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RESPONSE OF WHEAT AND SUDAN GRASS PLANTS TO PHOSPHORUS AND POTASSIUM FERTILIZATION IN NEWLY RECLAIMED SOILS

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Abstract

A pot experiment was conducted under greenhouse condition at Giza to study the response of wheat and Sudan grass plants to application of P and K fertilizers and interaction between them in newly reclaimed soils. Soil samples were collected from El-Salhia, El-Fayoum and South Sinai. Phosphorus and K fertilizers were added at two rates: 15 and 30 kg P_2O_5/fed. and 24 kg K_2O/fed., respectively alone or in combiation.

Data showed clearly that dry matter of both wheat and Sudan grass plants grown in Fayoum and South Sinai soils were markedly increased by P application at both rates alone or in combination with K fertilizer. In Salhia soil, wheat plants responded significantly to P application along with K. however, they were not affected by application of P or K individually. Dry matter of Sudan grass grown on the same soil increased significantly by addition of P alone at the two rates and by the higher rate when applied along with K.

In general nutrients uptake (N, P and K) of wheat and Sudan grass plants grown in Salhia, Fayoum and South Sinai soils gave the higher values when the combination of the high rate of P and the low rate of K (P_2K_1) was added while the low rate of K alone recorded the lowest increase.

INTRODUCTION

The newly reclaimed soils in Egypt are considered valuable for future agricultural expansion. Great attention should be taken with respect to their nutritional status. These soils are deficient in most of the essential macro- and micro-elements which should be added to maintain high productivity of crops grown on such soils. Many investigations dealt with fertilizer application to sandy soils in Egypt (Sabet *et al.* 1963, Abd El-Salam *et al.* 1964, Ozoris *et al.* 1977 and Abd El-Hadi *et al.* 1987). Some of these researches revealed the problem of unbalanced nutrition through fertilization. El-Saadani *et al.* (1992) showed that some field crops showed different responses to levels of N, P and K fertilization in sandy soils. They added that high levels of fertilizer application were less effective in increasing the yield of wheat, faba bean and lupin due to the conditions of unbalanced nutrition in sandy soils. Experiments carried out by Sabet *et al.* (1963) and Abd El-Salam *et al.* (1964) showed response to many elements but not K in sandy soils.

On loamy soil, Rashid *et al.* (1990) showed progressive increase in wheat yield with increasing doses of both phosphorus and potash. They added that response to phosphorus was more pronounced than to potassium.

Aslam Main and Ali (1990) showed that NP application compared to N alone caused a significant increase in the yield and yield components of rice and wheat. However, K application even at higher level did not show positive response for the yield of the two crops over six years period.

In Egypt cultivating summer fodder crops (as Sudan grass) in the new reclaimed soils aimed to cover the needs of farm animals during summer season. Dry and fresh forage yields of cowpea and Sudan grass increased significantly by application of organic manure and nitrogen rate up to 135 kg N/fed. to calcareous soil (Abd El-Gawad *et al.* 1992).

This paper reports on the response of wheat and Sudan grass plants to phosphorus and potassium application in newly reclaimed soils and their effect on nutrients uptake.

MATERIALS AND METHODS

A pot experiment was conducted under greenhouse condition at Giza to study the response of wheat and Sudan grass plants to application of phosphorus and potassium fertilizers in newly reclaimed soils. Soil samples were collected from El-Salhia, El-Fayoum (kom Oshim) and South Sinai (Agric. Res. Station). Texture and some chemical properties of these soils were determined (Table 1). The pots were arranged in complete randomized block design. Six kgs of each soil were placed into each pot. Wheat grains (Sakha 69) and Sudan grass grains (1.5 g/pot) were sown. Wheat plants were thinned to 10 plants/pot after 15 days from sowing. Phosphorus as Ca- superphosphate (Corresponding to 15 % P_2O_5) was added at two rates, 1.5 and 3 g/pot (15 and 30 kg P_2O_5/fed. respectively, before sowing. Potassium as K-sulphate (48% K_2O) at two rates, 0.75 and 1.5 g/pot (corresponding to 24 and 48 kg K_2O/fed. respectively) were added in two equal doses after thinning and 15 days later for wheat. Fertilizers were added in 7 days after sowing and 7 days later for Sudan grass and other treatments. All pots recieved 4.5 g ammon. Sulphate (20.5 % N) in three equal doses, after thinning and every 15 days for wheat and at two equal doses after 7 days from sowing and 7 days later for Sudan grass. Wheat plants were harvested at booting stage (70 days from sowing), while Sudan grass plants were harvested after 23 days from sowing. Dry matter for each crop was recorded. N, P and K contents were determined in the digested solution according to Jackson (1973).

RESULTS AND DISCUSSION

1-Dry matter

Data presented in Table 2, showed that in Salhia soil, wheat plants, responded significantly to P application along with K, however, they were not affected by application of P or K individually. It was also noticed that dry matter of Sudan grass grown on the same soil increased significantly by addition of P alone at the two rates and by the higher rate when applied along with K. Moreover, wheatplants had no response to K application alone and dry matter of Sudan grass was decreased by K application alone.

Data in Table 2 also showed clearly that dry matter of both wheat and Sudan grass plants grown on Fayoum and S.Sinai soils were markedly increased by P application at both rates alone or in combination with K fertilizer, while the two crops had no response to K application alone in both soils. Similar results for the effect of K fertilization on other crops in sandy soils were found by Sabet *et al.* (1963) and Abd El-Salam *et al.* (1964). This behaviour may be due to the nutrient unbalance in the sandy soil caused by inadequacy of available nutrients.

The response of the two crops to P and K application in Fayoum and S. Sinai soils was more pronounced than that in Salhia soil and this may be attributed to the high nutrient content of Salhia soil (Table 1). It could be concluded that plants need a complete or balanced rations of nutrients to obtain the optimum yield in sandy soils and calls for caution in the development of fertilizer programs for these soils aiming at the more efficient and economical usage of fertilizers.

2- Nutrients uptake

a - Salhia soil

The results in Table 3 showed that nutrients uptake by wheat plants increased under different treatments. Nitrogen and P uptake increase ranged from 4.1 to 39.4% and 13.5 to 46.2 %, respectively. The high rate of K alone gave the lowest increase whereas the high rate of P along with the low rate of K (P_2K_1) showed the highest increase in N and P uptake. Regarding K uptake by wheat plants, it was also observed that K uptake ranged from 3.6 to 28.1%. The high rate of K alone Gave the lowest increase and the highest increase was achieved by application of the high rates of P and K fertilizers as shown in Table 3.

Concerning Sudan grass, it was noticed that N uptake was increased by the low and the high rate of P in combination with the two K rates and decreased by other treatments especially the high rate of K alone which recorded the highest decreased (Table 3). On the other hand, P and K uptake increased ranged from 3.5 to 81.1% and 4.7 to 59.3%, respectively. The combination of the high rate of P and the low rate of K (P_2K_1) gave the highest increase while the high rate of K alone showed the lowest increase.

b - Fayoum soil

Data in Table (4) illustrated that N, P and K uptake by wheat plants were greatly increased by P application alone or in combination with K fertilizer and the combination treatment gave the highest uptake of N, P and K. It was also observed that K treatments alone gave the less increase in nutrients uptake.

Regarding Sudan grass, it was noticed that N uptake was markedly increased by P application alone or in combination with K while it was decreased by K application only. Meanwhile, P and K uptake by Sudan grass were increased by the combination of P and K fertilizers (P_1K_2 and P_2K_1) as shown in Table (4).

c - South Sinai soil

Nitrogen uptake by wheat plants increased clearly by P treatment alone or in combination with K while application of K at the two rates alone decreased N uptake (Table 5). The combination of the high rates of both P and K gave the highest N uptake. On the other hand, P and K uptake was increased due to different treatments used and the combination of the high rates of P and K fertilizers recorded the highest uptake of P and K. Potassium application alone caused the lowest increase in P and k uptake by wheat plants.

Regarding nutrients uptake by Sudan grass, data in Table (5) indicated that N uptake was slightly affected by K application alone. However, P application alone or along with K increase N uptake. On the other hand, P and K uptake increase ranged from 12.6 to 213.9% and 15.9 to 236.1%, respectively. The combination of the high rate of P and K (P_2K_2) gave the highest increase, while the low rate of K alone recorded the lowest increase.

Finally, the above discussion reveals that complete or balanced ratio of different nutrients is necessary to obtain the optimum dry matter and nutrients uptake in sandy soils.

Table 1. Some chemical properties and texture of investigated soils.

Properties	Salhia	Fayoum	South Sinai
Av. N ppm	45	15.0	15.0
Av. P ppm	30	3.0	2.0
Av. K ppm	270	145.0	80.0
Ec mmohs/cm (1:5) 25°C	1.40	0.67	0.54
pH (1: 2.5)	7.8	7.9	7.7
O.M. (%)	1.2	0.8	0.8
Texture	Sandy	Sandy loam	Sandy loam

Table 2. Effect of P and K application on dry matter (g/pot) of wheat and Sudan grass plants grown in newly reclaimed soils.

Treatment	Salhia		Fayoum		South Sinai	
	Wheat	Sudan grass	Wheat	Sudan grass	Wheat	Sudan grass
Control	24.4	16.4	4.3	12.0	2.3	6.1
P1	25.6	21.5	15.8	17.8	10.4	11.6
P2	25.7	20.5	18.0	17.7	15.4	16.3
K1	24.4	15.7	5.1	13.2	2.3	5.9
K2	25.4	14.7	8.1	12.0	2.4	6.9
P1K1	28.6	17.4	16.2	15.0	10.4	11.8
P1K2	26.5	15.1	15.2	21.3	11.4	13.3
P2K2	28.7	22.6	16.7	26.0	14.2	14.8
P2K2	29.0	19.4	18.3	27.5	15.5	14.6
L.S.D.						
(5%)	2.23	1.57	2.787	3.189	2.56	2.035
(1%)	3.24	2.16	3.84	4.394	3.53	2.805

Table 3. Effect of P and K applications on nutrients uptake of wheat and Sudan grass plants grown in Salhia soil.

Treatments	N		P		K	
	Uptake mg/pot	Relative uptake	Uptake pots mg/pot	Relative uptake	Uptake mg/pot	Relative uptake
			Wheat			
Control	658.8	100.0	88.5	100.0	1161.4	100.0
P1	418.1	123.6	91.8	113.8	1292.8	111.3
P2	717.0	108.8	105.4	130.9	1285.0	110.6
K1	744.2	113.0	97.6	121.2	1220.0	105.0
K2	685.8	104.1	91.4	113.5	1206.5	103.6
P1K1	880.9	133.7	102.9	127.8	1441.4	124.1
P1K2	869.2	131.9	103.4	128.4	1346.2	115.9
P2K1	918.4	139.4	117.7	146.2	1483.9	127.5
P2K2	899.0	136.5	101.5	126.1	1487.7	128.1
			Sudan grass			
Control	439.5	100.0	31.2	100.0	662.6	100.0
P1	554.7	126.2	45.2	144.9	993.3	150.0
P2	424.4	96.6	51.8	166.0	823.9	124.3
K1	361.1	82.2	33.0	105.8	775.6	117.1
K2	338.1	76.9	32.3	103.5	693.8	104.7
P1K1	408.9	93.0	38.3	122.7	840.4	126.8
P1K2	434.9	99.0	42.3	135.6	729.3	110.1
P2K1	594.4	135.2	56.5	181.1	1055.4	159.3
P2K2	494.7	112.5	38.8	124.4	781.8	118.0

Table 4. Effect of P and K applications on nutrients uptake of Wheat and Sudan grass plants grown in Fayoum soil.

Treatments	N		P		K	
	Uptake mg/pot	Relative uptake	Uptake mg/pot	Relative uptake	Uptake mg/pot	Relative uptake
			Wheat			
Control	126.9	100.0	9.9	100.0	181.5	100.0
P1	328.4	258.9	33.2	335.0	614.6	338.6
P2	504.0	397.2	54.0	545.0	676.8	372.9
K1	153.0	120.5	13.3	133.9	211.1	116.3
K2	214.7	169.2	18.6	187.9	358.8	197.7
P1K1	445.5	351.1	35.6	359.6	711.2	391.8
P1K2	349.6	275.5	30.4	307.0	665.8	366.8
P2K1	439.2	346.1	38.4	387.9	731.5	403.0
P2K2	545.3	430.0	49.0	499.0	378.4	208.5
			Sudan grass			
Control	297.6	100.0	21.6	100.0	381.6	100.0
P1	388.0	130.4	30.3	140.3	708.4	185.6
P2	439.0	147.5	42.5	196.7	582.3	152.6
K1	270.6	90.9	29.0	134.2	506.4	131.3
K2	285.6	96.0	30.0	138.9	508.8	133.3
P1K1	372.4	125.1	39.5	182.9	702.2	184.0
P1K2	500.6	168.2	68.2	315.7	1028.8	269.6
P2K1	559.0	187.8	72.8	337.0	1214.2	318.2
P2K2	737.0	247.6	41.3	191.2	948.8	248.6

Table 5. Effect of P and K applications on nutrients uptake of Wheat and Sudan grass plants grown in South Sinai soil.

Treatment	N		P		K	
	Uptake mg/pot	Relative uptake	Uptake mg/pot	Relative uptake	Uptake mg/pot	Relative uptake
Control	82.8	100.0	6.4	100.0	84.6	100.0
P1	299.5	361.7	23.9	371.1	366.1	432.7
P2	458.9	554.2	35.4	549.7	599.1	708.2
K1	67.4	81.4	8.3	128.9	103.7	122.6
K2	73.2	88.4	8.7	129.6	104.2	123.2
P1K1	343.2	414.5	25.0	388.2	434.7	513.8
P1K2	324.9	392.4	23.9	371.1	485.6	574.0
P2K1	390.5	741.6	34.1	529.5	563.7	666.3
P2K2	542.5	655.2	49.6	770.2	641.7	758.5
Control	140.3	100.0	7.9	100.0	178.1	100.0
P1	266.8	190.2	15.1	191.1	406.0	227.9
P2	415.7	296.3	24.2	312.9	554.2	311.1
K1	147.5	105.1	8.9	112.6	206.5	115.9
K2	148.4	105.8	11.0	139.2	216.0	121.3
P1K1	280.8	200.0	18.9	239.2	462.6	259.7
P1K2	283.3	201.9	18.6	235.4	514.7	289.0
P2K1	310.8	221.5	20.7	262.0	589.0	330.7
P2K2	423.4	301.8	24.8	313.9	599.30	336.1

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إستجابة القمح وحشيشة السودان للتسميد الفوسفاتى والبوتاسى فى الأراضى حديثة الإستصلاح

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أقيمت تجربة إصص فى الجيزة لدراسة إستجابة نباتات القمح وحشيشة السودان لإضافة الأسمدة الفوسفاتية والبوتاسية والتفاعل بينهما فى الأراضى الحديثة الإستصلاح. جمعت عينات التربة من الصالحية والفيوم وجنوب سيناء. أضيفت الأسمدة الفوسفاتية والبوتاسية بمعدلين ١٥ ، ٣٠ كجم فو٢ أ ٥ للفدان ، ٢٤ ، ٤٨ كجم بو٢أ للفدان مجمعة أو منفردة ومقارنتها بالكنترول.

أظهرت النتائج أن إضافة الفوسفور لأراضى الفيوم وسيناء بمعدلاتة منفرداً أو مع البوتاسيوم أدت الى زيادة مؤكدة فى المادة الجافة لكلا المحصولين.

إستجاب القمح معنوياً لإضافة الفوسفور والبوتاسيوم معاً لأرض الصالحية إلا أن النباتات لم تستجب لإضافة أى منهما على إنفراد. أما حشيشة السودان النامية على نفس التربة فقد زادت المادة الجافة معنوياً لجميع المعاملات.

وبوجة عام كانت أعلى قيم لإمتصاص المغذيات النيتروجينية والبوتاسيوم والفوسفور للنباتات المختبرة النامية على الأنواع المختلفة للتربة عند إضافة المعدل العالى من الفوسفور والمنخفض من البوتاسيوم معاً بينما سجل المعدل المنخفض من إضافة البوتاسيوم أقل قيم الزيادة.