IMPROVING WHEAT PRODUCTIVITY BY FARMYARD MANURE WITH PHOSPHORUS FERTILIZER SOURCES IN CLAYEY SOIL

Osman, E.A.M., A.A. Khalil and A.A. El- Masry
Soils, Water and Environ. Res. Inst., Agric. Res. Centre, Giza, Egypt

ABSTRACT

A field experiment was carried out at Bahtim Agricultural Research Station Farm during 2010/2011 and 2011/2012 seasons. The experimental site is located at lat. 30.80, long 31.16 and 14.00 m above the mean sea level, to study the effect of farmyard manure (FYM) application rates (zero, 12 and 24 t/ha.) as well as phosphorus fertilizer at the rate of 15% P_2O_5 with three sources i.e. without, supper phosphate (15 % water soluble P_2O_5) and rock phosphate (6.25 %P_2O_5 as a total form) on yield and its some attributes as well as macronutrients uptake and protein percentage of wheat variety (Giza 168).

The obtained results could be summarized as follows:

1- The highest significant values of grain, straw and biological yield as well as N, P, and K uptake of such yields, in addition protein % of wheat grain were recorded by adding FYM compared to without FYM addition in both seasons.
2- Generally, in most cases, supper phosphate gave the best significant values of all parameters under this study followed by the rock phosphate in both seasons. While, the lowest ones were observed without P source addition in both ones.
3- Maximum FYM rate, with supper phosphate significantly improved such parameters in the both seasons. Similar trend was recorded by the same rate of FYM with rock phosphate for most parameters under this study. On the contrary, the lowest ones were recorded without addition FYM and without P source in the both seasons. So, the phosphorus availability from either both P sources can be enhanced if it is mixed with farmyard manure. Since it increases availability and efficiency of P and enhances wheat yield and its quality.

Key words: Improving Wheat Productivity, Farmyard Manure, Phosphorus Fertilizer.

INTRODUCTION:

Wheat (*Triticum aestivum* L.) is cultivated worldwide primarily as a food and a strategic commodity. Globally, wheat is the leading source of crop protein in human food, having higher protein content than either maize (corn) or rice, the other major cereals **(FAO, 2004)**. Egypt is one of the major world's importers of wheat. Wheat is considered the most important food crop in Egypt, where its production of about 8.27 million tons in 2005/2006 season was obtained from 3.06 million feddans **(FAO, 2005).** However, the annual domestic requirements of wheat are about 11 million tons. To increase the wheat production especially, good fertilization management is needed. Organic manure and phosphorus are ones of the major nutrients affecting grains and straw yields of wheat crop **(El-Sherbieny, *et al*., 1999).**

One environmentally friendly and economically feasible strategy to maintain high crop productivity without increasing P fertilization rates is the integration of organic and inorganic P sources. Organic fertilizers have equivalent or even better effects on crop yields than P from mineral sources (**Sharpley, 1996)**. Besides serving as a source of nutrients itself, organic fertilization can improve the availability of P in soil, due to the influence on chemical, physical, and biological soil properties. (**Iyamuremye *et al*.**, **1996a** & **1996b**) related the reduction of P-sorption capacity induced by organic fertilization to changes of soil chemical properties (e.g., pH and exchangeable Al) and to complexation of P-sorption sites at reactive surfaces. Organic-matter supply to the soil is one of the most important factors for increasing the productivity in plant, with organic P as a significant part of the soil P cycle contributing to P nutrition of plants (**Richardson, *et al*., 2005**). Organic fertilization increases the humus content (**Hartl and Erhart, 2005**) and enhances the microbiological activity in soil (**Kihanda, *et al.*, 2006, Zingore, *et al*., 2008 and Ramesh, *et al*., 2009**). The importance of the use of organic sources of nutrients along with chemical fertilizers for maintaining soil health has been emphasized by **Singh *et al*. (2011).**

Phosphorus is necessary for all forms of life because of its genetic role in RNA and energy transformation by ATP. It is a factor for shorter growth period especially in cereals. Phosphorus deficiency effects metabolic processes such as transforming sugar to starch, and causes the production of anthocyanin. Phosphate fertilizers soon after spreading in the land, transform to low soluble or insoluble form. Only 15 to 20% of phosphate fertilizer is available and a small portion of it will be taken up by plants. Roots can deplete or concentrate mineral phosphorus in the rhizosphere, and so change phosphorus availability (**Havlin *et al.* 2004 and Hossein, *et al*., 2010).** In favourite to more sustainable agriculture, the study is aiming to get the most benefits of phosphate fertilizers in alkaline clay loam soil. This type of soil transforms the soluble calcium superphosphate to insoluble forms which are unavailable for plants. This phenomenon is quite famous by using the chemical calcium superphosphate fertilizer or with using natural rock phosphates individually in alkaline soils. This would lead farmers to add more supplementary chemical doses from phosphate fertilizers to avoid building up phosphor deficiency which affect plants by lowering their yield and quality. Furthermore, it will lead to put higher fertilization costs that interfere with sustainable agriculture concepts (**Abou El-Yazeid and Abou-Aly, 2011)**. Phosphorus is usually supplied to the plant in many different forms some of which are manufactured, i.e., phosphoric acid and calcium super phosphate, while some others are common in nature form such as rock phosphate. The appropriate utilization of rock phosphate (RP) as P source can contribute to sustainable agricultural intensification, particularly in developing countries endowed with RP resources, in addition to minimizing environmental pollution in countries where RP is processed industrially. The RP products are an agronomically and economically sound alternative P input to manufactured superphosphates (**Zapata and Roy, 2004; Schneider *et al*., 2010)**.

Therefore, the present investigation is to study the effect of farmyard manure incorporation with or without phosphorus fertilization sources to improve the quantity and quality of wheat plant under clayey soil of Egypt.

MATERIALS AND METHODS

A field experiment was conducted during the winter season of 2010/ 2011 and 2011/2012 mainly for getting some appropriate practices regarding the effect of farmyard manure rates and phosphate fertilizer sources on yield and its components as well as nutrients uptake of wheat plant. The sites for laying out the experiment were carried out in Bahtim Agricultural Research Station farm. The experimental site is located at lat. 30.80, long 31.16 and 14.00 m above the mean sea level. Some revenant physical and chemical properties of the experimental soils and farmyard manure are listed in Tables (1) and (2) which were measured and determined according to **Ryan *et al*., (1996)**

Table (1): Mechanical and chemical analysis of the used soil.

Characters		2010/2011	2011/2012
Particle size distribution	Coarse sand %	2.6	2.25
	Fine sand %	14.4	5.75
	Silt %	35	40
	Clay %	48	52
	Textural class	Clay	Clay
pH (1:2.5) in soil suspension		7.54	7.45
$CaCO_3$ (%)		2.64	2.72
EC_e (dSm^{-1}) in soil paste		0.96	1.02
Soluble cations meq/l (in soil paste extract)	Ca^{+2}	3.68	3.76
	Mg^{+2}	2.72	2.89
	Na^{+}	2.79	2.81
	K^{+}	0.47	0.56
Soluble anions meq/l (in soil paste extract)	HCO_3^{-}	2.61	2.72
	Cl^{-}	2.84	2.96
	SO_4^{--}	4.21	4.34
Available nutrients ppm	N	46.25	39.35
	P	3.60	4.55
	K	382.40	368.25

Table (2): Some chemical analysis of the used manure

Season	Parameters										
	*EC_e (dSm^{-1})	**pH	O C %	OM %	C/N ratio	N	P	K	Fe	Mn	Zn
						%			ppm		
2010/2011	1.42	6.45	28.84	49.89	17.17	1.68	1.14	1.69	385	94	80
2011/2012	1.46	6.125	27.30	47.30	15.87	1. 72	1.09	1.64	390	89	83

*manure paste ** manure suspension 1: 2.5

Wheat grains (Giza 168) were sown at the rate of 142.8 kg/ha., on the 20th and 26th of November, 2010 and 2011, respectively.

The experiment was arranged in a split plot design with three replications of 10.5 m^2 in which the main treatments were devoted for farmyard manure rates while the sub-ones included phosphate fertilizer sources. Such treatments were as follows:

Farmyard manure rates:

Farmyard manure rates i.e., FYM_1, FYM $_2$, and FYM $_3$ which were zero, 12 and 24 t/ha., respectively.

Phosphorus sources:

The phosphorus fertilizers were applied in the three forms, i.e., 100 kg superphosphate (15% water soluble P_2O_5), 240kg rock phosphate (6.25% total

P_2O_5) and no addition of P fertilizer. The phosphorus fertilizers were mixed with farmyard manure, and then added with preparation time before planting.

The ammonium nitrate and potassium sulphate was added to all experimental plots by rates of 178 kg N and 57 kg K_2O/ha., respectively after 25 and 49 days of planting for nitrogen fertilizer, while potassium sulphate was added with preparation time before planting. All cultural practices were carried out according to usual methods being adopted for such crop.

At the maturity stage, ten plants were randomly taken from each plot to study the following characters:- plant height (cm), grain number/ spike, grain weight /plant (g) and 1000 grain weight. The plants were harvested and separated into grains and straw. Grain yield was calculated by harvesting whole plants in each plot and left to dry in air, then they were threshed and the grains (which were at 13% moisture) were weighed (kg), and then converted to t/ ha. The straw resulted from each experimental plot was weighed in kg, and then it was converted to t/ha. Samples were dried at 70C, ground and wet digested. Nitrogen was determined using modified kjeldahl method, recorded then, the grains protein percentage was calculated. Phosphorus was determined calorimetrically using ammonium molybdate and ammonium metavanadate according to the procedure outlined by **Ryan *et al*., (1996).** Potassium was determined using the flame spectrophotometer method **(Black, 1982)**. Protein percentage in wheat grains was calculated by multiplying N % by 5.75.

All data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the Randomize Complete Block Design (RCBD) using M-STATC computer software package according to **Gomez and Gomez (1984).** Least Significant Difference (LSD) method was used to test the differences between treatment means at 5% level of significance.

RESULTS AND DISCUSSION

Some yield attributes

Data presented in Table (3) show that the plant height and grain weight/spike increased significantly by increasing farmyard manure (FYM) at the rate of 24 t/ha., while, the lowest ones were recorded by without addition or the low level of FYM in the first season only. On the other hand, the treatment of without addition of FYM gave the highest significant value of 1000 grain weight, whereas, the lowest one was observed by increasing farmyard manure rates in the second season. Vice versa, other parameters weren't affected with applying FYM. Applications of farmyard manure add nutrients to the soil and thus decreasing the total dependence on chemical fertilizer increases P availability. Also, the application of farmyard manure helps the microorganisms to produce polysaccharides, which improve the soil structure. Furthermore, FYM not only acts as a source of plant nutrients and energy for microorganisms but also influence the availability of native nutrients and the soil permeability as well as improves water holding capacity. Similar results were observed by **(Kihanda, *et al*., 2006, Zingore, *et al*., 2008 and Ramesh, *et al*., 2009)**

For the effect of phosphorus sources on such parameters, results reveal that the 1000 grain weight was increased by using rock phosphate or without P addition, meanwhile, the lowest one was obtained when supper phosphate was practiced in the second season only. On the contrary, other parameters weren't affected with applying phosphorus fertilizers level in both seasons.

Table 3

With regard to the interaction effect of farmyard manure rates and phosphorus fertilizers sources on such parameters, the plant height was increased significantly by mixing the high level of FYM 24 t/ha., with any P sources or combination the 2nd level of FYM 12 t/ha., with supper phosphate in the first season. While, the lowest one was showed when adding any P sources without FYM addition or with 2nd FYM rate with rock phosphate and without P application in the first one. On the other hand, sole application of any P sources without FYM addition or mixing the high FYM rate with super phosphate gave the highest significant value of plant height in the second season. Meanwhile, the lowest one was recorded by the treatment of without or 2nd rates with rock phosphate or without P addition in the second one. Also, data show that mixing the 2nd FYM rates with rock phosphate gave the best significant values of grain No. and grain weight/ spike, but, the lowest ones were observed by sole application of farmyard manure in both seasons. In most cases, 1000 grains weight was improved significantly by individual application of FYM and mixed with supper or rock phosphate in both seasons, while, it decreased significantly by using 2nd FYM rate and devoid of FYM with supper or rock phosphate in both seasons. Farmyard manure can enhance the P availability in the soil, due to the positive effect on chemical, physical, and biological soil properties.

Yield:

Results tabulated in Table (4) illustrate that the highest significant increases in wheat grain, straw and biological yields were recorded by using the high FYM level 24 t/ha., in the both seasons. The same trend was obtained when the 2nd one 12 t/ha., was practiced for grain and straw in the second season only. On the other hand, such parameters were decreased significantly without farmyard manure addition in the both seasons and second level in the first one. Addition of farmyard manure had a favorable influence on grain and straw of wheat plant. From the above-mentioned results, the increase in wheat yield may be attributed to better growth under favorable physical condition of treated soil and can be associated to the beneficial effect of FYM addition containing a considerable amount of organic acids and nutritional elements for plant growth. Also, adding farmyard manure gave improving in microorganisms of soil. This might led to accumulation of available nutrients and stimulate the microorganisms in rhizosphere soil. In this connection, the biological activity of the microorganisms would have helped the soil status to become ready to supply zone for necessary nutrients to plant's root system **(Premsekhar and Rajashree, 2009).** Also, **Yassen *et al*. (2010)** found that application of farmyard manure residue gave a significant increase in grain and straw weight, total yield, crop index, harvest index, crude protein, N, P and K content and uptake of wheat plant.

Concerning the effect of P sources on wheat yield, data show that the supper phosphate led to the best significant values of such parameters in both seasons. The same trend was observed for grain and straw yields by adding rock phosphate in the 2nd one only. Vice versa, the lowest ones were recorded by without P fertilizers in the both seasons. Phosphorus is a constituent of several essential cell components such as nucleotides, nucleic acids, phospholipids and P promotes root development, early flowering and ripening. It is a particularly important in early growth stage and taken up by plants in water soluble. Such finding agrees with those obtained by **(Richardson, 2005; Hartl & Erhart, 2005 and Kihanda, *et al.*, 2006**.)

Table (4): Effect of FYM and different phosphorus sources on grain, straw and biological yield of wheat

Treatments	Grain yield (t/ha)				Straw yield (t/ha)				Biological yield (t/ha)			
	Season 2010/2011											
	FYM1	FYM2	FYM3	Mean	FYM1	FYM2	FYM3	Mean	FYM1	FYM2	FYM3	Mean
Control	4.337	4.510	6.577	5.141	6.470	6.603	7.163	6.746	10.97	11.11	13.74	11.94
Superphosphate	6.810	6.973	7.463	7.082	7.083	7.610	8.353	7.682	13.89	14.58	15.81	14.76
Rock phosphate	5.817	6.667	7.067	6.517	6.983	7.270	7.790	7.348	12.80	13.94	14.85	13.86
Mean	5.654	6.050	7.036		6.846	7.161	7.769		12.55	13.21	14.80	
L.S.D. at 0.05												
FYM	0.4380				0.3259				0.6788			
P sources	0.2250				0.3047				0.2977			
Interaction	0.3898				0.5277				0.5156			
Season 2011/2012												
Control	6.133	6.310	6.610	6.351	6.793	7.150	7.673	7.206	12.93	13.46	14.28	13.56
Superphosphate	6.630	6.943	7.180	6.918	7.540	8.100	8.547	8.062	14.17	15.04	15.73	14.98
Rock phosphate	6.200	6.707	7.103	6.670	7.410	8.027	8.320	7.919	13.61	14.73	15.42	14.59
Mean	6.321	6.653	6.964		7.248	7.759	8.180		13.57	14.41	15.14	
L.S.D. at 0.05												
FYM	0.3487				0.5428				0.5705			
P sources	0.2756				0.3312				0.3558			
Interaction	0.4774				0.5737				0.6163			

With respect to the interaction effect between factors under study on wheat yield, data reveal that the mixing supper phosphate with the high level of FYM gave the highest significant values of wheat yield in both seasons. The same trend of grain and straw yield were shown by mixing supper or rock phosphate with the 2nd and 3rd level of FYM, while biological yield was better by mixing the high level of farmyard manure with rock phosphate in the second season. Conversely, the lowest ones were recorded by using 1st or 2nd farmyard manure without any phosphorus sources in both seasons. P-sorption capacity decrease of induced by farmyard manure to changes of soil pH and to complexation of P-sorption sites at reactive surfaces. Also, it increases the humus content and microbiological activity in soil. Similar results were obtained by **Singh *et al.* (2011).**

N, P and K uptake as well as protein % of wheat grain yield

Results in Table (5) demonstrate that the high FYM rate (24t/ha.), gave the best significant uptake values of N, P and K as well as protein % in wheat grain in both seasons. The same trend was observed when applying the 2nd level of FYM (12 t/ha.)for P uptake and protein percentage in the first one only. Vice versa, the lowest ones were obtained without FYM addition in both seasons. There is no significant difference between the 1st and 2nd level of FYM for giving the lowest significant value of K uptake in the first season only. The activity of soil organisms is very important for guarantee sufficient nutrient supply to the plant. If the micro-organisms find suitable conditions for their growth, they can be very efficient in dissolving nutrients and making them available to plants. These results are in agreement with those reported by **Yassen, *et al*., (2011)** who found that the farmyard manure had positive effect on mineral elements uptake (N, P and K) of the wheat especially at high rate of organic matter.

Regarding the effect of P sources on N, P and K uptake as well as protein % in wheat grain, data show that the supper phosphate treatment gave the highest significant values of such parameters in both seasons. On the contrary, the lowest ones were observed without P source addition in both ones.

Table (5): Effect of FYM and different phosphorus sources on N, P and K uptake as well as protein % in grain yield

Treatments	N Uptake (kg/ha)				P Uptake (kg/ha)				K Uptake (kg/ha)				Protein %			
	Season 2010/2011															
	FYM1	FYM2	FYM3	Mean	FYM1	FYM2	FYM3	Mean	FYM1	FYM2	FYM3	Mean	FYM1	FYM2	FYM3	Mean
Control	78.90	85.18	129.7	97.93	5.673	6.423	7.007	6.368	15.60	15.93	25.00	18.84	10.47	10.87	11.35	10.89
Superphosphate	146.9	158.0	171.5	158.8	8.433	9.023	9.563	9.007	28.87	30.47	35.84	31.73	12.40	13.03	13.21	12.88
Rock phosphate	112.1	143.6	154.0	136.6	6.253	8.207	8.550	7.670	23.66	27.55	31.33	27.51	11.10	12.39	12.54	12.01
Mean	112.7	128.9	151.7		6.787	7.884	8.373		22.71	24.65	30.72		11.32	12.10	12.36	
L.S.D. at 0.05																
FYM	6.216				0.9292				3.634				0.4553			
P sources	6.902				0.2775				1.598				0.3264			
Interaction	11.96				0.4807				2.767				0.5654			
Season 2011/2012																
Control	110.5	119.0	129.1	119.5	18.65	19.66	21.04	19.79	19.63	21.22	24.23	21.69	10.35	10.85	11.23	10.81
Superphosphate	137.4	156.5	164.7	152.8	23.58	27.35	29.59	26.84	24.28	32.16	33.97	30.14	11.94	12.96	13.19	12.70
Rock phosphate	119.5	139.9	153.1	137.5	19.77	24.50	27.52	23.93	24.80	28.84	31.97	28.54	11.08	12.00	12.40	11.83
Mean	122.4	138.5	148.9		20.67	23.84	26.05		22.90	27.41	30.06		11.13	11.94	12.27	
L.S.D. at 0.05																
FYM	9.140				1.389				2.125				0.2341			
P sources	6.511				1.202				1.278				0.3938			
Interaction	11.28				2.082				2.214				0.6821			

Concerning the interaction effect between factors under study, results reveal that the N, P and K uptake as well as protein % in wheat grain were improved significantly by mixing supper phosphate with the high farmyard manure rate (24 t/ha.) in both seasons. Similar trend was recorded when mixing the same P source with 2nd FYM level for protein % in both seasons as well as N and K content in the second season only. In contrast, the lowest significant ones were obtained by adding the 1st and 2nd FYM level without P source addition in both seasons. The same trend was obtained by adding rock phosphate individually without farmyard manure for P content of wheat grain in the tow seasons as well as N and K content in the second one only. These results agreed with those obtained by **Hussain, *et al*., (2008)** who found that the phosphorus availability can be enhanced if it is mixed with farmyard manure. Since it increases availability and efficiency of P and enhances wheat yield.

N, P and K uptake of wheat straw yield

Available data in Table (6) reveal that the high farmyard manure rate enhanced significantly N, P and K uptake of wheat straw in both seasons. On the other hand, the lowest ones were observed without FYM addition in the both ones. The same trend was obtained by using 2nd level in second season only. It must be stressed that the value of FYM in soil improvement is due to its micronutrient content, besides helping in the improvement of soil structure and water holding capacity of soil. Further, it stimulates the activity of microorganisms that help the plants to get the macro and micronutrients throughout the biological decomposition **(Nardi *et al*. 2004).**

N, P and K uptake of wheat straw were improved significantly when supper phosphate was applied in both seasons. Meanwhile, such parameters were decreased significantly without P source addition in both ones. This superiority might be attributed to the availability and speed solubility of chemical phosphorus form which hence the rooting system of wheat plant directly absorbed it in short time. **Awaad, *et al*., (2009)** found that, the highest values of N, P and K uptake by canola straw or seeds were obtained by superphosphate application when compared to rock phosphate treatments. Similar results were also observed by **Shafeek *et al.*, (2005)** who found that the chemical composition of green pea seeds tissues recorded the highest significant values of macronutrients uptake with applying the chemical source of P (superphosphate) addition as compared with the natural source (rock phosphate).

Table (6): Effect of FYM and different phosphorus sources on N, P and K uptake of straw yield

Treatments	N Uptake (kg/ha)				P Uptake (kg/ha)				K Uptake (kg/ha)			
	Season 2010/2011											
	FYM1	FYM2	FYM3	Mean	FYM1	FYM2	FYM3	Mean	FYM1	FYM2	FYM3	Mean
Control	25.63	28.01	32.71	28.78	5.113	4.607	6.280	5.333	84.14	86.80	105.0	92.00
Superphosphate	45.09	56.06	61.80	54.32	8.693	10.04	11.77	10.17	97.44	113.1	131.6	114.1
Rock phosphate	32.56	40.01	49.58	40.72	8.187	8.913	9.810	8.970	90.06	97.24	117.3	101.5
Mean	34.43	41.36	48.03		7.331	7.854	9.288		90.55	99.04	118.0	
L.S.D. at 0.05												
FYM	1.009				0.3013				4.690			
P sources	2.543				0.3829				4.435			
Interaction	4.405				0.6633				7.681			
Season 2011/2012												
Control	25.16	29.25	32.77	29.06	5.477	6.587	8.977	7.013	62.45	75.20	95.36	77.67
Superphosphate	35.68	43.22	48.37	42.42	9.273	10.78	11.44	10.50	98.83	111.0	130.4	113.4
Rock phosphate	32.61	37.45	45.11	38.39	8.103	8.693	9.767	8.854	77.27	89.35	106.7	91.12
Mean	31.15	36.64	42.09		7.618	8.687	10.06		79.52	91.85	110.8	
L.S.D. at 0.05												
FYM	3.898				1.123				6.765			
P sources	2.579				0.5971				3.948			
Interaction	4.467				1.034				6.837			

For the interacted factors under study on N, P and K uptake of wheat straw, data show that mixing the high FYM rate (24t/ha.) with supper phosphate improved significantly such parameters in both seasons. The same trend was recorded by mixing the same rate of FYM with rock phosphate for N uptake and mixing the 2nd rate with the same P source for P uptake of wheat straw in the second one only. On the contrary, the lowest ones were recorded without addition FYM and without P source in both seasons. Also, the same trend was observed when sole application of the second FYM rate without P source addition for such parameters in the first season and N uptake in the second one. Also, the addition of farmyard manure can release humic acid, which in turns converts unavailable soil phosphate into available forms. In addition, some soil microorganisms including bacteria, fungi and actinomycetes have the capability to convert plant unavailable phosphorus compound such as flour and hydroxyl apatite (the major components of rock phosphate) to plant available mono and dicalcium phosphate. In this connection **Moore and Miller, (1994)** reported that mixing rock phosphate with farmyard manure is likely to be beneficial for phosphate availability in soil, since acids in the decaying organic matter will aid the dissolution of the rock phosphate. Furthermore, chelating of soluble calcium with organic matter will restrict phosphorus fixation in soil.

N, P and K uptake of wheat biological yield

Data in Table (7) demonstrate that the high rates of farmyard manure followed by the second level gave the highest significant values of N, P and K uptake of wheat biological yield compared with other treatments (without FYM) addition in the both seasons. Similar trend were obtained by **Zeidan *et al*. (2005)** who found that farmyard manure application significantly enhanced the yield and N, P and K uptake of wheat. **Sieling *et al*. (2006**) found that N treatments (pig slurry) enhanced grain yield and total N uptake of wheat compared with the unfertilized control. **Yaduvanshi and Sharma (2008)** found that application of farmyard manure with chemical amendment increased wheat yield and N, P and K uptake in grain yield. **Enke Liu *et al*. (2010)** indicated that, long-term additions of organic manure have the most beneficial effects on grain yield of wheat and maize.

N, P and K uptake of wheat biological yield were improved significantly by using supper phosphate followed by rock phosphate compared to without P source addition in both seasons. This might be attributed to the better plant growth and the higher pigments contents of the chemical P fertilizers compared to the natural (rock P) form and the limited solubility of rock phosphorus.

Respecting the effect of interacted factors under study on the N, P and K content of wheat biological yield, results show that the treatment of high FYM rate mixed with supper phosphate gave the highest significant values of such parameters in both seasons. On the other hand, the lowest ones were observed without FYM and P source additions in both ones. The same trend was obtained by sole application of the second level of FYM without P source addition for N, P and K uptake in the first season, and P content in the second one. In this connection, **Zafar *et al*. (2011)** concluded that the application of organic sources along with mineral P sources increased the yield and yield components and P uptake of maize plant compared to either individual application of inorganic P sources. Integrated use of P sources not only increased crop productivity but also increased nutrient uptake, protein content of maize grain.

So, it could be concluded that the phosphorus availability from any source can be increased if it is mixed with farmyard manure. Integrated use of organic and inorganic fertilizers guarantees improved soil health and fertility as well as crop productivity. As a whole, the obtained results showed that application of farmyard manure at 24 m^3 ha^{-1}, in combination with supper phosphate produced the highest values of wheat straw, grain and biological yields as well as nutrient uptake by wheat plants followed by the same level of FYM applied with rock phosphate. Therefore, application of FYM combined with two P sources is recommended for best growth of wheat under the agro-climatic zone of Bahtim, El Qualubia Governorate, Egypt.

Table (7): Effect of FYM and different phosphorus sources on N, P and K uptake of biological yield

Treatments	N Uptake (kg/ha)				P Uptake (kg/ha)				K Uptake (kg/ha)			
	Season 2010/2011											
	FYM1	FYM2	FYM3	Mean	FYM1	FYM2	FYM3	Mean	FYM1	FYM2	FYM3	Mean
Control	104.5	113.2	162.4	126.7	10.78	11.00	13.28	11.69	99.74	102.7	130.0	110.8
Superphosphate	192.0	214.1	233.3	213.1	17.12	19.07	21.34	19.18	126.3	143.6	167.5	145.8
Rock phosphate	144.7	183.6	203.6	177.3	14.44	17.15	18.36	16.65	113.7	124.8	148.7	129.1
Mean	147.1	170.3	199.7		14.12	15.74	17.66		113.3	123.7	148.7	
L.S.D. at 0.05												
FYM	6.998				0.7275				7.979			
P sources	7.302				0.5166				5.048			
Interaction	12.65				0.8948				8.743			
Season 2011/2012												
Control	135.6	148.2	161.8	148.6	24.13	26.25	30.02	26.80	82.08	96.42	119.6	99.36
Superphosphate	173.0	199.7	213.1	195.3	32.84	38.12	41.04	37.33	123.1	143.2	164.3	143.5
Rock phosphate	152.1	177.4	198.2	175.9	27.78	33.19	37.29	32.75	102.1	118.2	138.7	119.7
Mean	153.6	175.1	191.0		28.25	32.52	36.11		102.4	119.3	140.9	
L.S.D. at 0.05												
FYM	9.259				1.221				6.478			
P sources	5.345				1.436				4.032			
Interaction	9.258				2.488				6.984			

REFERENCES

Abou El-Yazeid, A. and H.E. Abou-Aly, 2011. Enhancing Growth, Productivity and Quality of Tomato Plants Using Phosphate Solubilizing Microorganisms. Aust. J. Basic & Appl. Sci. 5: 371-379.

Awaad M.S., Azza A.Rashad and M.A. Bayoumi. 2009 Effect of Farmyard Manure Combined with Some Phosphate Sources on the Productivity of Canola Plants Grown on a Sandy Soil. Res. J. Agric. & Biol. Sci., 5(6):1176-1181.

Black, C.A. (1982). "Methods of Soil Analysis." Amer. Sec. Agron. Inc. Publisher. Madison, Wisconsin., U S A.

El-Sherbieny, AE.A., K.G. Soliman and R.M. Aly, 1999. Increasing the efficiency of nitrogen fertilizers in newly reclaimed sandy soil. Zagazig J. Agric. Res., 6(3B): 895-906.

Enke Liu, Changrong Yan, Xurong Mei, Wenqing He, So Hwat Bing, Linping Ding, Qin Liu, Shuang Liu and Tinglu Fan, 2010. Long-term effect of chemical fertilizer, straw, and manure on soil chemical and biological properties in northwest China. Geoderma, 158: 173-180.

FAO, 2004. Scaling soil nutrient balances: Enabling Meso- Level Applications for African Realities Fertilizer and Plant Nutrition Buletin, No. 15. Food and Agriculture Organization. Rome.

FAO., 2005. WWW. FAO. Org. Data base (2005).

Gomez, K.A. and A.A. Gomez, 1984. Statistical Procedures for Agriculture Research " 2td (ed) John Wiley and Sons Inc. New York.

Hartl, W.and E. J. Erhart, 2005. Plant Nutr. Soil Sci., 168: 781–788.

Havlin JL., SL. Tisdale and WL. Nelson, 2004. 'Soil fertility and fertilizers: An introduction to nutrient management'. (Prentic Hall).

Hossein M. H., S. Khayami, H. Besharati and S.Bybordi, 2010. Study of the effects of rock phosphate application with phosphate solublizing bacteria on P availability for corn. 19th World Congress of Soil Science, Soil Solutions for a Changing World 1 – 6 August 2010, Brisbane, Australia. Published on DVD

Hussain, N., M.B. Khan and R. Ahmad, 2008. Improving wheat productivity in calcareous soils through band replacement of farmyard manure with phosphorus. Int. J. Agri. Biol., 10: 709–14.

Iyamuremye, F., R.P. Dick, and J. Baham, 1996a. Soil Sci., 161: 426–435.

Iyamuremye, F., R.P. Dick, and J. Baham, 1996b Soil Sci., 161: 436–443.

Kihanda, F.M., G.P. Warren, and A.N. Micheni, 2006. Nutr. Cycl. Agroecosyst., 76:341–354.

Moore, P.A. and D.M. Miller, 1994. Decreasing phosphorus solubility in poultry manure litter with aluminium, calcium and iron amendments. Journal of Environmental Quality, 23: 325-330.

Nardi, S., F. Morari, A. Berti, M. Tosoni and L. Giardini, 2004. Soil organic matter properties after 40 years of different use of organic and minerals fertilizers. Eur. J. Agronomy, 21: 357-367.

Premsekhar, M. and R. Rajashree, 2009. Influence of bio-fertilizers on the growth characters, yield attributes, yield and quality of tomato. American-Eurasian Journal of Sustainable Agriculture, 3(1): 68-70.

Ramesh P., N.R. Panwar, A.B. Singh, S. Ramana and A.S. Rao, 2009. Plant Nutr. Soil Sci., ,172: 577–585.

Richardson, A.E., T.S. George, M. Hens, , and R.J. Simpson, 2005. In Turner et al. eds, Organic Phosphorus in the Environment. CABI Publishing, Wallingford, Oxfordshire, UK, pp.165–184.

Ryan, J., S. Garabet, K. Harmsen, and A. Rashid, 1996. A soil and plant Analysis Manual Adapted for the West Asia and North Africa Region. ICARDA, Aleppo, Syria. 140pp.

Schneider, K.D., P. van Straaten, R. de Orduña, S. Glasauer, J. Trevors, D. Fallow and P.S. Smith, 2010. Comparing phosphorus mobilization strategies using *Aspergillus niger* for the mineral dissolution of three phosphate rocks. Journal of Applied Microbiology, 108: 366-374.

Shafeek, M.R., OAH. El-Zeiny and M.E. Ahmed, 2005. effect of natural phosphate and potassium fertilizer on growth, yield and seed composition of pea plant in new reclaimed soil. Asian Journal of Plant Sciences, 4: 608-612.

Sharpley, A.N., 1996. Soil Sci. Soc. Am. J., 60: 1459–1466.

Sieling, K., T. Brase and V. Svib, 2006. Residual effects of different N fertilizer treatments on growth N uptake and yield of oil seed rape, wheat and barley . Europ. J. Agronomy, 25: 40-48.

Singh, C.M., P.K. Sharma, P. Kishor, P.K. Mishra, A.P. Singh, R. Verma and P. Raha, 2011. Impact of integrated nutrient management on growth, yield and nutrient uptake by wheat (Triticum aestivum L.). Asian J. Agric. Res., 5: 76-82.

Yaduvanshi, N.P.S. and D.R. Sharma, 2008. Tillage and residual organic manures/chemical amendment effects on soil organic matter and yield of wheat under sodic water irrigation. Soil & Tillage Research, 98: 11-16.

Yassen, A.A., F.A. Hellal and Doaa M. Abo-Basha, 2011. Influence of organic materials and foliar application of zinc on yield and nutrient uptake by wheat plants. J. Appl. Sci. Res., 7: 2057-2062.

Yassen, A.A., Sahar S.M. Khaled, and M. Zaghloul, 2010. Response of wheat to different rates and ratios of organic residues on yield and chemical composition under two types of soil. Journal of American Science, 6: 885-864.

Zafar, M., M.K. Abbasi, Abdul Khaliq and Zahid-ur-Rehman, 2011. Effect of combining organic materials with inorganic phosphorus sources on growth, yield, energy content and phosphorus uptake in maize at Rawalakot Azad Jammu and Kashmir, Pakistan. Arch. Appl. Sci. Res., 3:199-212.

Zapata, F. and R.N. Roy, 2004. Use of phosphate rocks for sustainable agriculture. FAO Fertilizer and Plant Nutrition Bulletin 13, Rome, Italy.

Zeidan, M.S., M. Hozayn and M.F. El-Krammany, 2005. Effect of different organic fertilizer sources and levels on growth and yield of wheat (Triticum aestivum L.) in sandy soil Egypt. J. Agric. Res., 2(2): 643.

Zingore S., R.J. Delve, J. Nyamangara, K.E. Giller, 2008. Nutr. Cycl. Agroecosyst., 80,267–282.

تحسين إنتاجية القمح بإضافة السماد البلدى مع مصادر من الفوسفور فى الارض الطينية

عصام الدين عبد العزيز محمد عثمان– احمد أبو الوفا خليل – عاطف عبدالمجيد المصرى
معهد بحوث الأراضى والمياه والبيئة – مركز البحوث الزراعية – الجيزة – مصر

أجريت تجربة حقلية فى محطة البحوث الزراعية ببهتيم لموسمين متتاليين ٢٠١١/٢٠١٠ - ٢٠١٢/٢٠١١ لدراسة تأثير إضافة معدلات مختلفة من السماد البلدي (صفر – ١٢ -٢٤ طن/هكتار) مع مصادر مختلفة من التسميد الفوسفاتي (١٠٠ كجم سوبر فوسفات – ٢٤٠ كجم صخر الفوسفات – بدون إضافة) على محصول القمح ومكوناتة والعناصر الكبرى والنسبة المئوية للبروتين فى محصول القمح (صنف جيزة ١٦٨).

ويمكن تلخيص النتائج المتحصل عليها فيما يلى:

١- أعطت معاملة إضافة الأسمدة البلدية زيادة معنوية فى مكونات المحصول وكذلك محصول الحبوب والقش والمحصول البيولوجى للقمح وكذلك الممتص من النتروجين والفوسفور والبوتاسيوم فى كل أجزاء المحصول وكذلك النسبة المئوية للبروتين فى الحبوب مقارنة بمعاملة عدم إضافة السماد البلدى.

٢- عموما، وفى معظم الحالات، أعطى السوبر فوسفات أفضل القيم معنويا لمعظم الصفات المدروسة فى هذه الدراسة ثم تلتها معاملة اضافة صخر الفوسفات، فى حين سجلت اقل القيم معنويا بعدم إضافة أى مصدر من مصادر التسميد الفوسفاتي وذلك فى كلا الموسمين.

٣- ادى خلط السماد البلدي بالمعدل العالي (٢٤ طن/هكتار) مع السوبر فوسفات لزيادة معنوية لكل الصفات المدروسة فى هذه الدراسة، أيضا أدى خلط نفس المعدل من السماد البلدي مع صخر الفوسفات لزيادة معنوية فى معظم الصفات فى كلا الموسمين، بينما سجلت اقل القيم معنويا عند استخدام معاملة بدون أسمدة فوسفاتية مع بدون سماد بلدى فى كلا الموسمين، لذلك تيسر الفوسفات من السوبر او صخر الفوسفات يمكن زيادتة بخلط السماد الفوسفاتي مع السماد البلدي ومن ثم يزيد من تيسرة وبالتالى يتحسن محصول القمح كما ونوعا.

Table (3): Effect of FYM and different phosphorus sources on plant height, grains number/spike, grain weight/ spike (g) and 1000 grain weight (g)

Treatments	plant high (cm)				Grain no./ spike				Grain weigh / spike (g)				1000 grain weight(g)			
	Season 2010/2011															
	FYM1	FYM2	FYM3	Mean	FYM1	FYM2	FYM3	Mean	FYM1	FYM2	FYM3	Mean	FYM1	FYM2	FYM3	Mean
Control	82.00	81.50	89.97	84.49	49.23	39.00	49.33	45.86	2.03	1.77	2.43	2.08	42.25	40.54	43.63	42.14
Superphosphate	80.20	86.60	88.37	85.06	47.47	47.83	45.23	46.84	2.00	2.27	2.53	2.27	40.86	39.77	41.56	40.73
Rock phosphate	80.43	81.10	83.27	81.60	42.13	54.20	41.60	45.98	2.07	2.63	2.17	2.29	39.58	40.88	42.14	40.87
Mean	80.88	83.07	87.20		46.28	47.01	45.39		2.03	2.22	2.38		40.90	40.40	42.45	
L.S.D. at 0.05																
FYM	2.776				NS				0.2413				1.325			
P sources	NS				NS				NS				NS			
Interaction	6.765				2.857				0.4904				2.734			
Season 2011/2012																
Control	86.40	82.30	81.30	83.33	49.33	37.27	48.30	44.97	2.47	1.70	2.07	2.08	42.46	41.77	41.21	41.81
Superphosphate	82.60	80.87	88.00	83.82	49.67	50.40	48.53	49.53	2.60	2.17	2.07	2.28	40.51	40.57	39.31	40.13
Rock phosphate	83.13	76.90	81.30	80.44	43.87	55.27	46.20	48.44	2.03	2.70	2.10	2.28	42.41	39.16	41.14	40.90
Mean	84.04	80.02	83.53		47.62	47.64	47.68		2.37	2.19	2.08		41.79	40.50	40.55	
L.S.D. at 0.05																
FYM	NS				NS				NS				1.130			
P sources	NS				1.641				NS				1.562			
Interaction	6.086				2.842				0.3468				2.706			