J. Agric. Sci. Mansoura Univ., 32 (11): 9769 - 9776, 2007

EFFECT OF MINERAL AND BIOFERTILIZERS APPLICATION ON RATIONALIZATION OF MINERAL FERTILIZERS CONSUMPTION BY WHEAT GROWN IN THE NORTH MIDDLE NILE DELTA REGION

Aziz, Manal A.; E.A. Moursi and Ahlam. M. Mehessen
Soils and Water and Environment of Research Institute, A.R.C., Egypt

ABSTRACT

Two field experiments were carried out at Sakha Agricultural Research Station during the two successive growing seasons 2005/2006 and 2006/2007 to investigate the impact of application of mineral fertilizers (60, 75 and 90 N/fed.) and biofertilizers (0.05, 1.0, 1.5 ton/fed.) on wheat yield and contents of nitrogen and phosphorus in wheat plant organs. The obtained results can be summarized briefly as follow:

With regard to grain yield the mean values were increased by increasing nitrogen level up to 90 kg. The mean values of wheat grain yield were 13.66, 15.80 and 17.4 ardab/fed., in the second growing season the mean values were 13.80, 15.24 and 17.64 ardab/fed. under 60, 75 and 90 kg N/fed, respectively. Also, application of biofertilizers up to 1.5 ton/fed. significantly increased the grain yield of wheat. The highest mean values were recorded under the highest amount of biofertilizer application and the mean values, 13.49, 14.53, 16.17 and 18.31 ardab/fed. in the first growing seasons. The mean values in the second growing season were 13.33, 14.64, 16.27 and 17.95 ardab/fed. under 0, 0.5, 1.0 and 1.5 ton biofertilizers/fed., respectively. Under the same treatments of biofertilizers, wheat straw yield was increased by increasing nitrogen dose up to 90 kg N/fed. The mean values of straw yield 1464, 2311 and 2250 kg/fed. in the 1st season while in the second growing season were 1271.0, 1916.0 and 2200 kg/fed. with 60, 75 and 90 kg N/fed., respectively. Also, data clearly showed that by increasing biofertilizer application up to 1.5 ton/fed. the mean values of straw yield were increased. The highest value was recorded under 90 kg N/fed. + 1.5 ton biofertilizer.

The mean values of wheat plant height were increased under all doses of biofertilizers application and by increasing nitrogen levels up to 90 kg N/fed. The mean values in 1st season were 100.4, 102.2 and 105.2 cm while the mean values in the second growing season were 98.4, 104.8 and 104.9 cm with 60, 75 and 90 kg N/fed., respectively. Also, data clearly showed that increasing doses of biofertilizers increased wheat plant height. The highest mean value was recorded under the highest level of biofertilizers and nitrogen (110.5 and 110.1 cm) in the 1st and 2nd season, respectively. The mean values of nitrogen and phosphorus content in wheat plant in the two growing seasons were increased by increasing nitrogen dose up to 90 kg N/fed. Also, application of biofertilizers up to 1.5 ton/fed. have a positive effect on contents, of N and P in wheat plant organs. Consequently the highest mean values were recorded under 90 kg N/fed. and 1.5 ton/fed. in both growing seasons.

Keywords: Wheat-Biofertilizers-Mineral Fertilizer

INTRODUCTION

Wheat is considered as one of the most important nutritional cereal crop which the Egyptian people depend mainly upon it in their nutrition. Wheat is widely cultivated in Egypt (about 3.04 million feddan). The mean production of wheat in the valley and Delta soils is about 19.02 ardab/fed.,

hence the national production is about 7.2 million tons and the consumption is about 10.7 million tons/year.

There is a wide gap between production and consumption of wheat. It is hoped to reduce this gap in the near future by increasing wheat production. Narrowing this gap is a national policy in Egypt, this policy aims at increasing production and decreasing wheat usages.

Farmers always make excessive in using mineral fertilizers aiming to increase the production. This belief is wrong because the wasteful in using mineral fertilizers has a bad effect on wasting a large sum of these fertilizers that have a high solubility number (Amer, 2005). So, in a short time these fertilizers reach the drainage water and pollute it and using this water in irrigation is very dangerous. In order to overcome this problem farmers can use biofertilizers which have low prices and don't cause a harmful effect on soil. These types of fertilizers have a good effect on soils by improving soil chemical and physical characteristics such as increasing water holding capacity and decreasing soil bulk density and soil compaction. Also, applying these fertilizers saved irrigation water, through increasing soil water holding capacity and hence, increasing irrigation interval and decreasing amount of water applied which can be used for watering other crops. Nadia El-Wakil *et al.* (2004) demonstrated that increasing nitrogen fertilizer level from 60 kg N/fed. to 90 kg N/fed. significantly increased plant height, spike length, number of spikes/plant, number of grains/spike, number of spikes/m^2,1000-gram weight and grain and straw yields/fed.

The main aim of this present work is to investigate the effect of applying mineral and biofertilizers on yield and yield components of wheat plant.

MATERIALS AND METHODS

Two field trails were conducted at Sakha Agricultural Research Station during the two successive winter growing season (2005/2006) and (2006/2007). The main target of this present work is to study the effect of mineral and biofertilizers application on mineral fertilizers consumption by wheat plants.

Table (1): Some chemical and physical characteristics for the experimental field before cultivation in the two growing seasons.

Growing season	EC dS/m^{-1}	Cations meq/L				Anions meq/L				SAR	pH	O.M	$CaCO_3$	Particle size distribution			Texture
		Na^+	K^+	Ca^{++}	Mg^{++}	CO^-_3	HCO^-_3	Cl^-	SO^-_4					Silt	Clay	Sand	
First	0.44	2.1	0.30	1.6	0.80	Nil	1.0	1.9	1.9	1.92	7.20	1.8	1.6	24.3	55.1	19.4	Clayey
Second	0.5	3.2	0.2	1.2	0.80	Nil	0.7	2.9	1.8	3.2	7.4	2.0	1.3	20.1	58.1	25.7	Clayey

The soil of the experimental site was clayey according to its soil mechanical analysis according to Blakc *et al.* (1965). The electrical

conductivity (EC) was measured in soil water extract (1: 5) also according to Blakc *et al.* (1965). Some chemical and physical properties for the soil under study were done according to Jackson (1967) as shown in Table (1).

Split plot design with four replicates was used in this study where the main plots were assigned by nitrogen fertilizer levels which were (urea 46.5%) (60, 75 and 90 kg nitrogen feddan). The submain plots were devoted for application of biofertilizers as follow:

C : Control treatment (without any addition of biofertilizers.
B_1 : Application of 2.5 kg/plot (20 m^2) or 500 ton/fed.
B_2 : Application of 5 kg/plot (1.000 ton/fed.).
B_3 : Application of 7.5 kg/plot(1.500 ton/fed.).

Mineral fertilizers were mixed with surface layer of the soil before cultivation. Nitrogen fertilizers super phosphate seeds were soaked in microbial inoculants 8 hours before cultivation. The microbial inoculant includes nitrogen fixing bacteria grains namely *Azospirillum barasilense* strain SP7 & SP245. Two ml of this culture suspension viable cells around 10^6-10^7/ml was used as a standard inoculation in all experiments. *Azospirillum barasilense* inoculant was prepared by growing in semi solid medium under the same condition according to Dobereiner *et al.* (1976). Wheat variety Giza 168 (*Triticum aestivum* were sown on 29th November in the both growing seasons (15.5% P_2O_5) were applied before planting as recommended for wheat crop. At maturity stage some parameters for yield and yield components were taken such as grain and straw yield, weight of rough 1000-grain and plant height.

The statistical analysis of the data was done according to the method described by Snedecor and Cochran (1967). Grain and straw samples were taken from each plot on May 18th, oven dried at 70°C and digested using sulphuric and perchloric acids mixture according to Peterburgski (1968) and the analytical procedure adapted was as follows:

1. Total nitrogen was determined by Microkjeldahl method according to Jackson (1967).
2. Total phosphorus was measured colourimetrically using hydroquinone method as described by Snell and Snell (1967).

RESULTS AND DISCUSSION

Grain yield (ardab/feddan):

Data presented in Tables (2 and 3) illustrated that without application of biofertilizers the values of grain yield were increased by increasing nitrogen application rate up to 90 kg N/fed. where the values of grain were 13.66, 15.8 and 17.43 ardab/fed. with 60, 75 and 90 kg N/fed., respectively, in the first growing season. The same trend was obtained in the second growing season where the mean values were 13.80, 13.24 and 17.64 ardab/fed. with 60, 75 and 90 kg N/fed, respectively.

Also, data showed that under application of biofertilizers the values were increased by increasing N applied but the increment rate was higher in comparison with application nitrogen only, where the mean values in the first growing season were 13.49, 14.56, 16.17, 18.31 and in the second one were

13.33, 14.69, 16.27 and 17.95 ardab/fed. for zero treatment, 0.5, 1.0 and 1.5 ton/fed., respectively.

Table (2): Effect of mineral and biofertilizers application on grain, straw yield and plant height for wheat in the 1st season.

Fertilization		Grain yield (ardab/fed.)	Straw yield (kg/fed.)	Plant height (cm)
Nitrogen kg/fed.	Biofertilizer			
60	C	11.830 d	1113.00 d	93.5 d
	B_1	13.86 c	1230.78 c	98.8 c
	B_2	14.07 b	1646.25 b	103.8 b
	B_3	14.88 a	1865.45 a	105.3 a
Mean		13.66	1463.87	100.28
75	C	13.65 d	1350.98 d	96.8d
	B_1	14.14 c	1862.30 c	101.0 c
	B_2	16.52 b	1946.93 b	102.5 b
	B_3	18.90 a	2220.78	108.5 a
Mean		15.80	2310.58	102.20
90	C	14.98 d	1741.88 d	100.0 d
	B_1	15.68 c	1896.83 c	102.5 c
	B_2	17.92 b	2642.15 b	107.8 b
	B_3	21.14 a	2721.73 a	110.5 a
Mean		17.43	2250.4	105.2
L.S.D. 5%		0.112 0.107	2.22 2.35	1.256 1.64
L.S.D. 1%		0.156 0.144	3.04 3.18	1.76 1.57

Table (3): Effect of mineral and biofertilizers application on grain and straw yield and plant height for wheat in the 2nd season.

Fertilization		Grain yield (ardab/fed.)	Straw yield (kg/fed.)	Plant height (cm)
Nitrogen kg/fed.	Biofertilizer			
60	C	12.01 d	1030.75 d	91.48 d
	B_1	13.54 c	110.1 c	96.4 c
	B_2	14.66 b	1215.5 b	101.2 b
	B_3	14.99 a	1728.5 a	104.6 a
Mean		13.8	1271.21	98.4
75	C	12.98 d	1421.53 d	94.2 d
	B_1	14.61 c	1751.03 c	100.08 c
	B_2	15.37 b	1951.15 b	104.3 b
	B_3	17.98 a	2011.3 a	106.2 a
Mean		15.24	1916.16	101.19
90	C	15.01 d	1819.43 d	101.4 c
	B_1	15.91 c	1931.2 c	104.5 b
	B_2	18.77 b	2430.9 b	105.2 b
	B_3	20.89 a	2621.4 a	110.1 a
Mean		17.64	2200.73	105.3
L.S.D. 5%		0.111 0.103	1.44 1.44	1.03 0.93
L.S.D. 1%		0.155 0.139	1.99 1.94	1.45 1.25

The highest value was (21.14 and 20.89 ardab/fed. in the 1st and 2nd season, respectively was recorded under the highest dose of N applied and highest amount of biofertilizers. Increasing grain yield by increasing nitrogen dose might be due to that the nitrogen considers one of the major elements for plant nutrition and it increases the vegetative cover for plants and forms strong plants with long panicles. Also, nitrogen plays an important role for forming filled grains consequently heavier grains and hence more yield. Nitrogen also encourages plant to take other elements increasing grain yield by increasing amount of biofertilizers may be due to that kinds of fertilizers plays an internal part for improving physical properties of soil such as decreasing bulk density and compaction, increasing soil porosity and consequently the uptake of soil elements and grain yield are increased.

Straw yield (kg/fed.):

Data presented in Tables (2 and 3) illustrated that by increasing amount of nitrogen application from 60 to 90 kg N/fed. increased straw yield under the same treatments of mineral biofertilizers. The mean values are 1463.87, 2310.58 and 2250.45 kg/fed. in the first growing season, while in the second growing season the values were 1271.21, 1916.2 and 2200.73 kg/fed. under 60, 75 and 90 kg N/fed., respectively. Also, data in the same table clearly showed that by application of mineral and biological fertilizers the straw yield increased in comparison with the application of nitrogen only. By increasing the amount of biofertilizers application (up to 1.5 ton/fed.) increased the mean values of straw yield where the highest mean values were recorded the straw yield were 1402, 1663, 2078 and 2269 kg/fed. in the 1st season. While, in the second growing season. The mean value were 1424, 1594, 1866 and 2120 kg/fed. under 0, 0.5, 1.0 and 1.5 ton biofertilizers/fed., respectively. Increasing straw yield by increasing nitrogen application may be due to increasing vegetative growth and increasing uptake of nitrogen and hence, forming a high straw yield.

Plant height:

Data in Tables (2-3) clearly showed that under all doses of biological fertilizers, increasing application of nitrogen up to 90 kg/fed. increased plant height, where the highest mean values of plant height were recorded under the highest dose of nitrogen application. The plant height were 100.3, 102.2 and 105.2 cm in the 1st season while, the values in the second growing season were 98.4, 101.2 and 105.3 cm at 60, 75 and 90 kg nitrogen/fed. unit, respectively. Also, data in the same tables showed that application of nitrogen and biological fertilizers increased plant height higher than nitrogen application only where the mean values in the first growing seasons are 96.8, 100.8, 104.7, 108.1 and in the second growing season the values were 95.7, 100.3, 103.6 and 106.97 cm, respectively. Data in the same Table clearly illustrated that by increasing doses of mineral and biological fertilizers increased plant height, where the highest mean value was recorded under the highest level of nitrogen and biological fertilizers application and the highest doses of nitrogen application and the mean 110.5 cm 110.1 cm in the 1st and 2nd season, respectively.

The increase of plant height by increasing nitrogen dose may be due to nitrogen which considers one of the major elements which is essential for plant growth and it also plays an important role in elongation of plant cells and encourages uptake of other elements which lead to elongation of plants.

Application of biofertilizers to the soil leads to increasing plant height, this may be due to application of these fertilizers improve physical and chemical properties of the soil, where increase soil porosity and decrease soil bulk density and soil compaction, so, plants find a good chance to grow easily and its roots penetrate through the soil to a long distances to get its nutritional needs and hence, firming plants with a good heights. These results are in a good agreement with those obtained by Hussein and Aiead (1978) who reported that increasing N-fertilizers levels increased growth of wheat plants.

Nitrogen content (N%):

Data presented in Table (4) clearly showed that under the same treatments of biofertilizers application, by increasing mineral nitrogen dose from 60 to 90 kg N/fed., the mean values of nitrogen content (N%) were increased. The mean values were 0.72, 0.85 and 1.02% in the first growing season, but the mean values in the second growing seasons were 0.66, 0.76 and 2.15% with 60, 75 and 90 kg N/fed., respectively. Increasing nitrogen content in wheat plant organs by increasing nitrogen application dose up to 90 kg/fed. may be due to increasing nitrogen applied increased content of nitrogen in the soil solution and hence increasing its availability and its uptake by plants.

Table (4): Effect of nitrogen and biofertilizers application on nitrogen content in wheat plant.

Nitrogen fertilization (kg/fed.)	Mineral fertilizers				Mean
	C	B_1	B_2	B_3	
	First season				
60	0.58 f	0.67 ef	0.75 de	0.89 cd	0.72 b
75	0.66 ef	0.78 de	0.89 cd	1.06 b	0.85 b
90	0.78 de	0.97 bc	1.05 bc	0.27 a	1.02 a
Mean	0.67 c	0.81 b	0.89 b	1.07 a	
	Second season				
60	0.50 b	0.50 b	0.70 b	0.93 b	0.66 a
75	0.54 b	0.64 b	0.74b	1.11 b	0.76 a
90	0.68 b	0.89 b	1.03 b	2.05 a	2.15 a
Mean	0.57 b	0.67 b	0.82 b	1.35 b	

C : Without application of biofertilizers (control).
B_1 : Application of 500 biofertilizers kg/fed.
B_2 : Organic application of 1000 biofertilizers kg/fed.
B_3 : Application of 1500 biofertilizers kg/fed.

Also, data in the same tables illustrated that under the same treatment of nitrogen doses the mean values of nitrogen content (N%) in plant organs were increased by increasing amount of biological fertilizers up to 1.5 ton/fed. application where the mean values were 0.67, 0.81, 0.90 and 1.073 in the first growing season, but the mean values in the second growing season

were 0.57, 0.68, 0.82 and 2.69% under control treatment, 0.5, 1.0 and 1.5 ton biofertilizer/fed.

Phosphorus content (P %):

Presented data in Table (5) showed that under the same level of nitrogen increasing amount of biological application up to 1.5 ton/fed. increased content of phosphorus (P %) in the two growing seasons. The mean values of P content in the first season were 0.28, 0.3, 0.35 and 0.40% and in the second growing season were 0.68, 0.74, 0.81 and 1.04% with zero, 0.8, 1.0 and 1.5 ton/fed., respectively. These results are in a great harmony with those obtained by Andriesh *et al.* (1971), who reported that the more the nitrogen applied, the more the amount of phosphorus was found:

Table (5): Effect of nitrogen and biofertilizers application on Phosphorus content in wheat plant.

Nitrogen fertilization (kg/fed.)	Mineral fertilizers				Mean
	C	B_1	B_2	B_3	
	First season				
60	0.27 e	0.30 de	0.29 de	0.35 bcd	0.30 b
75	0.27 e	0.30 de	0.36 bcd	0.40 ab	0.33 ab
90	0.32 cde	0.35 bcd	0.40 abc	0.45a	0.38 a
Mean	0.28 c	0.31 bc	0.35 ab	0.40 a	
	Second season				
60	0.61 e	0.70 cde	0.75 cde	0.99 ab	0.76
75	0.68 de	0.75 cde	0.84 bcd	1.08 a	0.83 a
90	0.75 cde	0.79 cd	0.85 bc	1.06 a	0.86 a
Mean	0.67 c	0.74 bc	0.81 b	1.04 a	

REFERENCES

Amer, M.M.A. (2005). Effect of N, K level and timing of application on some yield component of wheat varieties in the North Middle Delta region. M.Sc. Thesis, Tanta Univ. Fac. of Agric.

Andriesh, S.V.; I.G. Dikusar and N.A. Turturyanu (1971). Effect of mineral fertilizers on grain yield and quality of maize on leached chernozem soil in Molclavia 9, 71 (C.F. Field Crop Abst., 25, 3190, 1972).

Black, A.C.; D.D. Evans; J.L. White; E.L. Ensminyer and E.F. Clark (1965). Methods of soil analysis. Amer Soc. Agron. Inc. Mad. Wise. USA.

Dobereiner, J.; L.E. Marrial and M. Nery (1976). Ecological distribution of *Spirillum lipoferum* Bejerinck. Can. J. Microbiol., 22: 1464-1473.

Hussein, M.M. and M.Sh. Aiead (1978). Effect of quantity of water in the first irrigation and nitrogen fertilization on growth, y ield and chemical content of wheat plants 1st Conf. West Desert Growing, Acad. Sci. and Techn., Cairo, Egypt, May (1978).

Jackson, M.L. (1967). Soil chemical analysis. Prentice-Hall of India Private, New Delhi.

Jranov, S.N.; M.M. Romanenkova and P.V. Sanko (1976). Effect of levels of mineral nutrition on yield and nitrogen uptake by barley plants. Vests Abademi Novuk USSR sel' SKagaspadarachykh. Navuk, No. 2, 38-42.

Nadia, El-Wakil, A.R. and Maha M. Abd Alla (2004). Influence of seedling rate and nitrogen fertilization level on yield and its attributes of some weight cultivars. Egypt. J. Applic. Sci., 19(2): 129-150.

Peterburgski, V.A. (1968). Handbook of organic chemistry koles publishing House, Moscow, P. 29-28 (In Russia).

Snedecor, G.W. and W.G. Cochran (1967). Statistical method. 6th Ed. The Iowa State UNiv. Press.

Snell, F.D. and C.T. Snell (1967). Clorimetric methods of Analysis. D. Van Nostrand Company, Inc., 551-552.

تأثير اضافة الاسمدة المعدنية والحيوية على ترشيد استهلاك الاسمدة المعدنية بواسطة القمح النامى فى منطقة شمال وسط الدلتا

منال عادل عزيز ــ السيد ابو الفتوح مرسى ــ احلام مصطفى محيسن

معهد بحوث الاراضى والمياة والبيئة ــ مركز البحوث الزراعية

تجربتان حقليتان تم تنفيذهما فى المزرعة البحثية بمحطة البحوث الزراعية بسخا خلال موسمى النمو ٢٠٠٥ ، ٢٠٠٦م لدراسة تأثير إضافة السماد النتروجينى والحيوى (الأزوتوباكتر) على محصول القمح ومكوناته وكذلك محتوى العناصر الكبرى النيتروجين والفوسفور فى أعضاء نبات القمح.

النتائج التى تم الحصول عليها يمكن تلخيصها كما يلى:

- محصول الحبوب (أردب/فدان) زاد بزيادة النيتروجين المضاف حتى ٩٠كجم/فدان والقيم كانت فى الموسم الأول ١٣,٦٤ ، ١٥,٨٥ ، ١٧,٥ والموسم الثانى كانت القيم ١٣,٧٧ ، ١٥,٢٤ ، ١٧,٦٥ أردب/فدان تحت مستويات ٦٠ ، ٧٥ ، ٩٠كجم نيتروجين/فدان على الترتيب.
- إضافة الأسمدة الحيوية أثرت على زيادة محصول الحبوب حتى ١٥٠ كجم/فدان وكانت أعلى قيم سجلت تحت المعدلات العالية من إضافة الأسمدة الحيوية وكانت ١٣,٤٩ ، ١٤,٥٦ ، ١٦,١٧ ، ١٨,٣١ فى الموسم الأول وكانت فى الموسم الثانى ١٣,٣٣ ، ١٤,٦٤ ، ١٦,٢٧ ، ١٧,٩٥ أردب/فدان تحت صفر ، ٥٠٠ ، ١٠٠٠ ، ١٥٠٠ كجم سماد حيوى/فدان على الترتيب. محصول القش زاد بزيادة جرعة السماد النيتروجينى المضاف حتى ٩٠كجم نيتروجين/فدان وكانت القيم هى ١٤٦٤ ، ٢٣١١ ، ٢٢٥% كجم/فدان فى الموسم الأول وكانت القيم ١٢٧١ ، ١٩١٦ ، ٢٢٠ كجم/فدان مع ٦٠ ، ٧٥ ، ٩٠ كجم نيتروجين/فدان على التوالى. أيضا البيانات أوضحت أنه بزيادة الأسمدة الحيوية المضافة حتى ١٥٠٠ كجم/فدان تحت المعاملة ٩٠كجم نيتروجين/فدان فقد زاد محصول قش ومحصول حبوب قمح فى كلا الموسمين.
- زادت قيم أطوال النباتات تحت كل جرعات السماد الحيوى المضاف بزيادة مستوى النيتروجين المضاف حتى ٩٠كجم/فدان حيث القيم فى الموسم الأول ١٠٠,٤ ، ١٠٢,٢ ، ١٠٥,٢سم وكانت فى الموسم الثانى ٩٨,٤ ، ١٠٤,٨ ، ١٠٤,٩سم تحت ٦٠ ، ٧٥ ، ٩٠كجم نيتروجين/فدان أيضا أوضحت البيانات أنه بزيادة جرعات السماد الحيوى المضافة زادت قيم طول النبات. أعلى القيم سجلت تحت المعدلات العالية للسماد المعدنى والحيوى وكانت القيم (١١٠,٥ ، ١١٠,١سم) ، فى الموسم الاول والثانى على الترتيب.
- متوسط القيم بالنسبه للفوسفور والنيتروجين فى نبات القمح فى كلا موسمى النمو زادت بزيادة جرعة السماد النيتروجينى المضافة حتى ٩٠كجم نيتروجين/فدان أيضا إضافة السماد الحيوى حتى ١٥٠٠ كجم/فدان كان لها تأثير إيجابى على محتوى النيتروجين والفوسفور فى النبات. وبناء عليه فقج سجلت أعلى القيم تحت المعدلات العالية من السماد النيتروجينى المضاف (٩٠كجم نيتروجين/فدان + إضافة ١٥٠٠ كجم سماد حيوى/فدان) فى كلا الموسمين.