EFFECT OF FARMYARD MANURE AND DIFFERENT SOURCES OF P AND K ON SOME MACRONUTRIENTS IN SOIL AND PLANT

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ABSTRACT: *The pot experiments were performed at the Faculty of Agriculture, Minufiya University, Shibin El-Kom to investigate the effect of different sources and rates, of P, K and organic manure on corn plants grown in both alluvial and calcareous soils. Two surface soil samples (0 – 30 cm) were collected from two locations. A) alluvial soil from experimental farm of the Faculty of Agriculture, Minufiya University, Shibin El-Kom. B) calcareous soil from Nubaria farm, Behera Governorate. Each polyethylene pot (15 cm diameter) was filled with 2 kg soils and planted with five grains of corn plant (Zea mays L.). After 14 days from planting the plants thinned to three plants per pot. The pots were irrigated to keep soil moisture at approximately 60% of the water holding capacity. The organic manure was added at 0, 1 and 2%. P was added at (0, 15 and 30 ppm, P_2O_5) of superphosphate and Triplephosphate. The organic manure and phosphatic fertilizers were added before planting. Potassium was added at 0, 24 and 48 ppm K_2O of potassium sulphate and potassium chloride.*

After 45 days from planting the plants were harvested and dried at 70°C, weighted, ground and digested for chemical analysis.

The application of FYM at rates of 1 and 2% to the both alluvial and calcareous soils caused a significant increase in dry matter yield of corn plants. The values of dry matter yield in alluvial soil, were higher than those obtained in the calcareous soil. The additions of FYM to both soils increased the N, P and K uptake by corn plants. The application of FYM increased the availability of P and K in used soils. The application of phosphatic fertilizers increased the dry matter yield of corn plants grown in both. The dry matter yield of corn plants with triplephospate application was higher than those with superphosphate in alluvial soil, while the reverse was reverse was true in calcareous one. The N, P and K uptake by corn plants were obviously higher on alluvial soil than those on calcareous one with P application. The application of phosphate fertilizers increased available P and slightly increased available K in used soils. Available P and K in alluvial soil were higher than those in calcareous one. Application of potassium sulphate was more effective in increasing dry matter yield of corn plants than potassium chloride in both soils. The absolute values of N, P and K uptake by corn plants by K_2SO_4 application were higher than those treated with KCl-fertilizers. Application of potassium fertilizers increased the available K in both used soils and slightly decreased availability P in alluvial soil but there is no effect in calcareous soil.

Key words: *FYM, Macronutrients, Corn Plant, Alluvial and Calcareous Soils.*

INTRODUCTION

Organic fertilization deficiency limits the proctuction of many crops especially grain legumes in many soils. The application of farmyard manure to soil markedly increases plant growths availability of nutrients in soil and nutrients uptake by 0 at plants.

It is known that phosphorus next to nitrogen and plays a fundamental role in large number or enzymatic reactions that depend on phosphorylation. Hence, phosphorus stimulates early growth, strong root formation, nodulation, and fruit setting, hostens maturity and promotes seed and protein yield of legumes (Marschner 1998). In this connection, El-Koumy *et al.* (1993) found that the addition of phosphate fertilizers increased the dry matter yield of clover tops in the following order Abou-Zabaal triplephosphate (Abou-Zabaal-superphosphate > Kafr El-Zait superphosphate.

Potassium influences crop production by enhancing growth and synthetic processes. It is highly important in raising the disease resistance of many crop species. Abou Hussien (2001), reported that the dry mattes yield of wheat plants increased significantly by K-fertilization and this increase was more pronounced for the plants fertilized by K_2O as compared to those fertilized by KCl.

Maize is one of the most important grain crops grown in Egypt. It plays a fundamental role in human and animal feeding. So the main target of the current investigation is to study the effect of FYM and different sources of P and K on some macronutrients in soil and plant.

MATERIALS AND METHODS

Two surface soil samples (0 - 30 cm) were collected from two locations a) Alluvial soil from experimental farm of the Faculty of Agric., Menofiya university, Shibin El-Kom. B) Calcareous soil from Nubaria farm, Beheira Governorate, air dried, and ground to pass through a 2 mm sieve.

Some physical and chemical properties of these soils were determined and recorded in Table (1).

Treatments and experimental design.

Polyethylene pots of 15 cm in diameter and 17 cm in depth were used and devided into two main groups. Complete randomized blocks design was employed in this study with three replicates. Two Kg of alluvial and calcareous soils were placed in each pot of the first and second pot groups respectively.

Each pot was fertilized with ammonium nitrate (33.5% N) at 0.6 g NH_4 NO_3 / pot as a solution after thinning of plants. Each pot was planted with five seeds of Maize (Zea *mays* L.) and irrigated with tap water at 60 % of water holding capacity of each soil. After 14 days from planting the plants were thinned to three plants for each pot. Each main group was devided into three sub groups.

FYM was added at rates 0, 1 and 2% of the used soil (Farmyard manur OM 28.2 %, 1.25 % N, C/N ratio 14.6, 0.52 % P, 1.3 % K, 90 ppm Zn, 532 ppm Fe, 50 ppm Cu and 115 ppm Mn). Phosphorus was added at 0, 15 and 30 ppm P_2O_5 of superphosphate (S.P) and triplephosphate (T.P). All phosphatic fertilizers and OM treatments were added before the cultivation.

Potassium was added at 0,24 and 48 ppm K_20 of K_2S0_4 and KCl.

Potassium was added after 15 days from planting. The plants were harvested after 45 days from planting and dried at 70°C until its weight became constant weighted, ground and kept for chemical analysis. Dry weight of the samples was recorded and statical analyzed, according to Steel and Torri (1980).

Plant analysis

Plant samples were digested with concentrated H_2SO_4 and H_2O_2 (cottenie, 1980).

Phosphorus, nitrogen and potassium were determined according to Jackson (1973).

Soil analysis

Some physical and chemical properties of these soils were determined as follows :

1. Mechanical analysis was performed according to the pipette method (Piper, 1950).
2. Total $CaCO_3$ was determined volumetrically by means of collin's calcimeter (Black, 1965).
3. Soil pH was determined in soil suspension (1 : 2.5, soil : water ratio) according to Richards (1954).
4. Total soluble salts as well as soluble cations and anions were measured in soil extraction (1: 5, soil : water) according to Jackson (1958).

TABLE 1

5. Organic matter was determined according to walkley and Black method (Jackson, 1958).
6. Cation exchange capacity was measured by sodium acetate method as described by Richards (1954).
7. Available phosphorus and potassium were determined according to Jackson (1958).

RESULTS AND DISCUSSION

Effect of farmyard manure on dry matter yield of corn plants

Data in Table (2) showed the effect of Farmyard manure (FYM) on dry matter yield. The addition of FYM at rates 1 and 2% to the soil significantly caused an increases in dry matter yield compared with the control plants. These increases may be attributed to role of organic matter which improve the physical, chemical and biologtcal properties of soil. These double-fold results are in agreement with those obtained by El-Koumey (1998) and El-Shafie (1999).

Data in Table (2) revealed that the dry matter yield of corn plants was significantly affected by soil type. The highest mean value of dry matter yield was found in alluvial soil while the lowest one obtained in calcareous soil. These results may be due to the improvement of soil condition for plant growth on alluvial soil compared with calcareous one. The most beneficial effect of FYM could be explained on bases that they encouraged the formation and stabilization of soil aggregates, consequently susceptibility of soil to crusting sharbly decreased, hence seed germination increased. These results are in agreement with those obtained by Awad (2001). Farmyard manure significantly enhanced hydraulic conductivity in the clay and calcareous soils through their effect on improving aggregation and macro-pores. Also application of FYM decreased soil reaction "pH" values and increased organic matter content.

Effect of different sources of P on dry matter yield

Data presented in Table (2) showed that phosphatic fertilizers application increased dry matter weights of corn plants grown in both alluvial and calcareous soils compared with the control plants, and the relationship between the obtained dry matter yield and the applied levels of both phosphatic fertilizers were positive. These results may be attributed to the important role of phosphorus on the roots growth which increase nutrients uptake and, also to phosphorus role in plant metabolism, which increase absorption leading to increase dry weight (Marschner, 1998). These results are in agreements with those obtained by Mersal (1996).

The same date revealed that the dry matter values of corn plants occurred induced with triplephosphate additions were more than those with superphosphate at the same levels of application in alluvial soil. These increases are parallel to phosphorus availability in the studied fertilizers. This finding are in agreement with those obtained by El-Koumey *et al.* (1993).

Also, the results indicated that the values of dry matter with superphosphate additions were more than with triplephosphate additions at the same levels of applications for plants grown on calcareous soil.

This difference may be due to the different chemical formula of the fertilizers where, supperphosphate contains higher calcium and less phosphorus percentage than the triplephosphate. Calcium keeps phosphorus in available form to plants as mono or di-calcium phosphate, which still provides plants with phosphorus and calcium.

In addition calcium helps in preventing amorphus silica and alumina to mineralize phosphate (El-Attar *et al.,* 1986).

Ibrahim (2001) revealed that superphosphate produced more dry matter than triplephosphate with plant, leaves, stem and root.

Table (2): Effect of farmyard manure, phosphate and potassium fertilizer on the dry matter yield of corn plants.

Treatments		Alluvial		Calcareous	
		g\pot	R.I.	g\pot	R.I.
Control	0	3.20	--	0.80	--
F.Y.M. (O.M)	1%	7.30	128.125	1.55	93.75
	2%	7.50	134.375	2.05	156.25
Superphosphate	15 ppm P_2O_5	4.10	28.125	1.40	75.00
	30 ppm P_2O_5	4.40	343.500	1.50	87.50
Triplephosphate	15 ppm P_2O_5	4.40	37.500	1.10	37.50
	30 ppm P_2O_5	4.50	40.625	1.20	50.00
K_2SO_4	24 ppm K_2O	3.86	20.625	1.20	150.00
	48 ppm K_2O	4.11	28.440	1.30	62.50
KCl	24 ppm K_2O	3.86	20.620	1.10	37.50
	48 ppm K_2O	4.00	25.000	0.90	12.50

L.S.D.	0.050	0.010
Fertilizers	0.263	0.353
Levels	0.263	0.353
Levels x Soil	0.372	0.499
Soil x fertilizers	0.372	0.499
Fertilizers x levels	0.455	0.611
Soil x fertilizers x levels	0.644	0.864

In general, the dry matter yield of corn plants was higher for plants grown on alluvial soil than those grown on calcareous one. These results are attributed to the effect of high exchange able capacity of alluvial soil and its ability to release nutrients during different stages of plant growth and had a beneficial physical, chemical and biological properties. These results are in agreement with those obtained by Khalil (2000).

Effect of different sources of K on dry matter yield

Data in Table (2) showed that the dry matter yield of corn plants treated with potassium sulphate were in general more than that with potassium chloride at the same levels of application in both used soils.

The high efficiency of K_2SO_4 compared with KCl, may be attributed to its contain of sulphur (S) 18% which consider one of the essential plant nutrients and plays a major role in plant growth and improvement of physical and chemical properties of sandy and calcareous soils (El-Masry, 1995).

The response of corn growth grown on calcareous soil, was more pronounced with K application in an increasing order than that for alluvial soil compared to the control plants.

These results are confirmed with those obtained by Abou Hussien (2001) and Haggag and El-Kholy (1998).

Effect of (FYM) on nitrogen content

Data presented in Table (3) showed a positive relationship between FYM application and N-content. This may be due to relatively high availability of nitrogen in the added FYM its uptake by plants.

Consequently, it may help to increase the respiration rate metabolism and growth of plants, causing the plant to require more nutrients from soil and fertilizers. These results are in agrrement with those obtained by El-Koumey (1998) and Awad (2001).

Effect of different sources of P on nitrogen :

Data presented in Table (3) revealed that superphosphate and triplephosphate applications at different levels under study increased N concentration and its uptake by corn plants as compared with untreated plants. This result may be due to the biological effect of P on plant metabolism and increase nitrogen fixation by bacteria. In this connection, El-Koumey *et al.* (1993) who found that increasing P increased N-uptake by different plants.

The same data Table (3) also revealed that N uptake was markedly increased by phosphorus additions for corn plants grown on alluvial and calcareous soils. In general, the amount of N uptake was obviously higher for plants grown on alluvial soil than those on calcareous one. The raising of application rate of phosphate fertilizers raised the nitrogen uptake than control. These results are in agreement with those obtained by Mersal (1996)

Table (3): Effect of different fertilizers on nitrogen content of corn plants.

Treatements	Soil	Alluvial			Calcareous		
		Concentration N%	Uptake Mg\pot	R.I. Uptake	Concentration N%	Uptake Mg\pot	R.I. Uptake
Control		2.33	74.560	--	1.07	8.560	--
F.Y.M. (O.M)	1%	2.55	186.150	149.66	1.27	19.685	129.96
	2%	2.64	198.000	165.56	1.29	26.445	208.94
Superphosphate	15 ppm P_2O_5	2.45	100.450	34.72	1.12	15.680	83.18
	30 ppm P_2O_5	2.58	113.520	52.25	1.18	17.700	106.78
Triplephosphate	15 ppm P_2O_5	2.57	113.080	51.66	1.22	13.420	56.78
	30 ppm P_2O_5	2.70	121.500	62.96	1.46	17.520	104.67
K_2SO_4	24 ppm K_2O	2.58	99.590	33.57	1.26	15.120	76.63
	48 ppm K_2O	2.71	111.380	49.38	1.31	17.030	98.95
KCl	24 ppm K_2O	2.57	99.200	33.05	1.29	14.190	65.77
	48 ppm K_2O	2.69	107.600	44.31	1.56	14.040	64.02

Effect of different sources of K on nitrogen content :

Data in Table (3) show that K-applications at diferent levels under study increased N content by corn plants compared with control. These results may be due to the effect of K on plant growth. These results are in agreement with those obtained by Sobh *et al.* (2000) and Abou Hussien (2001).

Effect of FYM on phosphorus content :

Data in Table (4) show that the application of FYM increased P-content in corn plants as compared with untreated plants. This increases in P content may be attributed to the influence of FYM on the release of P and other elements. The results can be explained by the fact that organic matter plays an important role in improving physical, chemical and biological properties of soil. These results were in accordance with results obtained by El-Fiki (1994) and Awad (2001). The same data in Table (4) showed that P uptake by corn plants grown on alluvial soil was higher than those grown on calcareous soil. This may be due to the ability of organic matter in rendering soil nutrients more available and chelation of these elements by humic substances.

Table (4): Effect of different fertilizers on phosphorus content of corn plants.

Treatements	Soil	Alluvial			Calcareous		
		Concentration P%	Uptake Mg\pot	R.I. Uptake	Concentration P%	Uptake Mg\pot	R.I. Uptake
Control		0.274	8.770	--	0.183	1.46	--
F.Y.M. (O.M)	1%	0.445	32.485	270.41	0.270	4.185	186.64
	2%	0.533	39.975	355.82	0.309	6.33	333.56
Superphosphate	15 ppm P_2O_5	0.301	12.340	40.72	0.212	2.97	103.42
	30 ppm P_2O_5	0.322	14.170	61.57	0.236	3.54	142.47
Triplephosphate	15 ppm P_2O_5	0.345	15.180	73.09	0.232	2.55	74.66
	30 ppm P_2O_5	0.345	15.525	77.02	0.256	3.07	110.41
K_2SO_4	24 ppm K_2O	0.287	11.080	26.34	0.209	2.51	71.92
	48 ppm K_2O	0.295	12.120	38.20	0.200	2.60	78.08
KCl	24 ppm K_2O	0.285	11.000	25.43	0.190	2.09	43.15
	48 ppm K_2O	0.281	11.240	28.16	0.246	2.21	51.37

Effect of different sources of P on phosphorus content

Data recorded in Table (4) showed that both P uptake by corn plants increased with increasing P application levels from 0 to 30 ppm P_2O_5 of the two phospherous fertilizers used.

These results can be attributed to the fact that phosphorus fertilizer is often more available for plant than the native soil P. These results are in agreement with results obtained by El-Sharawy *et al* (1994).

Data in Table (4) showed also that the absolute values of P uptake by corn plants grown on alluvial soil fertilized with triplephosphate were more than those obtained by plants treated with superphosphate at all application levels of P. These results are in good agreements with those obtained by EI-Koumey *et al.* (1993).

The same Data also showed that P uptake from the applied superphosphate was higher than that by triplephosphate in plants grown on calcareous soil. This results may be due to the triplephosphate in calcareous soil, which precipitated faster than superphosphate. These resultes are in harmony with findings of Ibrahim (2001).

Effecet of diferent sources of K on phosphorus content

Data presented in Table (4) showed that the additions of K fertilizers increased P content in corn plants. Increases in P-uptake by corn plants as a results of K additions may be due to the role of K in plant as macronutrient. These results are in harmony with the findings of Mallarino *et al.* (1999).

Data in Table (4) also showed that the absolute values of P- uptake by corn plants when applied with K_2SO_4 were more than those obtained by plants treated with KCl at all application levels of K. These results are in good agreement with those obtained by El-Kabbany (1999).

Effect of FYM on potassium content :

Data presented in Table (5) showed that FYM application caused marked increases in K-content of corn plants as compared with untreated plants.

Also, increasing FYM application from 1 to 2% increased K- uptake by corn plants grown on both alluvial and calcareous soils. This may be due to the effect of organic residues on increasing available potassium and other elements in the soil (Abou-Hussien, 1997, El-Koumey, 1998 and Awad, 2001).

Effect of differed sources of P on potassium content:

Data presented in Table (5) showed that K uptake by corn plants grown on both alluvial and calcareous soils increased with increasing P application levels from 0 to 30 ppm P_2O_5 of the two used phosphorus sources. These results are in agreement with those obtained by Mersal (1996).

Effect of different sources of K on potassium uptake:

Data in Table (5) showed that the applications of potassium sulphate and potassium chloride at different levels under study increased of K content by corn plants as compared with untreated plants. This result may be attributed to enhace the availability of K as a result of K fertilizer addition.

Data in Table (5) showed also that the increases of K-uptake resulted from potassium sulphate application was higher than that obtained with potassium chloride.

These results are in agreement with those obtained by Moussa (2000) and Abou Hussien (2001).

Effect of FYM on the availability of some macronutrients (P and K)

Data in Tables (6,7) showed that the application of FYM increased the availability of P and K in soils. It may be due to richness of organic fertilizers (FYM) with organic carbon, total N, available N, P, K, and their higher C.E.C. rather than effect of FYM on soil pH. These results are in agreement with those obtained by Badran *et al.* (2000).

Effect of different sources of P on the availability of some macro nutrients (P and K)

Data in Tables (6 and 7) showed that, the application of phosphate fertilizers increased available P and slightly increased available K in the used soils. The obtained data showed that the available P and K were increased by increasing the rate of P-application either in the superphosphate or in the triplephosphate.

Data in Table (6) showed that the application of triplephosphate increased the available phosphorus in alluvial soil than the application of superphosphate. This seems to be in relation to different chemical composition and properties of the used fertilizers.

These results are in agreement with those obtained by El-Koumey *et al.* (1993).

Data in the same Table (6) revealed that, the application of superphosphate increased the available phosphorus in calcareous soil, than the application of triplephosphate. This may be due to the different chemical formula of the two fertilizers where superphosphate contains higher calcium and less phosphorus percentage than the triplephosphate.

Table (5): Effect of different fertilizers on potassium content of corn plants.

Treatements	Soil	Alluvial			Calcareous		
		Concentration K%	Uptake Mg\pot	R.I. Uptake	Concentration K%	Uptake Mg\pot	R.I. Uptake
Control		1.33	42.660	--	0.630	5.040	--
F.Y.M. (O.M)	1%	1.83	133.590	213.15	1.030	15.965	216.77
	2%	2.05	153.750	260.41	1.060	21.730	331.15
Superphosphate	15 ppm P_2O_5	1.43	58.630	37.44	0.819	11.470	127.58
	30 ppm P_2O_5	1.46	64.240	50.59	0.810	12.150	141.07
Triplephosphate	15 ppm P_2O_5	1.46	64.240	50.59	0.850	9.350	85.52
	30 ppm P_2O_5	1.57	70.650	65.61	0.940	11.280	123.81
K_2SO_4	24 ppm K_2O	1,64	63.300	48.38	0.710	8.520	69.05
	48 ppm K_2O	1.66	68.230	59.94	0.720	9.360	85.71
KCl	24 ppm K_2O	1.61	62.150	45.69	0.700	7.700	52.78
	48 ppm K_2O	1,65	66.000	54.71	0.925	8.325	65.18

Table (6): Effect of different fertilizers on available P in used soils after plant harvest.

Treatements	Soil	Alluvial		Calcareous	
		Concentration (ppm)	R.I. Change %	Concentration (ppm)	R.I. Change %
Control		7.73	--	2.83	--
F.Y.M. (O.M)	1%	13.90	80.10	11.86	319.00
	2%	22.40	190.16	20.49	624.00
Superphosphate	15 ppm P_2O_5	8.89	15.10	4.64	64.00
	30 ppm P_2O_5	10.05	30.01	5.40	91.31
Triplephosphate	15 ppm P_2O_5	9.47	22.51	3.10	9.50
	30 ppm P_2O_5	10.63	37.52	3.87	36.65
K_2SO_4	24 ppm K_2O	7.27	-5.95	2.83	00.00
	48 ppm K_2O	7.27	-5.95	2.83	00.00
KCl	24 ppm K_2O	7.27	-5.95	2.83	00.00
	48 ppm K_2O	7.27	-5.95	2.83	00.00

Table (7): Effect of different fertilizers on available K in used soils after plant harvest.

Treatements	Soil	Alluvial		Calcareous	
		Concentration (ppm)	R.I. Change %	Concentration (ppm)	R.I. Change %
Control		454.63	--	253.81	--
F.Y.M. (O.M)	1%	479.42	+5.45	360.04	+41.85
	2%	519.30	+14.22	452.73	+78.37
Superphosphate	15 ppm P_2O_5	461.02	+1.41	257.05	+1.28
	30 ppm P_2O_5	472.13	+3.85	258.61	+1.89
Triplephosphate	15 ppm P_2O_5	474.90	+4.46	262.39	+3.38
	30 ppm P_2O_5	481.85	+5.99	273.50	+7.76
K_2SO_4	24 ppm K_2O	482.51	+6.13	276.81	+9.06
	48 ppm K_2O	491.56	+8.12	296.55	+16.84
KCl	24 ppm K_2O	479.76	+5.73	271.56	+6.99
	48 ppm K_2O	489.91	+7.76	293.20	+15.52

Calcium Keeps phosphorus in available form to plants as mono-or di-calcium phosphate, which still provides plants with phosphorus and calcium. Also high calcium carbonate in calcareous soil precipitate a large portion of the added phosphorus.

Also, high pH level of the calcareous soils which tend to be low in organic matter and available nitrogen resulted in unavailability of phosphate. Also, it may be due to superphosphate contains gypsum. The gyysum-$CaCO_3$ interaction, the $CaCO_3$ was precipitated on the gypsum particle surfaces, forming a coating layer.

Available P and K in alluvial soil were higher than those in calcareous one. This may be attributed to high CEC, high organic matter and high clay content. These results are in agreement with obtained by Khalil (2000).

Data in Table (7) revealed that, the application of triplephosphate increased the available potassium in alluvial and calcareous soils than the application of superphosphate. El-Koumey *et al.* (1993).

Effect of different sources of K on the availability of macro-nutrients (P and K).

Data in Table (7) showed that the application of K increased the available K in both used soils and slightly decreased available P in alluvial soil but there is no effect in calcareous soil.

These results are in agreement with Abd-El-Hadi and Ismail (2000).

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تأثير السماد البلدى ومصادر مختلفة من الفوسفور والبوتاسيوم على بعض العناصر الكبرى فى التربة والنبات

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الملخص العربى

أجريت تجربة أصص بكلية الزراعة . جامعة المنوفية لدراسة تأثير مصادر ومعدلات مختلفة من الفوسفور والبوتاسيوم وكذلك المادة العضوية على نمو نبات الذرة فى كلا من الأراضى الرسوبية والجيرية .

وجمعت عينات التربة الطينية من الطبقة السطحية لمزرعة كلية الزراعة بشبين الكوم جامعة المنوفية والتربة الجيرية من الطبقة السطحية لمزرعة النوبارية محافظة البحيرة.

وضع ٢ كجم من عينات الأرض فى كل أصص ارتفاعة ١٥ سم وتم زراعته بـ ٥ حبوب من الذرة . تم خف النباتات الى ٣ نباتات بعد ١٤ يوم من الزراعة رويت الأصص بإنتظام حتى وصل مستوى الرطوبة بالأرض الى ٦٠% من السعة المائية الكلية (W.H.C) .

وقسمت التجربة الى ٣ أقسام :

١- القسم الأول لدراسة تأثير المعاملة بمعدلات مختلفة من السماد العضوى (السماد البلدى) (صفر ، ١ ، ٢% من وزن التربة).

٢- القسم الثانى لدراسة تأثير المعاملة بمعدلات مختلفة (صفر ، ١٥ ، ٣٠ مللجم/كجم P_2O_5) من كلا من سوبر فوسفات وتربل فوسفات .وقد أضيف كلا من التسميد العضوى والفوسفاتى قبل الزراعة .

٣- القسم الثالث تم معاملته بالبوتاسيوم بمعدلات (صفر ، ٢٤ ، ٤٨ مللجم/كجم K_2O) فى صورتى كبريتات بوتاسيوم وكلوريد بوتاسيوم .

تم إضافة أسمدة البوتاسيوم والزنك والحديد بعد ١٥ يوم من الزراعة ، حصدت النباتات بعد ٤٥ يوم وجففت فى القرن عند ٧٠ م وحسب وزنها الجاف وطحنت ثم تم تحليلها كيميائياً .

أدت إضافة السماد البلدى بمعدلاته ١ ، ٢% الى كل من الأرض الطينية والجيرية الى زيادة معنوية فى المادة الجافة لنباتات الذرة .

أدت إضافة السماد البلدى الى كل من الأرضين الى زيادة تركيز وامتصاص النيتروجين والفوسفور بواسطة نبات الذرة .

أدت إضافة السماد البلدى الى زيادة الفوسفور والبوتاسيوم الميسر فى التربة .

أدت إضافة الأسمدة الفوسفاتية الى زيادة معنوية فى المادة الجافة لنباتات الذرة .

المادة الجافة لنباتات الذرة المسمدة بالتربل فوسفات أعلى من المسمدة بالسوبر فوسفات فى الأرض الطينية بينما حدث العكس فى الأراضى الجيرية .

أدت إضافة الأسمدة الفوسفاتية الى زيادة الفوسفور الميسر وكذلك زيادة طفيفة للبوتاسيوم الميسر فى كل من نوعى التربة المستخدمتين.

أدت إضافة سماد التربل فوسفات الى زيادة الفوسفور الميسر فى الأرض الطينية بدرجة أكثر من السوبر فوسفات بينما حدث العكس فى الأرض الجيرية .

كان محتوى التربة الطينية من الفوسفور والبوتاسيوم الميسر أعلى من محتوى التربة الجيرية منهما .

إضافة سماد كبريتات البوتاسيوم كان أكثر تأثيراً فى زيادة المادة الجافة لنباتات الذرة مقارنة بسماد كلوريد البوتاسيوم فى كل من التربة الطينية والجيرية .

كانت النباتات النامية فى الأرض الجيرية أكثر استجابة للتسميد البوتاسى من النباتات النامية فى الأراضى الطينية .

إضافة التسميد البوتاسى أدى الى زيادة البوتاسيوم الميسر فى كل من نوعى التربة وقلل بدرجة طفيفة من صلاحية الفوسفور فى الأرض الطينية ، بينما لم يؤثر على صلاحيته فى الأرض الجيرية .

Table (1): Some physical and chemical properties of the used soils under consideration.

Soil sample	Water holding capacity %	Particle size dist. %			Text. grade	O.M. %	$CaCO_3$ %	pH 1: 2.5 soil: water Susp.	EC dSm^{-1}	Soluble ions (meq/100 g soil)								C.E.C meq/ 100 gm	Available nutrients (ppm)	
										Soluble cations meq/ 100 gm soil				Soluble anions meq/ 100 gm soil					Macro nutrients	
		Sand	Silt	Clay						Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{-}	HCO_3	CL^{-}	$SO_4^{=}$		P	K
Alluvial	65	30.61	20.32	49.07	Clayey	0.61	2.6	7.90	0.69	1.06	0.88	0.90	0.55	-	1.06	0.85	1.48	39.2	8.5	478.24
Calcareous	34	70.40	20.70	8.90	Sandy loam	0.134	12.8	8.24	1.54	1.11	0.74	4.80	1.55	-	0.48	2.33	5.39	8.0	3.0	260.00