل يعكس أثرها عامل الزمن.

(١-٣) الأهمية النسبية للاستثمار الزراعي إلي الاستثمار القومي

أشارت النتائج بالجدول رقم (١) أن الاستثمار الزراعي يمثل نحو ٨,٥٨٪ من جملة الاستثمار القومي عام ١٩٩٥، ثم أخذ في التناقص حتي بلغت أهميته النسبية نحو ٣,٩٧٪ من جملة الاستثمار القومي عام ٢٠١٥. هذا ويمثل الاستثمار الزراعي نحو ٥,٤٦٪ من جملة الاستثمار القومي وذلك خلال متوسط الفترة (١٩٩٥– ٢٠١٥). وتشير تقديرات المعادلة رقم (٣) أن نسبة الاستثمار الزراعي إلي الاستثمار القومي تتجه إلي التناقص بمقدار معنوي إحصائيا بلغ نحو ٠,٥٨ خلال الفترة (١٩٩٥ –٢٠١٥) مما يوضح أسباب التدهور الحاد في القطاع الزراعي وانخفاض مساهمته في الناتج القومي، وهجرة العمالة الزراعية، وابتعاد الزراع عن المحاصيل الإستراتيجية الهامة والتي لها قدرة تصديرية عالية.

جدول رقم (٢). معادلات الاتجاه الزمني العام لتطور الاستثمار القومي والاستثمار الزراعي والأهمية النسبية للاستثمار الزراعي من الاستثمار القومي خلال الفترة (١٩٩٥-٢٠١٥)

رقم المعادلة	المتغيرات الاقتصادية	معادلة الاتجاه الزمني العام	معدل النمو السنوي (٪)	R^2	F المحسوبة
١	الاستثمار القومي (مليار جنيه)	Y_i=- 20.72 + 14.26 T_i (- 1.45) (12.55)**	10.6	0.89	157.6**
٢	الاستثمار الزراعي (مليار جنيه)	Y_i=5.15 + 0.21 T_i (6.17)** (3.12)**	2.8	0.34	9.7**
٣	نسبة الاستثمار الزراعي إلي الاستثمار القومي	Y_i=14.32– 0.58 T_i (12.52)** (- 6.41)**	-	0.68	41.12**

** معنوي عند مستوي ١٪. **حيث أن:** Y_i = القيمة التقديرية للمتغير موضع البحث. T_i= متغير يعبر عن الزمن.

i= ١. ٢. ٣،..............،٢١ سنة. القيمة ما بين القوسين تشير إلي قيمة t المحسوبة

المصدر: نتائج الحاسب الآلي للبيانات الواردة بالجدول رقم (١).

ثانياً: توصيف المتغيرات الاقتصادية المرتبطة بكفاءة الاستثمار الزراعي:

(٢–١) الناتج المحلي الإجمالي بدراسة تطور الناتج المحلي الإجمالي بالجدول رقم (٣). يتبين أن الناتج المحلي الإجمالي بلغ حده الأدنى حوالي ١٥٣,٤ مليار جنيه عام ١٩٩٥، في حين بلغ حده الأقصى حوالي ٢٤٥٩,٠ مليار جنيه عام ٢٠١٥، بمتوسط عام بلغ حوالي ٨٤٤,٥ مليار جنيه. كما تشير نتائج المعادلة رقم (٤) بالجدول رقم (٤) إلي أن الناتج المحلي الإجمالي يتزايد سنوياً بمقدار معنوي إحصائيا بلغ حوالي ١٠٧,٦ مليار جنيه، وبمعدل نمو سنوي بلغ

النتائج البحثية

أولاً: تطور الاستثمار القومي الجاري والاستثمار الزراعي الجاري:

(١-١) تطور الاستثمار القومي الجاري

بدراسة تطور الاستثمار القومي الجاري بالجدول رقم (١). يتبين أن الاستثمار القومي الجاري قد بلغ حده الأدنى حوالي ٣٩,٤ مليار جنيه عام ١٩٩٥، في حين بلغ حده الأقصى حوالي ٣٣٧,٧ مليار جنيه عام ٢٠١٥، بمتوسط عام بلغ حوالي ١٣٦,١ مليار جنيه. وتشير تقديرات المعادلة رقم (١)، بالجدول رقم (٢) أن الاستثمار القومي الجاري يتزايد سنوياً بمقدار معنوي إحصائياً بلغ حوالي ١٤,٣ مليار جنيه، وبمعدل نمو سنوي بلغ نحو ١٠,٦٪، وقد بلغ معامل التحديد نحو ٠,٨٩، مما يعني أن نحو ٨٩٪ من التغيرات في إجمالي الاستثمار القومي الجاري ترجع لعوامل يعكس أثرها عامل الزمن.

جدول رقم (١). تطور كل من الاستثمار القومي والاستثمار الزراعي بالأسعار الجارية والأهمية النسبية للاستثمار الزراعي من الاستثمار القومي خلال الفترة (١٩٩٥- ٢٠١٥)

السنة	الاستثمار القومي الجاري (مليار جنيه)	الاستثمار الزراعي الجاري (مليار جنيه)	الأهمية النسبية للاستثمار الزراعي من الاستثمار القومي (٪)
١٩٩٥	٣٩,٤١	٣,٣٨	٨,٥٨
١٩٩٦	٤٤,١١	٤,٤٨	١٠,١٦
١٩٩٧	٤٧,٨٥	٥,١٩	١٠,٨٥
١٩٩٨	٥٠,٧٧	٨,١٦	١٦,٠٧
١٩٩٩	٥٧,٢٢	٨,٤٢	١٤,٧١
٢٠٠٠	٥٨,١٢	٨,١٣	١٣,٩٩
٢٠٠١	٥٨,٩٥	٨,٢٠	١٣,٩١
٢٠٠٢	٥٩,٦٤	٥,٥٩	٩,٣٧
٢٠٠٣	٦٦,١٢	٦,٤٠	٩,٦٨
٢٠٠٤	٧٧,٥٦	٧,٥٦	٩,٧٥
٢٠٠٥	٧٩,٣١	٧,٤٢	٩,٣٦
٢٠٠٦	١١٥,٧	٨,٠٤	٦,٩٥
٢٠٠٧	١٥٥,٧	٧,٧٩	٥,٠٠
٢٠٠٨	١٩٩,٥	٨,٠٧	٤,٠٥
٢٠٠٩	١٩٧,١	٦,٨٦	٣,٤٨
٢٠١٠	٢٣١,٨	٦,٧٤	٢,٩١
٢٠١١	٢٢٩,١	٦,٨٤	٢,٩٩
٢٠١٢	٢٤٦,١	٥,٣٧	٢,١٨
٢٠١٣	٢٤١,٦	٨,٣٨	٣,٤٧
٢٠١٤	٢٦٥,١	١١,٦٣	٤,٣٩
٢٠١٥	٣٣٧,٧	١٣,٤١	٣,٩٧
المتوسط	١٣٦,١	٧,٤٣	٥,٤٦

المصدر: الجهاز المركزي للتعبئة العامة والإحصاء، شبكة المعلومات الدولية.

القطاع الزراعي من الاستثمارات القومية بدرجة لا تتناسب مع أهميتها الاقتصادية ودورها الأساسي في تنمية القطاعات الاقتصادية الأخرى، فقد بلغ إجمالي حجم الاستثمارات الزراعية حوالي ٣,٤ مليار جنيه، يمثل نحو ٨,٦٪ من جملة الاستثمارات المحلية عام ١٩٩٥، انخفض إلي حوالي ١٣,٤ مليار جنيه، يمثل نحو ٤٪ من جملة الاستثمارات المحلية عام ٢٠١٥ (الجهاز المركزي للتعبئة العامة والإحصاء، شبكة المعلومات ، الموقع الإليكتروني). مما يعني انخفاض الأهمية النسبية لحجم الاستثمار الزراعي بنحو ٥٣,٥٪، وذلك علي الرغم من الدور الذي تقوم به الدولة في تطبيق برامج الإصلاح الاقتصادي لخلق طاقة استثمارية جديدة تقوم بمشروعات إنتاجية زراعية تساهم في تنويع القاعدة الإنتاجية للبنيان الاقتصادي القومي. ومن هنا تتبلور المشكلة البحثية في التساؤلين الآتيين:

(١) ماهي كفاءة الاستثمار الزراعي المصري الحالي؟

(٢) ماهي المحددات والعوامل المؤثرة عليه؟

الهدف من البحث

يهدف البحث بصفة عامة إلي التعرف علي كفاءة ومحددات الاستثمار الزراعي في مصر من خلال تحقيق الأهداف الفرعية التالية:

١- دراسة تطور الاستثمارات الزراعية،ونسبة مساهمتها في إجمالي الاستثمارات القومية.

٢- دراسة تطور المتغيرات الاقتصادية المتعلقة بكفاءة الاستثمارات الزراعية.

٣- قياس كفاءة الاستثمار الزراعي باستخدام المعايير الاقتصادية المختلفة.

٤- التقدير القياسي لأهم المتغيرات الاقتصادية تأثيراً علي أداء الاستثمار الزراعي في مصر.

أهمية البحث

ترجع أهمية دراسة الاستثمار الزراعي للدور الذي يلعبه في عملية التنمية الزراعية باعتباره متغيراً أساسياً في تحديد معدلات النمو بالقطاع الزراعي، حيث أن زيادة معدلات الاستثمار تؤدي إلي زيادة الطاقة الإنتاجية، زيادة قدرة الدولة علي إنتاج مزيد من السلع والخدمات، وهذا من شأنه زيادة الدخل الحقيقي للمجتمع، وزيادة قدرة الاقتصاد الذاتية علي التطور بصورة مستمرة، ولذلك يكتسب هذا البحث أهمية خاصة لكونه يسهم إسهاماً حقيقياً في التعرف علي الدور الذي يلعبه الاستثمار في قطاع الزراعة، وتأثير ذلك علي الناتج الزراعي المصري.

الطريقة البحثية ومصادر جمع البيانات

اعتمد البحث علي كل من التحليلين الوصفي والكمي في توصيف المتغيرات الاقتصادية موضع البحث، إلي جانب استخدام أدوات التحليل الإحصائي لتحديد أهم العوامل المؤثرة علي الاستثمار الزراعي، وحساب المعايير الاقتصادية لقياس كفاءة الاستثمار الزراعي، وقد اعتمد البحث بصفة أساسية علي البيانات المنشورة من خلال المواقع الإلكترونية لكل من الجهاز المركزي للتعبئة العامة والإحصاء، ووزارة التخطيط، ووزارة المالية، ونشرات البنك المركزي المصري، ونشرات الإحصاءات الزراعية التي يصدرها قطاع الشئون الاقتصادية بوزارة الزراعة واستصلاح الأراضي خلال الفترة (١٩٩٥- ٢٠١٥)، بالإضافة إلي البحوث والدراسات والرسائل العلمية ذات الصلة بموضوع البحث.

كذلك فإن نقص قيمة الصادرات الزراعية بنسبة ١٪ يؤدي إلي زيادة الاستثمارات الزراعية بنسبة ٠,٣٧٪. وقد أفاد البحث أن أهم أسباب انخفاض حجم وكفاءة الاستثمار علي المستوي القومي وداخل القطاع الزراعي المصري يرجع إلي تعقد وبطء إجراءات الاستثمار، ضعف الإطار المؤسسي وضعف كفاءة البرصة وتأثرها الشديد بالأحداث الجارية، التوزيع غير العادل للاستثمارات بين القطاعات الاقتصادية، انخفاض كفاءة العاملين بالقطاعات المختلفة في الاقتصاد المصري، تدني المركز التنافسي المصري، ضعف المخصص من الاستثمارات القومية للقطاع الزراعي، ضعف التكنولوجيا بالقطاع الزراعي، انخفاض الأهمية النسبية للأراضي الزراعية في جملة المساحة الكلية. وقد أوصي البحث بزيادة الاستثمارات العامة الموجهة لمشروعات البنية التحتية والخدمات الاقتصادية، مما يساهم في خفض التكلفة للمستثمرين، ومن ثم زيادة الاستثمارات الخاصة، إلي جانب قصر استخدام القروض الزراعية، الادخار الزراعي علي تمويل الاستثمارات الزراعية. وليس استخدامها في مجالات أخري.

المقدمة

يمثل القطاع الزراعي أحد الركائز الأساسية التي يقوم عليها البنيان الاقتصادي القومي المصري من حيث توفير الغذاء، والكساء، والمواد الأولية اللازمة لمعظم الصناعات، كما أن قطاع الزراعة يستوعب جزء كبير من العمالة الزراعية تبلغ نحو ٢٧,٢٪ من إجمالي عدد العاملين في الأنشطة الاقتصادية المختلفة، كما يساهم في زيادة نسبة الاكتفاء الذاتي من سلع الواردات لتخفيض عجز الميزان التجاري، وفي زيادة كمية الصادرات الزراعية لتوفير العملات الأجنبية اللازمة لزيادة الفرص الاستثمارية. وقد بلغت قيمة الناتج المحلي الزراعي حوالي١٠٦ مليار جنيه، تمثل نحو ١٢,٦٪ من قيمة الناتج المحلي الإجمالي والبالغ حوالي ٨٤٤,٥ مليار جنيه خلال متوسط الفترة (١٩٩٥–٢٠١٥)(وزارة الزراعة، نشرات الدخل الزراعي ، أعداد متفرقة). ويلعب الاستثمار دوراً هاماً وأساسياً في عملية التنمية الاقتصادية علي المستوي القومي، من خلال إحداث تغيرات في الهياكل الإنتاجية، والتحول من هيكل يعتمد علي المواد الخام إلي هيكل يتميز بنهضة التصنيع الزراعي وزيادة القيمة المضافة المحلية، وبالتالي زيادة الناتج القومي.ويعتبر زيادة الاستثمار من أهم الأهداف القومية لمواجهة المشاكل الاقتصادية والاجتماعية المتزايدة والمتمثلة في عجز الميزان التجاري، وارتفاع نسبة كل من البطالة والتضخم وانخفاض مستوي المعيشة، كما تعتبر الاستثمارات أحد الوسائل الهامة لتنفيذ برامج التنمية الاقتصادية، ويتوقف نجاح السياسات التنموية بدرجة كبيرة علي حجم وكفاءة توزيع الاستثمارات المتاحة بين مختلف القطاعات الاقتصادية في الدولة، لذا فإن إتباع سياسة استثمارية مناسبة والعمل علي تشجيعها وزيادة معدلاتها بصورة تتلاءم مع طبيعة المشاكل سوف يعمل علي إضافة مشروعات إنتاجية، تساهم في زيادة العمالة وزيادة إنتاجيتها من خلال زيادة كثافة رأس المال. هذا وقد بلغ متوسط قيمة الاستثمارات الموجهة لقطاع الزراعة حوالي ٧,٤ مليار جنيه، تمثل نحو ٥,٥٪ من إجمالي الاستثمارات القومية والبالغة حوالي ١٣٦,١ مليار جنيه خلال نفس الفترة السابق الإشارة إليها (موقع البنك المركزي المصري، WWW.cba.org.eg).

مشكلة البحث

تعتبر الاستثمارات من أهم وسائل تنفيذ برامج التنمية الاقتصادية في مصر، خاصة في القطاع الزراعي، حيث تعد الاستثمارات الزراعية الأداة الأساسية لتحقيق التنمية الزراعية. وتتمثل مشكلة البحث في انخفاض نصيب

دراسة اقتصادية لكفاءة الاستثمار الزراعي ومحدداته في مصر

رياض إسماعيل مصطفي

قسم الاقتصاد الزراعي – كلية العلوم الزراعية البيئية – جامعة العريش

الملخص: يمثل القطاع الزراعي المصري أحد الركائز الأساسية التي يقوم عليها البنيان الاقتصادي القومي. كما أن قطاع الزراعة يستوعب جزء كبير من العمالة الزراعية، تبلغ نحو ٢٧,٢٪ من إجمالي عدد العاملين في الأنشطة الاقتصادية،وقد بلغ متوسط قيمة الناتج المحلي الزراعي حوالي١٠٦ مليار جنيه، تمثل نحو ١٢,٦٪ من متوسط قيمة الناتج المحلي الإجمالي والبالغ حوالي ٨٤٤,٥ مليار جنيه خلال متوسط الفترة (١٩٩٥– ٢٠١٥). كما تعتبر الاستثمارات أحد الوسائل الهامة لتنفيذ برامج التنمية الاقتصادية، هذا وقد بلغ متوسط قيمة الاستثمارات الموجهة لقطاع الزراعة حوالي ٧,٤٣ مليار جنيه، تمثل نحو ٥,٥٪ من إجمالي الاستثمارات القومية والبالغة حوالي ١٣٦,١ مليار جنيه.وتتمثل مشكلة البحث في تضائل نصيب القطاع الزراعي من الاستثمارات القومية حيث انخفضت الأهمية النسبية لحجم الاستثمارات الزراعية في جملة الاستثمارات القومية من نحو ٨,٦٪ عام ١٩٩٥، إلي نحو ٤٪ عام ٢٠١٥. ويهدف البحث دراسة كفاءة الاستثمار الزراعي ومحدداته في مصر، وقد اعتمد البحث علي التحليلين الوصفي والكمي في توصيف المتغيرات الاقتصادية، إلي جانب استخدام أدوات التحليل الإحصائي، وفيما يختص بالاستثمار القومي والاستثمار الزراعي أشارت النتائج أن متوسطها العام قد بلغ حوالي ١٣٦.١ مليار جنيه، ٧,٤ مليار جنيه، ويتزايدان سنوياً بمقدار معنوي إحصائيا بلغ حوالي ١٤,٣ مليار جنيه، ٠,٢١ مليار جنيه، وبمعدل نمو سنوي بلغ نحو ١٠,٦٪، ٢,٨٪ علي الترتيب. وعن الناتج المحلي الإجمالي، والناتج المحلي الزراعي، والعمالة الزراعية أوضحت النتائج أن متوسطهم العام قد بلغ حوالي ٨٤٤,٥ مليار جنيه، ١٠٦,٠ مليار جنيه، ستة آلاف عامل، وتتزايد سنوياً بمقدار معنوي إحصائيا بلغ حوالي ١٠٧,٦ مليار جنيه، ١٠,٥ مليار جنيه، ١٢٠ عامل، وبمعدل نمو سنوي بلغ نحو ١٢,٧٪،٩,٩٪، ٢,٢٪ علي الترتيب. وفيما يختص بتقييم كفاءة الاستثمارات الزراعية أكدت النتائج أن معدل الاستثمار، والعائد علي الاستثمار، ومضاعف الاستثمار، ومعامل التوطن، ومعامل التكثيف الرأسمالي قد بلغ متوسطهم العام حوالي نحو ٠,١٠، ١٤,٢،١,٤،٠,٥١،١,٣٤ علي الترتيب، وأن معدل الاستثمار ومعامل التوطين يتناقصان بمقدار معنوي احصائياً بلغ نحو ٠,٠١، ٠,٠٢٤، أما العائد علي الاستثمار يتزايد بمقدار معنوي بلغ نحو ١,١٣. وفيما يختص بأهم المتغيرات المؤثرة علي حجم الاستثمارات الزراعية في مصر بالأسعار الحقيقية في الصورة الخطية أشارت النتائج أن أهم العوامل المؤثرة علي حجم الاستثمارات الزراعية تتمثل في قيمة المدخرات الزراعية، وسعر الفائدة علي الودائع بالجهاز المصرفي، أما في الصورة نصف اللوغاريتمية أكدت النتائج أن زيادة قيمة كلاً من قيمة الصادرات الزراعية، قيمة الأجور الزراعية، والمدخرات الزراعية بنسبة ١٪ يؤدي إلي انخفاض الاستثمارات الزراعية بنسبة ٠.٢٨٪، وإلي زيادة حجم الاستثمارات الزراعية بنسبة ٠,٠٢٪، بنسبة ٠,٢٧٪، علي الترتيب. وعن الصورة اللوغاريتمية المزدوجة أوضحت النتائج أن زيادة قيمة المدخرات الزراعية بنسبة ١٪ يؤدي إلي زيادة حجم الاستثمارات الزراعية بنسبة ١,٤٪،

المحتويات

مجلـة

الجديد في البحوث الزراعية

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