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IMPACT OF FARMYARD MANURE AND SOME MINERAL FERTILIZERS ON SOME SOIL PROPERTIES AND ITS PRODUCTIVITY OF WHEAT

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ABSTRACT: ***The present study was carried out to investigate the effect of organic manure and mineral fertilizers on improving some soil properties and its production of wheat plants and its chemical composition. A field experiment was designed in clayey soils during the two winter seasons 2006/2007 and 2007/2008 at Kafer El-Akram village, Quesna region Minufiya Governorate.***

The experiments included twenty seven treatments which were reperesented by three rates from each of FYM (0, 10, 20 m^3/fed), P (0, 15, 30 kg P_2O_5/fed) and K as a foliar spraing (0, 1, 2% K_2O) added into the soil and plant individually and in a compination.

The yields, yield components and some chemical analysis of soil and plants after harvesting were recorded. Application of FYM at any rate improved the soil properties (reduced the bulk density, soil pH, EC and soluble sodium and chloride). However, markedely increased soil organic matter content, total porosity, availability of NPK and soluble Ca^{++} and $SO_4^{=}$. The highest rate of FYM surpassed the other treatments in enhancing the determined properties. The wheat grain and straw yields as well as their NPK contents and grain protein content significantly augemented by the application of FYM. Raising the FYM rate gradually increased the quantity and quality of wheat. All studies characteristics were significantly affected by P-fertilizer. The maximum values were attained from the plots received highest rate (30 kg P_2O_5/fed) of application. Foliar application of potassium led to significant response of all studied characteristics. The highest rate of K gave the highest increments for all the aforementioned parameters. Application of FYM, P-fertilizer and foliar spraying of K in combination at the highest rates gave the better nutritive content than the control plants.

Therefore, it could be concluded that the application of 20 m^3 FYM/fed + 30 kg P_2O_5/fed + 2% K_2O (400 L/fed) is the best formula for achieving the best crop and improving its mineral content.

Key words: ***FYM, P-fertilizers, Wheat plant, K Foliar spray, Soil properties***.

INTRODUCTION

Wheat is one of the main cereal crops grown in many parts of the world. In Egypt, wheat productivity is only about 30% of the domestic needs. This shortage is mainly related to many factors such as soil salinity and alkalinity, fertilization practices and cultivar variety. Increasing the soil PH towards

alkalinity affects the equilibra and availability of nutrients in soil specially phosphorus and micronutrients as well as plant disorders are raised (Marschner, 1998). To overcome this problem, attention has been paid to improve the quantity and quality of total production through improving the soil properties, good management of soil fertilization and foliar spraying of some fertilizers.

Organic matter application to soils is known to improve soil properties and consequently the plant growth. Among the types of organic matter, farmyard manure could be one of the most economical ways to increase organic matter content in soil. Several investigators indicated that the application of FYM increased plant growth and dry matter production (Khalil *et al.*, 2000). Organic fertilizer is considered as an important source of humus, macro and micro elements carrier and at the same time increase the activity of the useful microorganisms (El-Gizy, 1994). Dahdouh *et al.* (1999) found that organic manures play an important role in nutrients solubility as activate physiological and biochemical processes in plant leading to increase the plant growth and nutrients uptake. The best means of maintaining soil fertility and productivity level could be achieved through periodic addition of proper organic materials in combination with inorganic fertilizer (Sakr *et al.,* 1992).

Phosphatic fertilization is important for different crops. This, in fact due to the fundamental role of P in a large number of enzymatic reaction depending on phosphorylation and in the synthesis of various organic compounds in the plant (Nassar *et al.,* 2001). Moreover, P has an enhancing impact on plant growth and the resultant crop through its importance as energy storage and transfer necessary for the metabolic processes (Omran, *et al.*, 1999, Nassar, *et al.*, 2005).

Foliar fertilization is more economical than root application due to its higher utilization, which makes the nutrients more efficient. It can, also, be used to satisfy acute need of macroelements. Moreover, some of soil fertilization problems can only be solved by foliar fertilizer application (Alexander, 1986).

Although potassium is not a structural component of plants, it is one of the most important nutrients with respect to its physiological and biochemical functions. Potassium plays an important role in many of the vital physiological processes in the plant, such as transpiration, translocation of sugers and starch, protein formation and osmotic regulation. Several enzyme systems requiring potassium (e.g. pyruvate kinase, nitrate reductase and activation of ATP ase systems). Foliar potassium application might have an important effect in improving potato growth and increasing tuber yield and its quality (Abdel-Ati, 1998, El-Sawy *et al.* 2000 and Mahmoud *et al.*, 2004).

The present study was carried out to investigate the effect of organic manure and mineral fertilizers on improving of some soil properties and its productivity of wheat plants and its chemical composition.

MATERIALS AND METHODS

A field experiment was conducted at Kafer Al Akram village, Quesna region, Minufiya Governorate during the two winter growing seasons, 2006/2007 and 2007/2008, to study the effects of fertilization with organic manure and P or K mineral fertilizers on improving of some soil properties and its production of wheat plants. Soil samples (0 – 30 cm depth) were taken before the performance of the experiments. Some soil physical and chemical analyses were performed according to Richards (1954) and Jackson (1973), respectively and presented in Table (1).

Table (1): Some physical and chemical characteristics of the soils under investigation:

a): Physical properties

Season	Depth cm	OM %	Total $CaCO_3$ %	Bulk density g/cm^3	Total porosity %	Partical size distribution				
						Coarse sand	Fine sand	Silt	Clay	Texture class
2006/ 2007	0-30	1.6	2.10	1.28	47.60	2.40	17.7	26.7	53.3	Clayey
2007/ 2008	0-30	1.65	2.80	1.27	47.20	2.06	15.4	24.95	57.59	Clayey

b): Chemical properties:

Season	pH (1:2.5 susp.)	EC dSm^{-1}	Soluble ions in soil paste extract (m.e/l)								Available nutrients mg/kg^{-1}		
			Cations				Anions						
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO^{=}_3$	HCO^{-}_3	Cl^{-}	$SO^{=}_4$	N	P	K
2006/ 2007	7.7	2.30	6.92	5.40	10.40	0.39	-	3.28	10.89	8.83	42	13	79
2007/ 2008	7.8	2.40	7.80	5.10	10.10	0.20	-	5.10	8.00	10.20	45	15	86

The chemical properties of the used farmyard manure are presented in Table (2). Each experiment included twenty seven treatments which were the combinations of three rates of farmyard manure, three rates of P-fertilizer and K-fertilizer at three rates of foliar application.

Table (2): Chemical analysis of the used farmyard manure.

C%	Total N%	C/N ratio	OM%	Total %		Available mg/kg^{-1}		
				P	K	N	P	K
22.91	1.60	14.31	39.5	0.83	1.92	1106	1519	2018

The farmyard manure and P–fertilizer were mixed with the surface soil layer (0 – 30 cm depth). The layout of the experiment was split-split plot design with four replicates. Each replicate was divided into three main plots were treated with farmyard manure at 0, 10 and 20 m^3/fed. Each plot was randomly subdivided into three subplots which were treated with P-fertilizer

as calcium super phosphate (15.5% P_2O_5) at rates of 0, 15 and 30 kg P_2O_5/fed. Potassium fertilizer were foliar sprayed at 0, 1 and 2% K_2O (400 L/fed) as sub sub plots. Basic application of N at the rate of 75 kg/fed were applied to all plots in the form of ammonium salphate (20.5% N). The other usual cultural processes of wheat plants were practiced. The wheat grains cultivar (Gemmaza 9) at a rate of 60 kg/fed were drilled in rows of 15 cm apart within plots on 20th and 24th November for the 1st and 2nd seasons, respectively. At harvest, samples of soil were collected from the surface layer of each plot (0 – 30 cm). They were air dried, crushed, sieved through a 2 mm sieve and then analyzed for EC, pH, organic matter, soluble cations and anions and available nutrients N, P and K according to (Jackson, 1973). Bulk density, total porosity were determined according to (Black, 1965).

Also, twenty plants from every plot were randomly chosen to determine some yield attributes namely number of spikelets/spike, grain weight/spike, and 1000 grain weight. However, grain and straw yields were recorded on plot basis. Then, the corresponding values per feddan were estimated as ardab and ton/fed for grains and straw yields, respectively. N, P and K percentage of both wheat grains and straw were determined in wet digested extract using the methods described by Chapman and Pratt (1961). Crude protein in grains (kg/fed) was determined by multiplying the values of N-content in grains (kg/fed) by 5.7, according to A.O.A.C. (1980).

Results of wheat characters of the growing seasons gave nearly the same trend. So, the obtained data was statistically analyzed using the combined analysis of the two seasons, according to Gomez and Gomez (1984). The significant differences among means were tested using the least significant differences (L.S.D.) at 5% level of significance.

RESULTS AND DISCUSSION

Data recorded in this study represent the mean values of the two investigated seasons i.e. 2006/2007 and 2007/2008. Results showed the effect of farmyard manure, phosphatic fertilizer and potassium fertilizer as well as their interactions on improving of some soil properties and the yield and chemical composition of wheat plants.

[1] Effect of FYM on some soil properties :

Data presented in Table (3) cleared some physical and chemical analysis of the soil under investigation before planting and after the harvesting.

A-Soil reaction (pH):

It worthy to notice that the pH values were reduced with the application of FYM to the studied soil as compared to control. The high rate of FYM (20 m^3/fed) was the superior treatment. These finding are in agreement with those obtained by Abd El-Moez and Saleh (1999) and El-Ghamry *et al.,* (2004). There are arguments that the decrease in the soil PH due to the formation of organic and inorganic acids as a result of organic manure decomposition and more CO_2 was formed with increasing the metabolic activity of the root

system. The latter plays an important role as H^+ pumping which also contributes to the soil PH decrement (Kandel, 2003; Salem, 2003; El-Shouny, 2006 and Reda *et al.,* 2006).

B-Soil electrical conductivity (EC):

Data in Table (3) revealed that the initial EC values of the soils at the two seasons dropped at the end of the experiments as a result of FYM. In this respect FYM application at 20 m^3/fed was the most effective in decreasing EC. This may be due to the positive effect of active organic acids that are released from applied organic manure on soil aggregation as well as creating conductive pores that encouraged the leaching of the exess soluble salts (Reda *et al.*, 2006).

C-Soil organic matter (OM):

The obtained results in Table (3) showed that the application of FYM was increased the OM content as compared to the control. The increase of OM values were recorded with raising the FYM rates at the two seasons of application up to 20 m^3/fed. This data were in harmony with those recorded by Ali, *et al.* (2005) and El-Shouny, (2006).

D-Soluble ions of the soil:

Table (3) revealed that the values of soluble calcium and sulphate ions increased gradually as a results of applying FYM compared with control, while it sharply decreased Na^+ and Cl^- concentration. On the other hand, the application of FYM had no appreciable effect on the soluble Mg^{++} and HCO^-_3 ions. The same trend was recorded by Nassar *et al.* (2004); Salem *et al.,* (2004) and El-Shouny, (2006).

E-Bulk density (BD):

Data in Table (3) revealed that application of FYM improved soil bulk density, since it decreased it at any rate of addition. The relatively high value obtained of bulk density was observed for the soil without treatment. The beneficial effect of FYM in improving the bulk density is due to the increase of soil organic matter content which consequently encourages soil aggregate. This results are in harmony with those obtained by Abd El-Aziz *et al.,* (1998); Nassar *et al.,* (2004) and El-Shouny, (2006).

F-Total porosity % :

Concerning total porosity % the data in Table (3) cleared that the values of total porosity were increased with raising the applied rates of FYM up to 20 m^3/fed over the control. The same results were obtained by Borhamy, (1998); Abd El-Aziz *et al.* (1998); Salem, (2003) and El-Shouny, (2006).

G-Available nutrients:

Data in Table (3) showed that, the effect of FYM applied to the soil on its availability of N, P and K after harvesting of the two seasons. The data showed that the availability of these nutrients were increased with applied FYM in the treated soil at any rate compared to the control.

Table 3

The increase in available nitrogen over control could be attributed to the mineralized N from FYM. The results also indicated a decreasing trend in available nitrogen from before to after second season could be due to the removal of nitrogen by wheat plants and also, due to nutrient loss by leaching. For the available phosphorus, the increasing in available P over the control may be due to the phosphorus content of the applied FYM and also by increasing P solubility by means of FYM decomposition and applied P-fertilizer. The maximum increase recorded with the highest rate of application.

The results in Table (3) indicated an increase in available K in the treated soil over control. It may attributed to the release of K from FYM as well as applied K. The results obtained are in agreement with those obtained by Thind, *et al.,* 1993 and Mahmoud, 2006.

On the other hand, we know that, the application of mineral fertilizers by these amounts had no appreciable effect on the soil properties.

II: wheat productivity:

1. Effect of farmyard manure :

Data in Table (4) showed the effect of farmyard manure on yield components (number of spikelets/ spike, grain weight/ spike and 1000 grain weight), wheat yield/fed. (grain and straw) as well as some grain and straw mineral contents (N, P, K and crude protein). All studies characteristics were significantly affected by the application of farmyard manure. Raising the FYM rate gradually increased the quanitity and quality of wheat yield. The heighest rate of FYM (20 m^3/fed) induced the superior treatment for increasing yield components, wheat yield and some mineral composition. The positive impacts of FYM on wheat crop production and its mineral compositions are mainly due to improving the soil physical and chemical properties, preparing the suitable bed for germination and development of plant growth that reflect on resultant yield. Moreover, FYM is considered as an important source of humus, nacro and microelements carrier, and on the same time, increase the activity of the useful microorganisms. Similar results were gained by Salem (2003), Nassar *et al.* (2004), Ali *et al.* (2005) and El-Shouny (2006).

2. Effect of phosphatic fertilization:

Data obtained in Table (5) revealed that the effect of phosphatic fertilizer on yield attributes, grain and straw yields as well as NPK contents of either wheat grain or straw and grain crude protein. All studies characteristics were significantly affected by the application of P-fertilizer except number of spikelets/ spike. The maximum values were attained from the plots received highest rate (30 kg P_2O_5/fed) compared with those attained with the others. The increase in both grain and straw yields was mainly related to the enhancing effect of P-fertilization on the yield components.

Table 4

Table 5 - 6

The results also showed that the plants adequately supplied with P achieved more yield attributes, grain and straw yields as well as better NPK and crude protein contents in comparison to those didn't adequately supply with phosphorus, these results are in agreement with Nassar *et al.,* (2005) and Reda *et al.,* (2006).

The promoting impact of P on the wheat yield and its meniral composition may be due to the fundamental role of P in all important nucleoproteins and a large number of enzymatic reactions that depend on phosphorylation (Nassar and Ismail, 1999). Likewse, the role of phosphorus element as an essential component of the energy transfer compounds, genetic information system, cell membranes and phosphoproteins.

3. Effect of potassium fertilization:

Data in Table (6) cleared that foliar application of potassium led to significant response of all studies characteristics. Increasing the rate of potassium application gradually increased the quantity and quality of wheat yield. In this concern, the highest rate of potassium (2%) gave the highest increments for all the aforementioned perameters. The beneficial effects of potassium may be attributed to the effect of potassium on some physiological and biochemical functions. El-Sawy *et al.* (2000) revealed that foliar K application twice at concentration of 1% K_2O to potato plant caused a significant increase in stem length, number of main stems and number of leaves per plant. Mahmoud *et al.* (2004) found that foliar K application at the concentration of 1% K_2O (400 L/fed) might have an important effect in improving potato growth and increased tuber yield and its quality compared with the K fertilization as soil application.

4. Interaction effect between FYM and P-fertilizers:

Data in Table (7a) indicated that the all examined parameters except 1000 grain weight and nitrogen content in straw were significantly responded to FYM with P-fertilizer. The values recorded with 10 m^3 FYM and 15 kg P_2O_5/fed surpassed the values recorded with 10 m^3 FYM and 30 kg P_2O_5/fed. The highest increments for all examined parameters were observed by treating the soil with 20 m^3 FYM and 30 kg P_2O_5/fed. These results are in harmony with those obtained by Patil and Biradar (2001) who reported that application of P+FYM to pepper produced the highest yield compared to organic or inorganic fertilizer applied alone. Similar results were gained also by El-Zawity *et al.* (2002) and Ewais *et al.* (2004).

5. Interaction effect between FYM and foliar spraying with K-fertilizer:

Data recorded in Table (7b) indicated that all studied parameters except grain weight of spike, 1000 grain weight and nitrogen content in straw significantly responded to foliar spraying with K-fertilizer under the three rates of FYM.

Table 7 a

Table 7 b

Table 7 c

Table 8

The obtained values for all studied parameters were increased by increasing the rates of both FYM and K-fertilizer. In this respect, the highest increments were attained with the highest rates of application. Similar results were gained by Mahmoud *et al.,* (2004).

6. Interaction effect between P-fertilization rates and foliar spraying with potassium:

Data in Table (7c) declared that there were insignificant differences between the investigated fertilizers concerning yield attributes as well as nitrogen content of wheat straw, where there were significant differences between the other examining parameters with the investigated fertilizers. Raising the rates of application of both P and K fertilizer gradually increased the quantity and quality of wheat yield. The height rates of both P and K fertilizers was the superior treatments for increasing yield components, wheat yield, mineral compositions and grain crude protein.

7. Interaction effect between FYM, P-fertilization rates and foliar spraing of potassium:

Data presented in Table (8) clearly showed that significantly increments for all aforementioned parameters were scored with the application of FYM, P-fertilization and spraying with potassium except 1000 grain weight and nitrogen content in straw. The superior treatment for the FYM x P. fertilizer x K foliar application was appling the highest rates of all of them.

CONCLUSION

1-Appliation of 20 m^3 FYM is the most effective rate compared with the other ones, under the condition of this experiment.

2-Application 30 kg P_2O_5 of P-fertilization as sake of producing the highest grain and straw yields, improving their nutritive contents and obtaining the highest content of grain protein.

3-Spraying the wheat plants with 2% potassium achieved the highest values of grain and straw yields and their NPK contents.

4-Application of 20 m^3 FYM as a soil amendment, with 30 kg P_2O_5/fed and spraying the wheat plants with 2% potassium, simultaneously gave an additional promoting effect on both quantity and quality of wheat crop.

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تأثير إضافة السماد العضوى وبعض الأسمدة المعدنية على بعض خواص الأرض وإنتاجيتها لمحصول القمح

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الملخص العربى

أجرى هذا البحث لدراسة تأثير إضافة السماد العضوى وبعض الأسمدة المعدنية على خواص الأرض وإنتاجية محصول القمح النامى فى هذه الأراضى وتحسين صفاته . ولتحقيق هذا الهدف أجريت تجربة حقلية على أرض طينية فى قرية كفر الأكرم . مركز قويسنا . محافظة المنوفية، خلال موسمى النمو الشتويين المتتاليين ٢٠٠٦/ ٢٠٠٧ ، ٢٠٠٧/٢٠٠٨ . اشتملت التجربة على سبعة وعشرون معاملة ممثلة كل منها فى أربعة مكررات استخدم فيها السماد العضوى (صفر ، ١٠ ، ٢٠ م^{٣}/فدان) وسماد السوبرفوسفات بمعدلات (صفر ، ١٥ ، ٣٠ كجم فو$_{٢}$أ$_{٥}$/فدان) على الترتيب والرش بعنصر البوتاسيوم بتركيز (صفر ، ١ ، ٢% جم/لتر بو$_{٢}$أ) بمعدل ٤٠٠ لتر/فدان .

وقد أدت معاملات التجربة الى أن إضافة السماد العضوى الى تحسين خواص الأرض حيث انخفضت قيم كل من الكثافة الظاهرية ورقم الحموضة (pH) ودرجة التوصيل الكهربى (EC) وكلا من أيونات الصوديوم والكلوريد الذائبين . بينما زادت قيم كل من المسامية الكلية للتربة وكذلك محتوى التربة من المادة العضوية وعناصر NPK الميسرة وكذلك زيادة كل أيونات الكالسيوم والكبريتات الذائبة ، وقد تفوق المستوى الأعلى من السماد العضوى فى تأثيرة على القياسات السابقة عن باقى المعاملات

كذلك كان هناك استجابة معنوية لمحصولى الحبوب والقش لنبات القمح وكذلك المحتوى العنصرى لكل منهما ومحتوى الحبوب من البروتين لإضافة السماد العضوى وكانت الزيادة متدرجة مع زيادة معدلات الاضافة .

وأيضا أدت إضافة السماد الفوسفاتى الى زيادة معنوية فى المحصول ومكوناته وتحققت أفضل النتائج مع المستوى الأعلى من الإضافة .

أظهر محصول الحبوب والقش وكذلك المحتوى العنصرى ومحتوى الحبوب من البروتين استجابة معنوية للرش بعنصر البوتاسيوم واعطى المستوى الأعلى من الرش أعلى زيادة فى جميع صفات المحصول المدروسة .

أدت المستويات الأعلى من السماد العضوى والسماد الفوسفاتى والرش بالبوتاسيوم متحدة معاً أفضل النتائج المتحصل عليها .

ومن ثم يمكن القول بأنه تحت ظروف هذه التجربة يمكن تحسين خواص هذه الأرض وزيادة إنتاجيتها من القمح وذلك بإضافة ٢٠ م^{٣} من السماد العضوى و ٣٠ كجم فو$_{٢}$أ$_{٥}$ لكل فدان ورش البوتاسيوم بتركيز ٢% بو$_{٢}$أ بمعدل ٤٠٠ لتر/فدان.

Table (3): Effect of farmyard manure on some physical and chemical properties of the soils under investigation.

Soil properties FYM m^3/fed	OM %	pH (1:2.5 susp.)	Bulk density g/cm^3	Total porosity %	EC dS/m	Soluble ions in soil paste extract								Available nutrients mg/kg^{-1}		
						Cations				Anions						
						Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$Co_3^{=}$	HCO_3^{-}	Cl^{+}	$SO_4^{=}$	N	P	K
2006/2007 season																
0	1.60	7.70	1.28	47.60	2.30	6.92	5.40	10.40	0.39	-	3.28	10.89	8.83	28	13	79
10	1.71	7.40	1.22	47.18	2.16	8.18	4.41	8.54	0.47	-	3.50	8.31	9.79	35	48	105
20	1.79	7.20	1.20	48.05	2.02	8.36	4.11	7.27	0.46	-	3.50	6.62	10.08	43	65	132
2007/2008 season																
0	1.65	7.80	1.25	47.50	2.40	7.80	5.10	10.10	0.20	-	4.10	11.00	8.20	18	15	86
10	1.78	7.60	1.19	48.48	2.05	8.68	4.07	7.20	0.55	-	3.40	7.32	9.78	26	83	123
20	1.84	7.40	1.17	49.35	1.85	9.13	4.52	4.26	0.59	-	3.65	5.32	9.53	37	121	165

Table (4): Effect of FYM on the yield, yield components and some chemical compositions of wheat plants, (combined analysis of 2006/2007 and 2007/2008 growing seasons).

FYM m^3/fed	Yield components				Yield /fed		Chemical compotions kg/fed									
	Number of spikelets /spike	Grain weight / plant (g)	Grain weight/ plant (g)	1000 grain weight (g)	Grain (ardab)	Straw (ton)	Nitrogen			Phosphorus			potassium			Grain crude protein
							Grain	Straw	Whole plant	Grain	Straw	Whole plant	Grain	Straw	Whole plant	
0	16.00	2.36	37.73	40.45	11.97	2.98	33.41	7.29	40.70	3.70	3.19	6.89	5.43	13.28	18.71	190.44
10	17.00	2.87	48.79	44.63	15.36	4.00	47.17	11.59	58.76	4.20	4.12	8.32	8.87	19.57	28.44	268.87
20	18.33	2.97	54.44	46.62	16.21	4.24	49.85	12.88	62.74	5.10	5.51	10.61	10.09	21.46	31.55	284.84
L.S.D. at 0.05	0.28	0.06	0.30	1.94	0.11	0.061	1.09	1.13	1.93	0.22	0.04	0.17	0.15	0.38	0.43	3.7

Table (5): Effect of P-fertilizer rates on the yield, yield components and some chemical compositions of wheat plants, (combined analysis of 2006/2007 and 2007/2008 growing seasons).

P_2O_5 kg/fed	Yield components				Yield /fed		Chemical compotions kg/fed									
							Nitrogen			Phosphorus			potassium			Grain crude protein
	Number of spikelets /spike	Grain weight / plant (g)	Grain weight/ plant (g)	1000 grain weight (g)	Grain (ardab)	Straw (ton)	Grain	Straw	Whole plant	Grain	Straw	Whole plant	Grain	Straw	Whole plant	
0	17.00	2.60	44.49	41.75	13.11	3.09	36.80	9.46	46.16	2.44	2.32	4.75	7.46	16.99	24.45	209.76
15	17.00	2.76	47.25	44.20	14.97	3.76	44.24	10.32	54.56	4.57	4.33	8.90	8.13	17.54	25.67	252.16
30	17.30	2.83	49.91	45.74	15.18	4.17	49.37	12.09	61.47	5.45	6.16	11.62	8.81	19.78	28.59	281.40
L.S.D. at 0.05	NS	0.03	0.04	1.28	0.11	0.064	1.15	1.12	1.71	0.17	0.04	0.18	0.14	0.36	0.39	2.8

Table (6): Effect of foliar spraying of potassium on yield, yield components and some chemical compositions of wheat plants, (combined analysis of 2006/2007 and 2007/2008 growing seasons).

K_2O %	Yield components				Yield /fed		Chemical compotions kg/fed									
							Nitrogen			Phosphorus			potassium			Grain crude protein
	Number of spikelets /spike	Grain weight / plant (g)	Grain weight/ plant (g)	1000 grain weight (g)	Grain (ardab)	Straw (ton)	Grain	Straw	Whole plant	Grain	Straw	Whole plant	Grain	Straw	Whole plant	
0	15.33	2.32	35.65	38.05	11.81	2.62	34.01	6.65	40.66	2.92	2.71	5.63	4.49	10.81	15.30	194.30
1	17.33	2.82	48.92	44.86	15.22	4.25	45.22	11.93	57.15	4.36	4.86	9.22	8.99	20.28	29.27	257.70
2	18.77	2.95	55.17	48.78	16.77	4.46	50.97	13.43	64.40	5.20	5.43	10.63	11.21	24.38	35.59	290.50
L.S.D. at 0.05	0.27	0.04	0.28	1.64	0.18	0.053	1.05	1.07	1.23	0.18	0.04	0.20	0.14	0.34	0.36	2.9

Table (7): Yield component , grain and straw yields as well as some chemical compositions of weat plants as affected by:

a) Farmyurd manure X P-fertilization rates interactions.

FYM m^3/fed	P_2O_5 kg/fed	Yield components				Yield /fed		Chemical compotions kg/fed									
								Nitrogen			Phosphorus			potassium			Grain crude protein
		Number of spikelets /spike	Grain weight / plant (g)	Grain weight / plant (g)	1000 grain weight (g)	Grain (ardab)	Straw (ton)	Grain	Straw	Whole plant	Grain	Straw	Whole plant	Grain	Straw	Whole plant	
0	0	15.00	2.42	36.30	38.04	10.48	2.43	23.38	5.97	29.35	1.68	1.64	3.32	4.67	11.10	15.77	133.26
	15	16.00	2.32	37.12	40.55	12.38	3.00	34.11	7.17	41.28	2.24	3.03	6.27	5.70	13.22	18.92	194.42
	30	17.00	2.34	39.78	42.77	13.05	3.52	42.73	8.75	51.48	4.54	4.90	9.44	5.94	15.54	21.48	243.56
10	0	17.00	2.62	44.54	42.18	14.07	3.52	37.26	9.69	46.95	2.56	2.82	5.38	7.48	18.52	26.00	212.38
	15	18.00	3.16	56.88	45.83	17.19	4.40	53.76	12.66	66.42	5.25	4.58	9.83	9.94	19.60	29.54	306.43
	30	16.50	2.83	46.69	45.88	14.84	4.08	50.48	12.43	62.91	4.81	4.96	9.77	9.21	20.59	29.80	287.73
20	0	17.00	2.81	47.77	45.05	15.34	3.89	44.86	11.13	55.99	3.08	2.49	5.57	8.76	18.15	26.91	255.70
	15	19.00	2.77	52.63	46.23	15.64	3.92	49.78	12.42	62.20	5.21	5.40	10.61	10.23	23.02	23.25	283.74
	30	19.00	3.33	63.27	48.59	17.65	4.93	54.92	15.11	70.03	7.02	8.64	15.66	11.28	23.23	34.51	313.04
L.S.D. at 0.05		0.66	0.06	0.61	NS	0.49	0.11	1.99	NS	1.32	0.30	0.07	0.29	0.24	0.62	0.65	3.77

Table (7): Con.
b) Farmyurd manure X foliar spraying of potassium interactions.

FYM m^3/fed	K_2O %	Yield components				Yield /fed		Chemical compotions kg/fed									
								Nitrogen			Phosphorus			potassium			Grain
		Number of spikelets /spike	Grain weight / plant (g)	Grain weight / plant (g)	1000 grain weight (g)	Grain (ardab)	Straw (ton)	Grain	Straw	Whole plant	Grain	Straw	Whole plant	Grain	Straw	Whole plant	crude protein
0	0	14.66	1.88	27.56	35.90	10.12	2.19	27.55	4.83	32.38	2.40	2.20	4.60	3.39	8.18	11.57	157.03
	1	16.16	2.62	42.33	41.63	12.35	3.32	34.44	8.02	42.46	3.23	3.50	6.73	5.67	14.78	20.45	196.30
	2	17.16	2.59	44.44	43.83	13.43	3.44	37.56	9.03	46.59	3.83	3.89	7.72	7.24	16.92	24.16	214.09
10	0	15.16	2.46	37.29	38.49	12.07	2.66	35.56	6.76	42.32	2.92	2.50	5.42	4.40	11.05	15.45	202.69
	1	17.66	2.71	47.85	45.11	15.54	4.48	48.33	9.59	57.92	4.17	4.52	8.69	9.58	20.69	30.27	275.48
	2	19.33	3.11	60.11	49.85	18.49	4.87	57.61	15.08	72.69	5.52	5.32	10.84	12.65	26.97	39.62	328.37
20	0	16.16	2.63	42.55	39.30	13.24	3.03	38.93	8.37	47.30	3.69	3.57	7.26	5.28	12.35	17.63	221.90
	1	18.16	3.14	57.02	47.90	16.99	4.64	52.88	14.10	66.98	5.35	5.88	11.23	11.25	22.80	34.05	301.41
	2	19.83	3.19	63.05	52.66	18.41	5.05	57.76	16.18	73.94	6.26	7.07	13.33	13.74	29.25	42.99	329.23
L.S.D. at 0.05		0.46	NS	0.17	NS	0.31	0.092	1.81	NS	1.13	0.30	0.06	0.24	0.25	0.58	0.62	2.51

Table (7): Con.
c) Phosphorus fertilization rates X foliar spraying of potassium interactions.

P_2O_5 kg/fed	K_2O %	Yield components				Yield /fed		Chemical compotions kg/fed									
								Nitrogen			Phosphorus			potassium			Grain crude protein
		Number of spikelets /spike	Grain weight / plant (g)	Grain weight / plant (g)	1000 grain weight (g)	Grain (ardab)	Straw (ton)	Grain	Straw	Whole plant	Grain	Straw	Whole plant	Grain	Straw	Whole plant	
0	0	15.16	2.23	33.85	36.39	11.18	2.30	29.22	5.71	34.93	1.86	1.46	3.32	4.13	9.88	14.01	166.55
	1	17.00	2.79	47.48	42.30	13.56	3.53	37.49	9.81	47.30	2.46	2.60	5.06	7.84	18.77	26.61	213.69
	2	18.50	2.79	51.73	46.58	15.77	4.04	43.71	12.55	56.26	2.99	2.88	5.87	10.40	24.02	34.42	249.14
15	0	15.16	2.35	35.67	38.05	11.77	2.64	33.84	6.56	40.40	3.13	2.75	5.88	4.24	10.42	14.66	192.88
	1	17.33	2.96	51.29	45.71	15.28	4.20	45.43	11.48	56.91	4.63	4.62	9.25	8.69	17.84	26.53	258.95
	2	18.83	2.98	56.11	48.85	17.85	4.44	53.46	12.91	66.37	5.94	5.64	11.58	11.48	22.72	34.20	304.72
30	0	15.66	2.39	37.42	39.69	12.47	2.93	38.99	7.70	46.69	4.02	4.06	8.08	4.70	11.28	15.98	222.24
	1	17.66	2.71	47.97	46.64	16.04	4.71	52.72	13.76	66.48	5.66	6.68	12.34	9.98	21.67	31.64	300.50
	2	19.00	3.10	58.96	50.90	17.03	4.88	55.75	14.83	70.58	6.68	7.77	14.45	11.74	26.41	38.15	317.77
L.S.D. at 0.05		NS	NS	NS	NS	0.31	0.092	1.81	NS	1.27	0.30	0.06	0.32	0.25	0.58	0.69	3.31

Table (8): Interaction effect between FYM, P-fertilization rates and spraying of potassium on yield components and grain & straw yields as well as some chemical compositions of wheat plants (combined analysis of 2006/2007 and 2007/2008 growing seasons) .

FYM m^3/fed	P_2O_5 kg/fed	K_2O %	Yield components				Yield /fed		Chemical compotions kg/fed									
									Nitrogen			Phosphorus			Potassium			Grain crude protein
			Number of spikelets /spike	Grain weight / plant (g)	Grain weight / plant (g)	1000 grain weight (g)	Grain (ardab)	Straw (ton)	Grain	Straw	Whole plant	Grain	Straw	Whole plant	Grain	Straw	Whole plant	
	0	0	14.00	2.52	28.28	23.87	9.63	10.84	21.38	3.87	25.25	1.45	1.11	2.56	3.03	6.82	9.85	121.86
		1	15.50	2.57	39.83	39.93	10.61	2.42	23.56	5.55	29.11	1.75	1.69	3.44	4.93	11.15	16.53	134.29
		2	16.50	2.69	44.38	41.34	11.2	3.53	25.2	8.49	33.69	1.85	2.12	3.97	6.03	15.48	21.52	134.64
0	15	0	15.00	1.91	28.65	36.35	10.09	2.26	27.85	4.97	23.82	2.32	2.03	4.45	3.48	8.59	21.07	158.74
		1	16.50	2.58	41.28	41.11	12.88	3.32	35.56	7.96	43.52	3.28	3.31	6.59	5.78	14.26	20.04	202.69
		2	17.00	2.48	42.16	44.25	14.18	3.43	38.92	8.57	47.49	4.04	3.77	7.81	7.86	16.8	24.66	221.84
	30	0	15.00	1.72	25.8	38.54	10.64	2.47	33.43	5.67	39.1	3.35	3.46	6.81	3.67	9.13	12.8	190.55
		1	17.00	2.71	46.07	43.87	13.58	4.23	44.2	10.57	54.77	4.68	5.5	10.18	6.31	19	25.31	251.94
		2	18.00	2.6	46.8	45.91	14.92	3.86	48.56	10.54	58.59	5.6	5.79	11.39	7.83	18.5	26.33	276.79
	0	0	15.50	2.28	35.34	37.25	11.32	2.42	29.05	5.59	34.64	1.87	1.69	3.56	4.08	10.41	14.49	165.58
		1	17.00	2.81	47.77	41.75	14.24	3.88	37.59	10.09	47.68	2.56	3.1	5.66	7.9	20.18	28.08	213.26
		2	19.00	2.79	53.01	47.55	16.63	4.31	45.15	13.35	58.5	3.24	3.66	6.9	10.47	24.98	35.45	257.35
10	15	0	15.00	2.802	42	39.7	12.82	2.78	38.65	7.21	45.86	3.46	2.77	6.23	4.42	10.81	15.23	220.3
		1	19.00	3.14	59.66	47.58	16.82	5.02	53.51	14.56	68.07	5.05	5.02	10.07	10.6	20.5	31.1	305
		2	21.00	3.53	74.13	50.22	21.94	5.41	69.13	16.23	85.36	7.24	5.95	13.19	14.81	27.5	42.31	344.54
	30	0	15.00	2.30	34.50	39.85	12.09	2.78	39.00	7.50	46.50	3.44	3.05	6.49	4.71	11.94	16.65	222.30
		1	17.00	2.18	37.06	46.01	15.56	4.56	53.91	14.12	68.03	4.90	5.46	10.36	10.26	21.41	31.67	307.28
		2	18.00	3.02	52.36	51.80	16.90	4.90	58.55	15.68	74.23	6.08	6.37	12.45	12.67	28.43	41.10	333.73
	0	0	16.00	2.40	38.40	39.06	12.60	2.65	37.23	7.67	44.90	2.27	1.58	3.85	5.29	12.43	17.72	212.21
		1	18.50	3.00	55.50	45.22	15.84	4.31	51.34	13.80	65.14	3.09	3.02	6.11	10.69	25.03	35.72	292.63
		2	20.00	2.91	58.20	50.87	18.51	4.79	60.79	15.81	76.60	3.88	2.87	6.75	14.71	31.60	46.31	346.50
20	15	0	15.50	2.35	36.42	38.16	12.42	2.89	35.02	7.51	42.53	3.53	3.46	6.99	4.84	11.85	16.69	199.61
		1	17.00	3.16	53.72	48.44	16.15	4.26	47.24	11.93	59.17	5.57	5.54	11.11	9.69	18.76	28.45	269.26
		2	18.50	2.94	54.39	52.10	17.44	4.50	52.34	13.95	66.33	6.54	7.20	13.74	11.77	23.86	35.63	298.33
	30	0	17.00	3.15	53.55	40.70	14.70	3.55	44.54	9.94	54.48	5.29	5.68	10.97	5.73	12.78	18.51	253.87
		1	19.00	3.26	61.94	50.06	18.98	5.35	60.07	16.59	76.66	7.40	9.10	16.50	13.38	24.62	38.00	342.39
		2	21.00	3.69	77.49	55.01	19.28	5.88	60.15	18.80	78.95	8.38	11.16	19.54	14.74	32.31	47.05	342.85
L.S.D. at 0.05			0.81	0.13	0.62	NS	0.54	0.16	3.13	NS	NS	0.53	0.11	0.17	0.43	1.00	0.73	2.63