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EFFECT OF PHOSPHORUS FERTILIZATION AND FARMYARD MANURE APPLICATION ON GROWHT AND YIELD OF PEANUT

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ABSTRACT

This work aims to study the effect of farmyard manure addition in combined with different rates of inorganic phosphate fertilizer on the growth and yield of peanut grown in sandy soil . Sprinkler irrigation system was used during two summer seasons (2005 and 2006) at Ahmed Ramy village , El-Bustan , El-Beheira Governorate .

The natural organic manure was added for improving soil characteristics as well as enhancing nutrients availability were taken into consideration .

The obtained results strongly confirmed that application of farmyard manure increased organic matter content, CEC and decreased the hydraulic conductivity of the investigated soil .

The results also showed that the application of organic materials either alone or in combination with inorganic P fertilizers caused a substantial increase in available N, P,K and micro nutrients (Fe , Mn , Cu , Zn) as well as peanut yield (straw and kernel) .

The highest yield (biomass and kernel) and other growth parameters were obtained when farmyard manure was applied in combination with the recommended dose of inorganic phosphorus fertilizer .

The results also showed that application of farmyard manure combined with inorganic phosphorus fertilizer caused a substantial increase in the peanut kernel content from NPK and nutrients availability in soil.

Keywords ; phosphorus fertilization , farmyard manure , peanut , growth , yield .

INTRODUCTION

The increase of population in Egypt requires putting new desert soil , either sandy & calcareous (which occupies about 96 % of the total area) under cultivation .

As it is well known that desert sandy soil is poor in organic matter content , both total and available essential nutrients for plant growth as well as inadequate water retention .

In additions the application of either organic manure or inorganic fertilizer alone or in combination with each other lead to raise the nutrients content of soil and improve soil characteristics .

Under such severe conditions , the productivity of different crops grown in this soil tends to decrease markedly . The resultant widespread chemical fertilizers demand and their high prices make their use uneconomic for certain crops in sandy soils . It is widely recognized that organic substances play a direct role in sustaining soil fertility , as they are sources of plant nutrients .

Amendment of the soils with organic manure improves their physical , chemical and biological properties which in turn , influence the growth and

development of plants (Khadr *et al* ., 1988 ; Antoun *et al* ., 1989). When organic solid composts are incorporated into the soil, a gradual assimilation occurs through chemical and biological reactions . Abdel-Sabour *et al* ., (1997) evaluated the effect of organic waste composts on the hydro-physical properties of a desert sandy soil . They found that all treatments resulted in reduced bulk density and greater water holding capacity. Abdel-Aziz *et al* ., (1996) found that the application of farmyard manure did not show any change in soil texture , while soil bulk density was decreased as well as infiltration rate and hydraulic conductivity were increased .

Fiedler . *et al*. (1989), carried out an experiment in Nebraska to predict the most profitable amount of P fertilizer to winter wheat in terms of grain yield increase as influenced by soil test P and method of P application yield increase to applied P was related by multiple regression to rate and method of P application . When grain yield increased with applied P , seed applied P results in much higher grain yield increase per kilogram of applied P than broadcast P Khalil *et al*. (2000), found that the addition of different organic manures significantly increased the dry matter yield of corn plants in both sandy and clayey soil, In addition, the application of organic manure significantly increased N, P and K uptake by corn plants. They recommended the use of any organic manure in combination with inorganic fertilizers (NPK) increased dry matter yield ,N,P and K uptake, particularly in sandy soils.El-Fayoumy and Ramadan (2002), found that peanut pod yield was significantly affected by organic manure application. Basyony *et al*. (2004), studied the response of plants grown in sandy soil to organic and inorganic fertilization. Peanut pods yield, grains, and straw yields of wheat were enhanced by the addition of compost combined with inorganic fertilizers. The effect of compost application on the yields of wheat was enhanced by the addition of compost combined with mineral fertilizers. The effect of compost application on the yields of peanut and wheat, gave higher yields than that of the untreated soil, whereas, the results indicated the superiority of compost for increasing the pod yields and 100 seed weight of peanut and grain and straw yields of wheat as compared to untreated one (without compost).

The aim of this investigation was to study the effect of farmyard manure and inorganic phosphorus application in combination with each other or in alone on peanut plants yields and nutrient availability in sandy soil .

MATERIALS AND METHODS

A field experiment was conducted to study the effect of different rates of either organic manure or inorganic P fertilizer (ordinary supper phosphate 15.5 % P O) added to soil alone or in combination with each other on the growth and yield of peanut crop growing in sandy soils under sprinkler irrigation system during the two summer seasons of 2005 and 2006 at Ahmed Ramy village , El-Bustan, El-Beheira Governorate . In order to achieve the above objective the experimental site was classified into equal parts of experimental area where the plant area was 20 m^2 (2 m× 10 m).

This experiment consisted 17 treatments arranged in complete randomized design with four replicates including the control .

All treatments received the recommended rates of N,P ,K and micronutrients (Zn , Cu , Fe and Mn) and also the recommended dose of farmyard manure (control) .

Four additional rates (250,300,350 and 400 kg fed $^{-1}$) from inorganic phosphorus fertilizer(ordinary super phosphate 15.5% P O) and four additional rates (25 , 30 , 35 and 40 m^3 fed $^{-1}$) from farmyard manure and also the combination of P fertilizer and FYM were 200 kg P fed $^{-1}$ + 5,10,15,20 m^3 (FYM) and 20 m^3 fed^{-1} from FYM +50, 100 ,150 and 200 kg fed^{-1} from P fertilizer . All additional rates from inorganic phosphorus fertilizer and organic manure (FYM) represent (25,50,75 and 100%) from recommended dose (200 kg fed^{-1} supper phosphate) and (20 m^3 fed $^{-1}$ FYM) .

Surface (o – 30 cm) and sub surface (30 – 60 cm) soil samples were collected to analyze the main physical, chemical and fertility characteristics Table 1 according to the methods described by Black (1965). The applied farmyard manure analysis was done and results are recorded in Table 2 .

Giza 5 peanut cultivar seeds were sown at the first week of May and harvested at the second week of September for two growing seasons and 360 plants per plot were kept after thinning to one plant per hill .

After 40 days of planting , five random plants per plot were picked from all the treatments , thoroughly washed with tap water , followed by distilled water , dried in an oven at 65 c for 48 hr and ground in a stainless steel mill , then stored for chemical analysis . The number of pods plant^{-1} , pods weight plant^{-1}, 100 kernel weight , were determined for each treatment . Total pod and kernel yield for each plot were weight and related to kg fed $^{-1}$.

Plant samples were digested to determine N,P ,K and micronutrients (Fe, Mn, Zn and Cu) contents according to Page *et al* (1982) and Jackson , (1973) .

After harvesting soil samples from experimental plots were collected for the determination of available N,P ,K and micronutrients (Fe,Mn,Zn and Cu) using the methods described by Page *et al* (1982) .

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Table 2 : Some chemical properties of the used farmyard manure .

pH	Ec (dS m^{-1})	C/N ratio	Organic carbon, %	Organic matter, %	Total						
					N %	P %	K %	Fe, ppm	Mn, ppm	Zn, ppm	Cu, ppm
3.42	7.53	1:19	5.82	10	0.31	0.21	0.61	207	71	36	14

RESULTS AND DISCUSSION

Effect of phosphorus fertilization and farmyard manure application on peanut growth parameters and yield

The results shown in Table 1 indicate that the soil layers up to 60 cm depth are characterized by sand texture with low content of CaCo3 (1.98 – 2.90 %) , slightly alkaline and Ec values varied between 0.12 and 0.21 dS m^{-1} . The hydraulic conductivity is very high (20.60 – 25.01 cm/h) . In view of soil fertility soil samples were deficient in nitrogen , phosphorus, potassium , organic matter and micro nutrients .

Data of Table 3 and Figure 1 and 2 show that the values of peanut growth parameters and yield increased with increasing the rate of both phosphorus and farmyard manure fertilization added to soil alone or in combination with each other .

Table 3 : Effect of phosphorus fertilization and farmyard manure application on peanut growth parameters and yield .

Treatments		Biomass yield kg fed^{-1}	pod weight $plant^{-1}$ (g)	No, of pods $plant^{-1}$	Kernel yield kg fed^{-1}	100 kernel weight (g)	Pod yield kg fed^{-1}	Fresh weight of kg fed^{-1}	Dry weight of kg fed^{-1}
Control (P0F0)		1960	30	29	340	51	659	1275	600
P *	F1	2998	49	34	525	67	998	2000	950
	F2	3526	59	40	610	69	1176	2350	1095
	F3	3730	64	43	645	73	1230	2500	1130
	F4	4060	47	47	695	78	1360	2700	1235
Mean		3578.5	59.75	41	618.75	71.75	1191	2387.5	1102.5
P *	P1	2660	37	29	449	62	870	1790	799
	P2	2780	42	34	471	65	920	1860	850
	P3	2950	45	38	495	67	980	1970	900
	P4	3070	52	41	520	70	1020	2050	925
Mean		2865	44	35.5	483.75	66	947.5	1917.5	868.5
F*	P1	2735	40	30	470	64	919	1835	835
	P2	2978	45	34	500	67	1015	2000	915
	P3	2270	52	38	563	70	1130	2200	995
	P4	2440	60	42	590	75	1185	2310	1050
Mean		2855.75	49.25	36	530.75	69	1062.25	2086.25	948.75
F*	F1	2754	43	32	480	66	915	1820	850
	F2	3015	49	37	513	70	998	1980	925
	F3	3330	56	40	575	72	1100	2170	1010
	F4	3495	64	45	600	72	1150	2290	1070
Mean		3148.5	53	38.5	542	70	1040.75	2065	963.75

P*:The recommended dose (200 kg fed^{-1} super phosphate 15.5% P2 O5)
F*:The recommended dose (20 m^3 fed^{-1} FYM)
P1 : P* + 25 % from P* (225 kg) F 1 : F* + 25 % from F* (25 m^3)
P2 : P* + 50 % from P* (250 kg) F 2 : F* + 50% from F* (30 m^3)
P3 : P* + 75 % from P* (275 kg) F 3 : F* + 75 % from F*(35 m^3)
P4 : P* + 100% from P* (400 kg) F 4 : F* + 100% from F*(40 m^3)

Figure 1:Effect of phosphorus fertilization and farmyard manure application on peanut yield (biomass and kernel).

Figure 2 : Effect of phosphorus fertilization and farmyard manure application on peanut yield (pods and 100 kernel) .

This was true for all treatments. The highest values for either growth parameters or peanut yields were obtained at rate of P combined with different rats of farmyard manure .This results indicated that recommended dose as organic fertilizer has a beneficial effect on the availability of phosphorus in soil which the results showed that the highest kernel yield (618.75 kg fed^{-1},1191 kg fed^{-1} pod yield) and (3528.5 kg fed^{-1} biomass yield) were obtained by adding the recommended dose of P with FYM application .

In this respect the mean lowest values were obtained at different rates of P indicating that organic manure improve soil characteristics and has supplying power of nutrients to plant .

Moreover the other treatments represent an intermediate case . These results are in harmony with there obtained by El- Fayoumy and Ramadan (2002), who found that peanut pod yield was significantly affected by organic manure application . From this results , it can be concluded that mixing the organic materials with recommended dose of P fertilizers more benefits than increasing the dose of P fertilizers alone .

Effect of phosphorus fertilization and farmyard manure application on the content of N P K in peanut kernel.

Data in Table 4 and Figure 3 indicate that all treatments increased the kernel content of N , P and K .The highest amounts of phosphorus absorbed were obtained from the treatments which received the phosphorus application (134.75 ppm) . It is noticed also that as the rate of phosphorus increased P content in kernel peanut increased.

Table 4 :Effect of phosphorus fertilization and farmyard manure application on the content of N P K in peanut kernel .

Treatments		N (ppm)	P (ppm)	K (ppm)
Control		110	85	180
P *	F1	180	120	260
	F2	195	129	295
	F3	215	139	310
	F4	225	144	325
Mean		203.75	133	297.5
P *	P1	160	120	235
	P2	175	131	246
	P3	190	140	257
	P4	210	148	265
Mean		183.75	134.75	250.75
F*	P1	185	119	250
	P2	200	128	265
	P3	219	137	290
	P4	230	143	315
Mean		208.5	131.75	280
F*	F1	200	114	255
	F2	210	124	275
	F3	219	130	295
	F4	239	135	310
Mean		217	125.75	288.75

Figure 3 : Effect of phosphorus fertilization and farmyardmanure application on the content NPK in peanut kernel .

The results show that the highest values of kernel content of N were obtained with FYM treatments (217 ppm) while kernel content of K were obtained with recommended dose of P in combination with FYM (297.5 ppm)

From above mentioned results it can be concluded that additions of farmyard manure with inorganic phosphorus fertilizer increased the contents of NPK in peanut . This is may be due to the increasing availability of nutrients in soil . These results are in agreement with Samya E.H. Omran , Eman A.I.Mohamed and Amal H. El – Guibali . (2009). They found that application of FYM with the recommended dose of N and P increased N,P and K contents in kernel .

Effect of phosphorus fertilization and farmyard manure application on the content of N P K in peanut straw.

Data of Table 5 and Figure 4 . Show the effect of phosphorus fertilizers and FYM application on content of N,P and K peanut straw .

Data of Table 5 show that all treatments increased N,P and K content and also, increased by the application rate .

Table 5 : Effect of phosphorus fertilization and farmyard manure application on the content of N P K in peanut straw.

Treatments		N (ppm)	P (ppm)	K (ppm)
Control		120	90	185
P *	F1	160	110	210
	F2	185	117	221
	F3	199	123	230
	F4	210	130	239
Mean		188.5	120	225
P *	P1	146	116	199
	P2	155	125	210
	P3	165	130	215
	P4	175	138	223
Mean		160.25	127.25	211.75
F*	P1	155	111	209
	P2	175	118	219
	P3	195	126	228
	P4	205	131	237
Mean		182.5	121.5	223.25
F*	F1	162	112	200
	F2	183	117	212
	F3	200	122	229
	F4	215	123	245
Mean		190	118.5	221.50

Again as mentioned for kernel content of N,P and K , the straw content of P was more pronounced in P treatments and then P and FYM combination while straw content of K,P and FYM combination treatments were more than other treatments .

In all cases kernel and straw content from N in FYM treatments were the highest .

Figure 4 : Effect of phosphorus fertilization and farmyard manure application on the content of N P K in peanut straw.

Comparing the content of peanut kernel and straw . It is noticed that the values of kernel content of N , P and K were more than of straw content this is may be due to that the increasing P fertilizers increased the yield and P,N, K content by plants . That is P may have increased the physiological activity of the roots and accordingly P fertilization can enhance P content by plants .

Also, increasing K in grains with increasing P and farmyard manure fertilizers could be explained by forming greater ATP which could increase nutrient influx . Also , P significantly increased root surface area and this was important in supplying the nutrients needed by plants . Hallmark and Barber (1984) , Khalil and Aly (2004) who found that the additions of chicken manure at planting give the highest levels of N ,P and K percentage in grains and protein . Reading to the increase of grains content of N by increasing P application rate , this may be due to the interaction effect of N and P on grain yield and content were significant. Increasing grains content of K by increasing the application rate of P may be due to the energy–rich phosphorus (in the form of ATP) and the close relations ship between K-content and ATP as activity .

Effect of phosphorus fertilization and farmyard manure application on the availability of some nutrients in soils .

Data of Table 6 and Figure 5 show the values of available nutrients in soils after peanut cultivation . The results indicated that all treatments increased the studied available nutrients FYM application was the best treatments for increasing N and K availability in soil .

Table 6 : Effect of phosphorus fertilization and farmyard manure application on the availability of some nutrients in soil .

Treatments		N (ppm)	P (ppm)	K (ppm)	Micro nutrient (ppm)			
					Fe	Mn	Zn	Cu
Control		14.10	5.10	65	7.05	3.80	1.25	0.50
P *	F1	30.10	11.48	82	8.55	7.40	1.91	0.71
	F2	36.15	12.60	86	10.09	8.20	2.72	0.95
	F3	39.22	13.70	89	10.80	9.90	3.41	1.02
	F4	43.25	14.90	96	11.40	10.70	3.97	1.20
Mean		37.18	13.17	88.25	10.21	9.5	3	0.97
P *	P1	23.09	11.97	79	8.45	6.90	1.65	0.60
	P2	25.12	12.98	82	9.14	7.95	1.87	0.75
	P3	27.14	14.18	84	9.18	8.75	2.35	0.81
	P4	31.16	15.26	89	11.91	9.76	3.20	0.89
Mean		26.62	13.80	83.50	9.75	8.34	2.26	0.76
F*	P1	29.11	13.45	78	8.90	7.50	2.05	0.69
	P2	31.14	13.60	82	9.14	8.60	2.35	0.92
	P3	32.16	14.00	86	11.11	9.20	2.95	0.99
	P4	34.19	14.10	90	11.81	10.30	3.15	1.10
Mean		31.65	13.78	84	10.24	8.90	2.62	0.92
F*	F1	32.00	11.05	83.10	8.65	7.50	1.95	0.76
	F2	37.00	12.10	86.70	10.15	8.31	2.79	1.05
	F3	39.50	13.17	89.60	10.95	9.95	3.50	1.10
	F4	44.10	14.25	96.90	11.97	10.79	4.12	1.27
Mean		38.15	12.64	89	10.43	9.13	3.1	1.05

Figure 5: Effect of phosphorus fertilization and farmyard manure application on the availability of some nutrients in soil.

Data also, indicate that the availability of micronutrients (Fe , Mn , Zn and Cu) were increased by the applied rates of all treatments.

The highest availability of macro and micronutrients of FYM in combinations with P fertilizers could be attributed to the difference between the rate of loss and the rate of supplement the nutrient under different treatments.Khater *et al*.(1997), indicted that the application of 600 kg fed^{-1} ordinary super phosphate to tomato plant in a calcareous soil has increased phosphorus uptake . This increase was due to the increase of phosphorus availability in soil solution and minimum phosphorus fixation in the growth medium . Hammad *et al* .(1990) , found that increasing P fertilizers level in a sandy soil, has resulted in an increase soil available P. Locascio *et al*,(1990). El-Garhi (1996) studied the residual effect of P fertilizer in a sandy soil under broad beans . He found that available P, after harvesting the crop, was higher in the soil receiving phosphorus fertilization than the unfertilized soil. Eghball *et al*. (1999), stated that manure or compost application to provide for corn N requirements greatly increases soil levels of P due to the N/P ratios of beef cattle feedlot manure and composted manure are significantly smaller than N/P uptake ratios of most crops.

The N/P ratio was 2.6 for feedlot manure and 1.9 for composted manure. Mohamed (2001) , stated that the application of organic residues significantly increased the chemically available N, P and K in the cultivated sandy soil and DTPA-extractable Fe, Mn, Zn and Cu .

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تـأثير التسـميد الفوسـفاتى مـع إضـافة السـماد البلـدى علـى نمـو و محصـول الفـول السودانى

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اقيمت تجربـة حقليـة فـى قريـة أحمـد رامـى – منطقـة البسـتان – النوباريـة بمحافظـة البحيـرة خـلال موسمى 2005 - 2006 (التربـة الرمليـة) بهـدف دراسـة تـأثير اضـافة المـادة العضـوية (FYM) بمعـدلات مختلفة (20 م^3/ فدان) وهـو المعـدل الموصـى بـه ثـم اضـافات متزايـدة بمـا يـوازي (25 ، 50 ، 75 ، 100 %) مـن الموصـى بـه بمـا يعـادل (25 , 30 ، 35 ، 40 م^3/ فدان) مـع اضـافات من سماد معدنى (السـوبر فوسـفات العـادى 15.5 فو2أ5) بمعـدلات (200 كجم/ فدان) الكميـة الموصـى بهـا ثـم اضـافات متزايـدة بمـا يوازى (25 ،50 ،75 ،100 %) مـن الموصـى بـه بمـا يعـادل (250 ، 300 ، 350 ، 400 كجم / فدان) ثم تم خلط السماد العضوى مع السماد المعدنى فكانت المعـاملات 17 معاملـة بـالكنترول فـى تجربـة قطاعـات كاملـة العشـوائية حيث تـم خلـط التربـة بالكميـات السـابقة قبـل زراعـة محصـول الفـول السـودانى جيـزه 5 وذلـك بهدف معرفة تأثير هذه المعاملات على نمو محصول الفول السودانى ومحتواه من العناصر الغذائية .

كانت النتـائج المتحصـل عليهـا توضـح زيـادة جميـع مقـاييس النمـو وأهمهـا الكتلـة الحيويـة ومحصـول القـرون وكـذلك محتـوى القـرون مـن عناصـر النتـروجين والفوسـفور والبوتاسـيوم وذلـك فـى جميـع المعـاملات وتتناسب الزيادة تناسبا طرديا مع زيادة المعدل عن كل اضـافة سـواء كانـت الاضـافات منفـردة أو مخلوطـة مـع بعضـها وكانـت أعلـى النتـائج المتحصـل عليهـا فـى المعـاملات التـى يتـم فيهـا خلـط الاسـمدة العضـوية مـع السـماد الفوسفاتى

اوضـحت الدراسـة أيضـا زيـادة تيسـير عناصـر النتـروجين والفوسـفور والبوتاسـيوم وكـذلك العناصـر الصـغرى (حديـد–منجنيـز–زنـك–نحاس) فـى التربـة بعـد الزراعـة .

توصـى الدراسـة باسـتخدام معـدل الاضـافة (30 م^3/ فدان) مـن السـماد العضـوى مـع اضـافة الكميـة الموصـى بهـا مـن السـماد الفوسـفاتى المعدنى وذلـك للحصـول علـى أعلـى النتـائج مـن المحصـول فـى الاراضـى الرملية .

قام بتحكيم البحث

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Table (1): some physical and chemical characteristics of the studied soil samples .

Location	Year	soil depth (c m)	Caco3 %	Particle size distribution %				Soil texture	Bulk density (gm cm^{-3})	Hydraulic conductivity (cm/hr)	EC (dS m^{-1}) (1:2.5)	Soil pH (1:2.5)	O . M %
				coarse sand	fine sand	silt	clay						
Ahmed Ramy Village	2005 - 2006	0-30	2.45	40.08	49.32	2.80	7.80	Sandy	1.51	25.01	0.18	7.9	0.14
		30-60	2.90	36.51	45.23	6.60	11.86	Sandy	1.42	20.60	0.12	7.8	0.07
		0-30	1.98	39.11	45.40	5.73	9.76	Sandy	1.39	23.72	0.21	8.10	0.22
		30-60	2.52	35.44	41.50	9.33	13.73	Sandy	1.28	21.80	0.15	7.90	0.09

		Soluble ions (1:2.5 Soil water extract) meq L^{-1}								Available P (p p m)	Available N %
		CO_3^{--}	HCO_3^-	CL^-	SO_4^{--}	Na^+	K^+	Ca^{++}	Mg^{++}		
	0-30	0.00	1.11	0.95	0.20	0.36	0.24	0.95	0.71	2.13	0.020
	30-60	0.00	0.91	0.86	0.14	0.24	0.17	0.85	0.65	1.25	0.012
	0-30	0.00	1.25	1.04	0.36	0.52	0.26	1.06	0.81	2.95	0.030
	30-60	0.00	1.01	0.95	0.20	0.29	0.20	0.95	0.72	1.82	0.019