WHEAT PRODUCTIVITY AS AFFECTED BY VARIETIES, NITROGEN, ORGANIC AND BIO-FERTILIZERS UNDER NEW RECLAIMED SOIL CONDITION.

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ABSTRACT

Two field experiments were carried out in the Experimental Farm , of the Faculty of Agriculture , Fayoum University on Sandy Loam soil during 2011 / 2012 and 2012 / 2013 seasons to study the effects of two organic manure levels i.e. (15 and 30 m^3 / fed.), bio-fertilizer (Azotobacter who was inoculation the seeds) and three levels of nitrogen fertilizer .[100% (75 kg N / fed.) & 50 % (37.5 kg N / fed.) and 25 % (18.75 kg N / fed.)] of Urea (46 % N) and their combinations on productivity of two wheat cultivars i.e. (Sakha 93 (V_1) &Sakha 94 (v2)).The treatments were set in Randomized Complete Block Design (RCBD) in factorial arrangement with three replications .

Significant effect for wheat varieties were obtained on plant height (cm) , in the 1st season and on total protein percentage in both seasons but was insignificantly on other traits .The superiority was for Sakha 94 in most characters .

Fertilizer treatments was significantly effect on all traits in both season except plant height , number of spike / plant ,1000-grain weight in second season and harvest index% in first season .F_3 (30 m^3 / fed. organic manure + bio – fertilizer + 50 % (37.5 kg N / fed.) treatment gave the highest values followed by F_4 (30 m^3 / fed. organic manure + bio – fertilizer + 25 % (18.75 kg N / fed.)) or F_5 (30 m^3 / fed. organic manure + 50 % (37.5 kg N / fed.)) treatments .

Interaction between varieties and fertilizer treatments was significantly effect on number of spike / plant and weight of grains / spike in both seasons and on grain yield (ton / fed.) and total protein (%) in 1st and number of grains / spike in second season only but was insignificantly on plant height (cm) , 1000-grain weight, and harvest index (%) in both seasons .

Results of stepwise regression revealed that both the harvest index, 1000 grains weight, number of grains/ spike and plant height were causes high grains yield genotypes in wheat programs.

By using organic fertilizer and / or bio-fertilizer with half dose of mineral fertilizer it could be increased in plant growth and yield . Besides, using bio-fertilizers that contain different microbial strains had led to decrease in the use of chemical fertilizers and had provided height products free of harmful agrochemicals for human safety.

Key word: *Wheat, Organic manure, Bio-fertilizer, Nitrogen fertilizer, Varieties, Stepwise .*

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important cereal crops in Egypt . Nowadays, major efforts have been made to minimize the gap between production and consumption. Production of wheat grains in Egypt is not enough to achieve self-sufficiency due to the high consumption rate per capita and high increasing rate in population every year, its cultivated area is about 3.1 milion feddan. The local production is about 9.5 million ton however; it covers less than 60% of local consumption **(FAO, 2013).**

Wheat is one of the cheapest sources of carbohydrate and also contains a considerable amount of protein, minerals and vitamins.

There are many factors, which can help to increase wheat production of which the use modern varieties and judicious fertilization are important. It is well recognized that crop productivity depends on adequate plant nutrient and organic matter content of the soil.

Manure play an important role in improving physical, chemical and biological properties of soils.

Due to low nutrient content and slow acting nature, organic manure alone may fail to meet the high nutritional requirements of crops.

Some of the plant nutrients, when added to the soil in inorganic form, have low efficiency as compared with the effect of the same nutrients applied along with organic manure.

Thus, organic manure reduce the application rate of chemical fertilizers and also help to solve the problem of micro – nutrient deficiency in the soil.

Azotobacter is a heterotrophic, aerobic micro-organism, fixing nitrogen as non-symbiotix which is a good source of bio-fertilizer to improve the growth and yield of cereals and many other crops.

Fertilizer N and organic N have their own merits and demerits and the drawbacks associated with either sources of these plant nutrients are often overcome when these are mixed in judicious combinations .

In additional, stepwise regression is a method that is used to estimate the value of a quantitative variable regarding its relation with one or some other quantitative variables. This relation is such that it is possible to predict other changes using one variable. Many investigators have used this technique on wheat such as **Mohamed (1999), Pržulj and Momcilovic (2011), Soleymanifard *et al.* (2012).**

The objective of the present investigation was to study the effect of mineral (urea) , organic N and bio-fertilizer (Azotobacter) applied alone and in various combinations on productivity for two wheat cultivars, so as to select the most appropriate combinations doses of these fertilizers in wheat production saving as much fertilizer N as possible and to determine effective traits on yield under newly reclaimed soil.

MATERIALS AND METHODS

Experimental Procedures. Two field experiments were conducted at the Experimental Farm of the Faculty of Agriculture Fayoum, University in Demo Farm, during 2011/2012 and 2012/2013 seasons. The experiments were carried out to study the effect of two organic manure and bio-fertilizer as a total or partial replacement of nitrogen fertilizer under new reclaimed soil conditions in two bread wheat cultivars. A factorial experiment based on completely randomized design with three replications was used. The studied factors were two bread wheat varieties i.e. Sakha 93 (V_1) and Sakha 94 (V_2) were obtained from Field Crop Research Institute, Agricultural Research Center, Giza, Egypt, and Seven different combination of fertilizer treatments between organic manure, mineral and bio-fertilizer (*Azotobacter* was inoculated the seeds). The combination treatments were Control= 75 kg N/fed (F_1), 30 m^3/fed organic manure + bio-fertilizer (F_2), 30m^3/fed organic manure + bio-fertilizer + 37.5 kg N/fed. (F_3), 30m^3/fed organic manure + bio-fertilizer + 18.75 kg N/fed.(F_4), 30m^3/fed organic manure + 37.5 kg N/fed.(F_5), 15m^3/fed organic manure + 37.5 kg N/fed.(F_6) and bio-fertilizer + 37.5 kg N/fed (F_7). A Randomized complete block design in factorial arrangement with three replications was used. The size of each plot was 10.5 m^2 (3.5 m long and 3.0 m wide).

Agronomic Traits. Plant height, number of spike/plant, number of grains/spike, Weight of grains/spike, 1000-grain weight, Harvest index, grain yield/fed. and protein percentage (Pro.%) were determined after the plants were harvested. protein percentage measured by near infrared analyzer according to **Granland and Zimmerman (1975)**.

Statistical Analysis. All the data collected of wheat at the two seasons were statistically analyzed according to the procedures cut lined by **Snedecor and Cochran (1980)**. To compare treatment means, LSD at 5 % level of significance was used according to **Stell and Torrie (1960)**. The stepwise regression analysis was also carried out for the data obtained to test the significance of the independent variables affecting the grain yield.

RESULTS AND DISCUSSION

Effect of varieties

The data illustrated in table (1) show the effect of wheat varieties and treatments of fertilizer. Plant height was significantly in first season only and protein percentage was significantly in both seasons, whereas, there was no significant effect of varieties on other studied traits in both seasons. Sakha 94 variety superiority on Sakha 93 for all studied traits except for 1000-grain weight in both seasons and harvest index and grain yield in 2nd season. This may be due to the differences in genetic construction, these results are in generally agreement with those obtained by**, Ali *et al* (2004), Badran (2009), Mattas *et al* (2011), Woyema *et al* (2012), Zaki *et al* (2012), Abd El-Razek and El-Sheshtawy (2013), Bithy (2014), Radwan *et al* (2014), Lemma**

(2015), Mehasen *et al* (2015), Abo-Remaila and Abo El-Enin (2016) and **Babar *et al* (2016).**

Effect of treatments of fertilizer:

The results presented in Table 1, clearly, indicated that there were significant on all studied traits in both seasons except plant height, number of spike/plant and 1000-grains weight in the 1st season and harvest index in the 2nd season. The tallest plants were obtained from F_3 treatment, and F_4 treatment followed by F_2 treatment gave the largest number of spike/plant (5.17 and 5.00, respectively). The two treatments F_5 and F_4 gave higher number of grains per spike (63.67, 63.33) in 1st season and (68.67, 68.50) in 2nd season and weight of grains/spike in the second season (3.53,3.17) respectively, also F_7 and F_5 followed by F_3 treatment (in 1st season) gave higher weight of grains per spike than the other fertilizer treatments. F_3 treatment alone gave higher weight for 1000-weight (48.03g), grains yield/fed (2.23 and 2.59t in 1st and 2nd seasons, respectively) and high percentage for harvest index (44.90% in 2nd season) and protein percentage (14.38 and 14.79% in 1st and 2nd seasons, respectively) than the other fertilizer treatments. It's may be due to the organic manure, bio-fertilizer and nitrogen fertilizer increased mineral contents of soil and adjusted physical characters of soil to good conditions, this finding are conceded with those obtained by **Abraham and Lal (2004), El Gizawy (2009), Shah *et al* (2010), Hammad *et al* (2011), Agamy *et al* (2012), Mohammed *et al* (2012), Zaki *et al* (2012), El-Nady and Borham (2013) and Esmailpour *et al* (2013).**

Effect of the interaction:

The interaction between wheat varieties and fertilizer treatments in table (2) was significant in 2011/2012 season only in grain yield (two varieties Sakha 93 and Sakha 94 remained at par under F_3 treatment gave highest yield per feddan) and in total protein (%) (Sakha 94 variety (V_2) when treated by F_3 treatment gave the highest grain protein percentage) and significant in two seasons in number of spike/plant and weight of grains / spike , the highest number of spike/plant resulted from the variety Sakha 93(V_1) when fertilized with F_2 treatment in first season and Sakha 94(V2) when fertilized with F5 or f4 treatment in second season ,while,v1f1 interaction gave the highest weight of grains / spike in first season also the same variety followed by v2 under f5 treatment gave the highest weight in second season. On the other hand number of grains/spike was significant in the second season only, v1f5 and v2f4 interaction gave largest number (70.33 ,69.33) respectively. But was not significant in both seasons in 1000 – grains weight (g) and harvest index %, this finding are conceded with those obtained by **Ali *et al*(2004) , Woyema *et al* (2012) , Zaki *et al* (2012) , Abd El – Razek and El – Sheshtawy (2013) ,Bithy (2014) and Radwan *et al*(2014) .**

Table (1): Effect of wheat varieties and treatments of fertilizer on yield and some yield traits in two seasons (2011/2012 – 2012/2013).

Treatments	plant height (cm)		No. of spike/plant		No. of grains /spike		Weight of grains /spike		1000-grains weight (g)		Harvest index (%)		Grain yield (ton/fed.)		Protein %	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Varieties (V)																
V_1=Sakha93	77.19	85.95	4.62	5.10	59.76	63.90	2.93	3.06	46.45	47.01	36.97	43.95	1.76	2.44	11.51	11.71
V_2=Sakha94	84.48	87.29	4.81	5.19	59.71	64.24	3.02	3.09	45.68	46.33	37.12	42.72	1.89	2.32	11.89	12.02
$LSD_{0.05}$ for V	**3.99**	**n.s**	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	**n.s**	**n.s**	**0.21**	**0.22**
Fertilizer (F)																
F_1	82.67	85.67	4.33	5.17	60.50	62.83	3.10	2.98	46.78	47.22	36.19	45.60	1.92	2.59	7.53	7.53
F_2	75.67	81.67	5.00	5.33	50.67	62.00	2.80	2.83	46.33	47.08	36.33	41.27	1.97	2.31	11.02	11.03
F_3	85.67	88.83	4.50	5.00	59.67	61.00	3.10	3.07	48.03	48.52	38.46	44.90	2.23	2.59	14.38	14.79
F_4	81.83	89.33	5.17	5.50	63.33	68.50	2.78	3.17	45.55	46.13	37.29	45.78	1.68	2.45	14.15	14.42
F_5	83.33	88.83	4.67	5.33	63.67	68.67	3.13	3.53	44.85	45.58	35.30	40.39	1.75	1.93	12.53	12.78
F_6	80.67	87.33	4.50	4.83	59.67	63.50	2.73	2.92	44.75	45.57	37.59	40.05	1.62	2.22	9.21	9.39
F_7	76.00	84.67	4.83	4.83	60.67	62.00	3.18	3.02	46.15	46.60	38.15	45.34	1.59	2.56	13.07	13.10
$LSD_{0.05}$ for F	**3.44**	**n.s**	**0.58**	**n.s**	2.49	3.03	0.209	0.220	2.01	n.s	n.s	2.80	**0.31**	**0.26**	**0.40**	**0.41**

F_1=Mineral fertilizer 75 N (Control), F_2=Organic 30 m^3 + Bio-fertilizer, F_3=Organic 30 m^3 + Bio-fertilizer + 37.5 N, F_4=Organic 30 m^3 + Bio-fertilizer + 18.75 N, F_5=Organic 30 m^3 + 37.5 N, F_6=Organic 15 m^3 + 37.5 N, F_7=Bio-fertilizer + 37.5 N, 1st = 1st season (2011/2012), 2nd = 2nd season (2012/2031) and n.s= no significant.

Table (2): Effect of the interaction between wheat varieties and fertilizer treatments on yield and some yield traits in 2011/2012 and 2012/2013 seasons.

Fertilizer	plant height (cm)		No. of spike/plant		No. of grains /spike		Weight of grains /spike		1000-grains weight (g)		Harvest index (%)		Grain yield (ton/fed.)		Protein %	
	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2
1st Seasons (2011/2012)																
F_1	76.67	88.67	4.67	4.00	61.00	60.00	3.30	2.90	46.17	47.40	36.57	35.81	1.70	2.15	7.57	7.49
F_2	75.00	76.33	5.67	4.33	52.33	49.00	2.90	2.70	47.47	45.20	36.06	36.60	2.07	1.88	11.01	11.02
F_3	81.00	90.33	3.67	5.33	60.00	59.33	3.10	3.10	48.23	47.83	38.77	38.14	2.23	2.24	14.08	14.69
F_4	77.00	86.67	5.00	5.33	62.67	64.00	2.47	3.10	46.13	44.97	37.53	37.05	1.55	1.81	14.03	14.27
F_5	79.33	87.33	4.00	5.33	62.67	64.67	3.17	3.10	45.57	44.13	35.83	34.77	1.69	1.81	12.20	12.85
F_6	78.67	82.67	4.67	4.33	58.00	61.33	2.57	2.90	44.87	44.63	36.41	38.77	1.54	1.70	8.63	9.79
F_7	72.67	79.33	4.67	5.00	61.67	59.67	3.03	3.33	46.70	45.60	37.61	38.69	1.53	1.65	13.05	13.08
$LSD_{0.05}$ for V*F	**n.s**		**0.81**		**n.s**		**0.30**		**n.s**		**n.s**		**0.24**		**0.56**	
2nd Seasons (2012/2013)																
F_1	86.33	85.00	5.67	4.67	64.33	61.33	3.17	2.80	46.70	47.73	48.00	43.20	2.52	2.66	7.55	7.51
F_2	83.33	80.00	5.33	5.33	63.00	61.00	3.03	2.63	48.03	46.13	41.03	41.50	2.24	2.38	10.96	11.10
F_3	89.33	88.33	5.00	5.00	64.00	58.00	3.17	2.97	48.87	48.17	46.04	43.76	2.66	2.52	14.63	14.95
F_4	87.00	91.67	5.33	5.67	67.67	69.33	2.97	3.37	46.73	45.53	44.30	47.27	2.45	2.45	14.39	14.45
F_5	86.67	91.00	4.67	6.00	70.33	67.00	3.63	3.43	46.07	45.10	40.30	40.48	2.10	1.75	12.64	12.92
F_6	87.33	87.33	4.67	5.00	60.33	66.67	2.77	3.07	45.70	45.43	41.29	38.80	2.31	2.14	8.77	10.00
F_7	81.67	87.67	5.00	4.67	57.67	66.33	2.70	3.33	47.00	46.20	46.66	44.01	2.80	2.31	13.00	13.20
$LSD_{0.05}$ for V*F	**n.s**		**0.87**		**4.29**		**0.31**		**n.s**		**n.s**		**n.s**		**n.s**	

F_1=Mineral fertilizer 75 N (Control), F_2=Organic 30 m^3 + Bio-fertilizer, F_3=Organic 30 m^3 + Bio-fertilizer + 37.5 N, F_4=Organic 30 m^3 + Bio-fertilizer + 18.75 N, F_5=Organic 30m^3 + 37.5 N, F_6=Organic 15 m^3 + 37.5 N, F_7=Bio-fertilizer + 37.5 N, 1st = 1st season (2011/2012), 2nd = 2nd season (2012/2031) and n.s= no significant.

Stepwise regression

Stepwise regression is a semi-automated process of building a model by successively adding or removing variables based solely on the t-statistics of their estimated coefficients. In order to remove effect of non-effective characteristics in regression model on grain yield, stepwise regression was used. Results of stepwise regression (**Table 3**) showed that the harvest index

(HI), 1000 grains weight (SI), number of grains/ spike (NGS) and plant height (PLH) with R square of 69.35%, had justified the maximum of yield changes. Therefore the following equation can be obtained:

Grain yield (GY) = - 2.049 + 0.071HI + 0.029SI – 0.012 NG + 0.008PLH

Existence of significant R square in a successful regression equation indicates the effectiveness of these traits to increase grain yield**. Leilah and Al-Khateeb (2005), Ahmadizadeh *et al.* (2011) and Zarei *et al.* (2011)** reported importance of Harvest index to grain yield. However, obtained results were in the opposite of those of Soleymanifard *et al.* (2012), who found that 75% of variation in grain yield is explained by 1000 grain weight and plant height traits. With respect to the positive and significant regression coefficients of harvest index, it could be stated that increasing the amount of these traits will cause an increase in the yield. Thus, in this study, harvest index trait had the most effect on the grain performance in newly reclaimed soil.

Table (3): Regression coefficient, standard error, t-value and probability of the accepted variables by the stepwise procedure to predict grain yield.

Traits or variable	B	SE	t	Sig	VIF	R^2
Plant height	0.008	0.004	1.880	0.064	1.200	1.37%
No. of grains /spike	-0.012	0.006	-2.020	0.047	1.230	0.91%
1000-grains weight	0.029	0.011	2.590	0.011	1.070	3.20%
Harvest index	0.071	0.006	11.110	0.000	1.230	63.87%

B: Regression coefficient, SE: Standard error, t: Student t-value and Sig: Probability. R^2 = 69.35%, Adj R^2 = 67.80%, Predicted R^2= 65.83% and Constant = -2.049.

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الملخص العربى

تاثير الاصناف والتسميد المعدني والعضوي علي انتاجية محصول القمح تحت ظروف الاراضي الجديدة

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أقيمت تجربتان حقليتان بمزرعة كلية الزراعة – جامعة الفيوم – بمنطقة دمو– محافظة الفيوم خلال الموسمين ٢٠١١ / ٢٠١٢، ٢٠١٢ / ٢٠١٣ وذلك لدراسة تأثير مستويين من السماد العضوى (١٥ و٣٠م ٣) والسماد الحيوى (لقحت التقاوى ببكتريا الازوتوباكتر) قبل الزراعه وثلاث مستويات للسماد المعدنى (١٠٠% (٧٥ كجم ن/فدان) و٥٠% (٣٧,٥ كجم ن/ فدان) و٢٥% (١٨,٥ كجم ن/فدان) من سماد اليوريا ٤٦% ن على انتاجية صنفين من القمح هما (سخا ٩٣ وسخا ٩٤) تحت ظروف الأراضي حديثة الاستصلاح. وتم ترتيب المعاملات فى تجربه عاملية فى تصميم قطاعات كاملة العشوائيه فى ثلاث مكررات.

أثرت الأصناف تأثيرا معنويا على صفة ارتفاع النبات (سم) فى الموسم الأول ونسبة البروتين فى الحبوب فى كلا الموسمين، وكانت غير معنوية التأثير على باقى الصفات . وكان الصنف سخا ٩٤ متفوق فى معظم الصفات.

أظهرت معاملات التسميد تأثيرا معنويا على كل الصفات فى الموسمين ما عدا صفة ارتفاع النبات (سم) وعدد السنابل على النبات ووزن الالف حبة فى الموسم الثانى ودليل الحصاد للموسم الاول.

وأعطت المعاملة الثالثة (٣٠ م^{٣} /ف سماد عضوى + سماد حيوى + ٥٠% سماد أزوتى الموصى به) أعلى القيم ثم المعاملة الرابعة (٣٠ م^{٣} /ف سماد عضوى + سماد حيوى + ٢٥% سماد أزوتى موصى به) والمعاملة الخامسة (٣٠ م^{٣} /ف سماد عضوى + ٥٠% سماد أزوتى موصى به).

أظهر التفاعل بين الأصناف ومعاملات التسميد تأثيرا معنويا على صفة عدد السنابل / نبات و ووزن حبوب السنبله فى الموسمين بينما كان التاثير معنوى على عدد حبوب السنبله فى المسم الثانى فقط ومعنويا على صفة محصول الحبوب (طن / فدان) نسبة البروتين فى الموسم الاول فقط، وكان التاثير غير معنوى فى كلا الموسمين على صفات ووزن الالف حبة ودليل الحصاد .وتباينت الاصناف فى تفوقها بالتسميد بالمعاملات الثالثه (٣٠ م٣ /ف سماد عضوى + سماد حيوى + ٥٠% سماد أزوتى الموصى به) ثم المعاملة الرابعة (٣٠ م٣ /ف سماد عضوى + سماد حيوى + ٢٥% سماد أزوتى موصى به) والمعاملة الخامسة (٣٠ م٣ /ف سماد عضوى + ٥٠% سماد أزوتى موصى به).

واظهرت نتائج تحليل الانحدار متعدد المراحل ان صفات دليل الحصاد ودليل الحبوب(وزن ١٠٠٠ حبه) وعدد حبوب السنبله وطول النبات بالترتيب هى اهم الصفات مساهمه فى المحصول العالى للقمح.

فى النهاية، باستخدام السماد العضوى مع او بدون السماد الحيوى مع نصف الكمية الموصى بها من السماد المعدنى أوضحت النتائج زيادة فى نمو النبات وأيضا زيادة المحصول والذى كان يمكن الحصول عليه من السماد المعدنى بمفرده ولكن باستخدام الأسمدة السابقة يقلل من استخدام السماد المعدنى ويحسن المنتج الذى يكون أمن لحياة الأنسان وأيضا يحد من تلوث البيئة مع تقليل التكاليف المستخدمة.