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EFFECT OF POTASSIUM FERTILIZATION AND GYPSUM APPLICATION ON POTATO (*SOLANUM TUBEROSUM* L.) IN NEWLY CULTIVATED SAND SOIL

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ABSTRACT: **This study was carried out to evaluate the effect of some potassium sources (potassium sulfate and potassium chloride) and levels on growth, chemical analysis of different parts of potato (*solanum tuberosum L.*) plant, tuber quality and yield of potato at harvest under the effect of gypsum application in newly cultivated sand soil located at El-qassasin Horticulture Research Station, Esmailia Governorate. During autumn of the two successive seasons 2000/2001 and 2001/2002.**

Application of potassium sources (K_2SO_4, 48% K_2O or KCl 60% K_2O) each at the rate of 0, 48, 96 and 144 kg K_2O/fed. with or without gypsum application (1metric ton/ fed.).

The addition of gypsum significantly increased total fresh weight of leaves, dry weight of stem/plant, dry matter percentage of stems, number of tubers/ plant, weight and volume/ tuber and tuber yield.

The application of potassium sulphate significantly increased tubers yield while, the addition of potassium chloride significantly increased carbohydrate percentage in tuber. Increasing potassium level significantly increased weight and volume/ tuber, potassium percentage in stem, leaves and tubers and carbohydrate percentage in tuber while, significantly decreased starch percentage.

Key words: **Potato, potassium source, potassium levels, gypsum application, yield quality.**

INTRODUCTION

Potato (*Solanum tubersum* L.) is considered one of the major and the most important vegetable crop in Egypt. There is a high demand on potatoes for human local consumption as well as exportation. In the past few years, a great attention was paid to increase the cultivated area by adding new reclaimed lands in the Egyptian desert. However, these new reclaimed lands suffer from deficiency in macro and micronutrients as well as organic matter.

Potassium and calcium are considered major limiting factors in potato production specially in the new reclaimed lands of the Egyption desert. Yogesha *et al.* (1999) mentioned that most growth and yield parameters increased by adding up to 150 % of the recommended K rate. Singh and Singh (1995) found that total tuber yield of large and medium size tubers increased with increasing K rate, while the number and yield of small tubers decreased as K rate increased, Negrila *et al.* (1994) added potassium in different proportions of KNO_3 and KCl and recorded increase in tuber yield with increasing KNO_3 compared with KCl. Oktay *et al.* (1997) found that K sources had no significant effect on yield. Reis-Junior and Fontes (1996) Concluded that starch content decreased with increasing K rates. Reixota *et al.* (1996) reported that tuber dry matter yields and average tuber weight increased linearly with increasing K rates. Kamar and Omar (1987) found that the application of gypsum significantly increased total potato yield, average tuber weight and the dry matter percentage of tubers. Awad *et al.* (2002) concluded that addition of gypsum increased plant height foliage dry weight, N, P and K per plant while, the foliage fresh weight was not affected. Shahid-Umar *et al.* (2001) studied different rates and sources of K on potato yield. Application of S (as gypsum) along with potassium chloride significantly enhanced tuber yield, and a similar trend was recorded with sulfate of potassium with respect to S supply.

Craighead and Martin (2003) found that trials on seed crops showed no significant effect of N or K on yield; and that potato yield response to K was not related to soil exchangeable K levels. K applied as KCl increased yield but reduced tuber dry matter content

compared to K applied as K_2SO_4. Lu-Jinwei *et al.* (2001) found that adequate K levels increased yield and quality assessed by measuring the average weight and starch content of Sweet potato. However, KCl was more efficient, in terms of yield, than K_2SO_4 .Total starch yield was higher with KCl due to higher fresh sweet potato yield. Davenport and Bentley (2001) mentioned that no correlation was found between applied K (KCl or K_2SO_4) and commercial yield of potato or the starch or water content.

The aim of this study was to assess the effect of two potassium sources out different levels alone or in combination with or without gypsum on growth, yield and yield quality of potato plants in a newly cultivated sandy soils, Ismailia Governorate, Egypt.

MATERIALS AND METHODS

Two field experiments were carried out during the autumn of the two successive seasons 2000/2001 and 2001/2002 in a newly reclaimed sand soil located at El-qassasine Horticulture Research Station, Ismailia Governorate under drip irrigation to study the effect of potassium sources (K_2SO_4, 48 % K_2O or KCl, 60 % K_2O) each at the rate of 0, 48, 96 and 144 kg K_2O/fed. with the addition of gypsum, 1 metric ton/fed. or without gypsum application. Chemical and physical properties of the soil were conducted by methods described by Piper (1950), Jackson (1958) and Black (1965) and are shown in Table 1.

The experiment was conducted in a randomized complete block design, factorial. There where 3 factors involved in the experiment. They were (A) gypsum: without, and with; (B) source of K: sulphate and chloride; (C) rate of K: four rates. Thus, the experiment consisted of 16 treatments which were (2 gypsum levels X 2 potassium sources X 4 potassium levels); executed in 3 replicates i.e., 48 plots Each plot area was 21 m^2 including 10 rows with 70 cm. distance between rows and each row contained 10 hills with 30 cm. distance between hills and each hill contained one plant. The first experiment 2000/2001 was sown on 28 October and harvested on 2 March 2001 while the second one was sown on 17 November and harvested on 22 March 2002.

Table 1: Physical and chemical properties of experimental soil for the two seasons

Mechanical analysis					*	**	** Ions me/L							
season	Sand %	Silt %	Clay %	Soil texture	P^H	E.C. ds/m	Ca^{++}	Mg^{++}	Na^{+}	K^{++}	Ca_3^{--}	HCo_3^{-}	Cl^{-}	So_4^{--}
2000/2001	90.8	4.2	5.0	sand	8.4	2.1	0.33	0.54	0.98	0.07	-	0.43	0.54	1.25
2001/2002	87.3	4.3	8.4	sand	8.3	2.6	0.43	0.34	0.94	0.07	-	0.35	0.34	1.15

* 1:2.5 soil: water; ** in saturation extract

Potassic fertilizers were split in two equal doses at planting and 45 days after sowing, while the nitrogen fertilizer (ammonium nitrate, 33% N) was split in 4 doses as the 30, 40, 50 and 60 days after planting at percentage 10, 20, 40 and 30% of the total rate (120 kg N/fed.) and calcium superphosphate (15.5% P_2O_5) was added before planting at 70 kg P_2O_5/fed. Irrigation water (well water) was used with dripper spaced 25 cm. on line and the rate of water discharge was 4 L/h./dripper.

Data Recorded:

Plant growth: Random samples of three plants each from each plot were taken at harvest. Stem, leaves, total fresh and dry weight and dry matter percentage of each were recorded.

Yield and yield attributes: Number and volume of tubers /plant, single tuber and volume, tuber fresh and dry weight /plant, and total yield metric ton/fed. were recorded.

Chemical constituents: Total macronutrients of N, P and K in stems, leaves and tubers as well as total carbohydrates and starch in tubers were determined according to Michel *et al.* (1956), Reda (1970), Black (1956), and Jackson (1958).

Statistical analysis: data were subjected to the statical analysis according to Fisher (1960).

RESULTS AND DISCUSSION

1. Plant Growth

1.a. Plant fresh weight

Data presented in Table 2 show that the addition of gypsum significantly increased leaves fresh weigh/plant in the two successive seasons as well as total fresh weight/ plant in the second season and did not significantly affect

Table 2: Main effects of gypsum application, potassium source and level on fresh weight (g/plant) of potato plant at harvest

Season	Season 2000/2001			Season 2001/2002		
Character / Treatment	Stems	Leaves	Total	Stems	Leaves	Total
Without gypsum (A1)	18.72	29.37	48.09	5.725	33.91	39.63
With gypsum (A2)	21.15	40.18	61.34	6.845	56.86	63.71
L.S.D 0.05	n.s	9.51	n.s	n.s	12.51	10.52
K_2SO_4 (B1)	19.94	34.06	54.00	7.077	47.24	54.27
KCl (B2)	19.94	35.50	55.44	5.543	43.53	49.08
L.S.D 0.05	n.s	n.s	n.s	n.s	n.s	n.s
Level K kg. K_2O/fed.						
0 (C1)	18.43	33.38	51.81	5.455	40.21	45.66
48 (C2)	18.78	36.26	55.04	6.243	47.62	53.86
96 (C3)	17.61	30.65	48.25	6.701	43.34	50.04
144 (C4)	24.63	38.83	63.76	6.741	50.33	57.12
L.S.D 0.05	n.s	n.s	n.s	n.s	n.s	n.s

Table 2-a: Main Effect of gypsum application, potassium source and level on foliage dry matter (%) and dry weight (g/plant) of potato plant at harvest

Season	Season 2000/2001				Season 2001/2002			
Character	Dry weight (g/plant)		Dry matter %		Dry weight (g/plant)		Dry matter %	
Treatment	Leaves	Stems	Leaves	Stems	Leaves	Stems	Leaves	Stems
Without gypsum (A1)	9.660	0.911	37.37	4.994	6.810	0.724	21.34	7.418
With gypsum (A2)	9.891	1.770	50.76	8.256	11.000	0.576	18.28	8.553
L.S.D 0.05	n.s	0.157	n.s	0.953	n.s	n.s	n.s	n.s
K_2SO_4 (B1)	9.969	1.372	47.10	6.732	8.750	0.528	19.44	8.080
KCl (B2)	9.583	1.309	41.03	6.521	9.067	0.475	20.38	7.891
L.S.D 0.05	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s
Level K kg. K_2O/fed.								
0 (C1)	9.217	1.362	44.05	6.672	8.155	0.412	22.33	6.990
48 (C2)	9.801	1.404	42.86	6.490	8.972	0.550	18.98	9.397
96 (C3)	9.132	1.112	47.24	6.773	8.899	0.509	19.74	7.641
144 (C4)	10.953	1.484	42.11	6.571	9.608	0.536	18.58	7.913
L.S.D 0.05	n.s	n.s	n.s	n.s	n.s	n.s	2.78	n.s

Gypsum rate: 1 metric ton/fed

stem fresh weight/ plant in the two successive seasons as well as total fresh weight/plant in the second season. The obtained data show that according to the main effect the two potassium sources were similar in effect regarding the studied characters in the two successive seasons, Also increasing potassium rate did not significantly affect these characters in both seasons. In contrast Awad *et al.* (2002) found that the foliage dry weight per plant of potato significantly increased by gypsum application while foliage fresh weight was not significantly affected in both growing seasons.

1.b. Plant dry weight

Table 2-a show that addition of gypsum significantly increased stem dry weight/plant and dry matter percentage in the first season only, while addition of gypsum did not significantly affect leaves dry weight/plant as well as leaves dry matter percentage in the two successive seasons and stem dry matter percentage in the second season. The recorded data show that the two potassium sources were not significantly different from each other on leaves and stems dry weight/plant or leaves and stems dry matter percentage in the two successive seasons. Also increasing potassium rate did not significantly affect all these studied characters except for dry matter percentage in the second season where the increasing of potassium rates resulted in decreases. Values of % dry matter were 22.3, 18.96, 19.74 and 18.58 % for the addition of 0, 48, 96 and 144 K_2O/fed., respectively. These results are in agreement with those obtained by Awad *et al.* (2002) who found that the foliage dry weight /plant was significantly increased by gypsum application and they attributed these results to gypsum decreasing in the pH of the soil.

2. Yield and Yield Components

2.a. yield component

Data in Table 3 show that the addition of gypsum significantly increased the number of tubers per plant only in the second season while addition of gypsum did not significantly affect the weight/ tuber or the volume/ tuber in both seasons as well as the number of tubers/plant in the first season. Also, the two different potassium sources were similar in effect on

Table 3: Main Effect of gypsum application, potassium source and level on yield component of potato plant at harvest

Season	Season 2000/2001			Season 2001/2002		
Character / Treatment	Number of tuber plant	Singly tuber weigh (g)	Singly tuber volume (cm^3)	Number of tuber plant	Singly tuber weigh (g)	Singly tuber volume (cm^3)
Without gypsum (A1)	7.417	74.67	67.71	4.604	59.04	55.48
With gypsum (A2)	7.000	106.27	86.93	6.792	57.56	54.06
L.S.D 0.05	n.s	n.s	n.s	1.087	n.s	n.s
K_2SO_4 (B1)	7.708	86.49	71.13	5.542	60.11	56.89
KCl (B2)	6.708	94.45	83.51	5.854	56.49	52.66
L.S.D 0.05	n.s	n.s	n.s	n.s	n.s	n.s
Level K kg. K_2O/fed.						
0 (C1)	5.557	72.78	72.07	6.500	44.92	38.19
48 (C2)	7.000	76.56	79.17	5.333	60.94	58.11
96 (C3)	7.500	100.21	85.84	6.625	58.16	57.47
144 (C4)	8.667	112.33	72.21	5.333	69.18	65.32
L.S.D 0.05	n.s	n.s	n.s	n.s	14.37	16.18

Table 3-a: Main Effect of gypsum application, potassium source and level on yield component per potato plant at harvest

Season	Season 2000/2001				Season 2001/2002			
Character / Treatment	Tuber fresh weight/ plant (g)	Tuber volume/ plant (cm^3)	Tuber dry weight/ plant (g)	Tuber dry matter/plant (%)	Tuber fresh weight/ plant (g)	Tuber volume/ plant (cm^3)	Tuber dry weight/ plant (g)	Tuber matter dry/plant (%)
Without gypsum (A1)	528.8	499.2	100.42	18.90	260.4	238.1	43.16	17.05
With gypsum (A2)	714.3	582.7	134.9	18.92	368.5	347.3	59.41	17.00
L.S.D 0.05	n.s	n.s	n.s	n.s	65.03	68.54	n.s	n.s
K_2SO_4 (B1)	632.0	537.1	118.1	18.71	314.5	298.2	54.16	17.26
KCl (B2)	611.1	544.7	117.3	19.11	314.3	292.2	48.41	16.78
L.S.D 0.05	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s
Level K kg. K_2O/fed.								
0 (C1)	494.3	448.3	96.20	19.21	387.7	253.8	45.83	16.46
48 (C2)	618.3	523.2	116.3	18.71	316.6	299.4	56.47	17.99
96 (C3)	676.9	591.0	125.0	18.50	319.7	302.8	51.45	16.32
144 (C4)	696.6	601.1	133.3	19.21	333.8	314.8	51.40	16.82
L.S.D 0.05	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s

Gypsum rate: 1 metric ton/fed

number of tubers/plant, weight and volume per tuber in both seasons. Increasing potassium rate did not significantly affect number of tubers/plant, weight and volume/ tuber in the first season as well as number of tubers/plant in the second season. The addition of 48 kg K_2O/fed. significantly increased both tuber weight and tuber volume, in the second season.

Further potassium application (96 and 144 kg K_2O/fed.) had no effect on these parameters compared with the 48 kg K_2O/fed. These results are in agreement with those obtained by Awad *et al.* (2002)

Data in Table 3-a show that the addition of gypsum did not significantly affect tuber fresh weight/plant, tuber volume/plant, tuber dry weight/plant and tuber dry matter percentage/plant in the first season as well as tuber dry weight and tuber dry matter percentage/plant in the second season. However, addition of gypsum significantly increased tuber fresh weight and tuber volume/plant in the second season. The two different potassium sources did not significantly differ from each other for these studied characters in the two successive seasons. Also the obtained data show that increasing potassium rates from did not significantly affect these studied characters.

These results are in agreement with those of Singh and Singh (1995), Reis-Junior and Fontes (1996), Lu-Jianwei *et al.* (2001) and Shahd-umar *et al.* (2001).

2.b. Total yield

Data in Table 4 show that the addition of gypsum significantly increased potato yield in the two successive seasons. The two potassium sources differed significantly on potato yield, only in the second season when potassium sulphate was superior to potassium chloride. However, the two different sources did not significantly differed regarding the yield in the first season. Increasing potassium rate did not significantly affect potato yield, in the two successive seasons. These results were in agreement with those of Noqueian Kamar and Omr (1987), Tawfik (2001) and Awed *et al.* (2002) and this was a disagreement with the results of Negrila *et al.* (1994) and Oktay *et al.* (1997).

Table 4: Main Effect of gypsum application, potassium source and level on total yield metric ton/fed. of potato plant at harvest

Season	Season 2000/2001	Season 2001/2002
Character / Treatment	Total yield ton/fed.	Total yield ton/fed.
Without gypsum (A1)	9.524	7.728
With gypsum (A2)	13.821	10.276
L.S.D 0.05	2.718	2.104
K_2SO_4 (B1)	11.702	9.504
KCl (B2)	11.644	8.499
L.S.D 0.05	n.s	0.834
Level K kg. K_2O/fed.		
0 (C1)	10.257	8.494
48 (C2)	12.833	9.677
96 (C3)	12.494	9.244
144 (C4)	11.107	8.592
L.S.D 0.05	n.s	n.s

Table 5: Main Effect of gypsum application, potassium source and level on total nitrogen percentage of potato plant at harvest

Season	Season 2000/2001			Season 2001/2002		
Character / Treatment	Stems	Leaves	Tuber	Stems	Leaves	Tuber
Without gypsum (A1)	0.816	2.128	1.089	1.442	2.189	1.047
With gypsum (A2)	1.020	1.832	1.041	1.461	1.186	1.224
L.S.D 0.05	n.s	0.0962	n.s	n.s	n.s	n.s
K_2SO_4 (B1)	0.983	1.886	1.062	1.457	1.697	1.194
KCl (B2)	0.852	2.074	1.068	1.445	1.678	1.077
L.S.D 0.05	n.s	n.s	n.s	n.s	n.s	n.s
Level K kg. K_2O/fed.						
0 (C1)	0.850	2.137	1.170	1.507	1.603	1.117
48 (C2)	0.098	2.038	1.023	1.442	1.635	1.123
96 (C3)	0.990	1.820	1.067	1.433	1.742	1.217
144 (C4)	0.733	1.925	1.000	1.423	1.770	1.086
L.S.D 0.05	n.s	n.s	n.s	n.s	n.s	n.s

Gypsum rate: 1 metric ton/fed

3. Chemical Constituents

3.a. N, P and K percentage in different plant parts

Data in Table 5 show that the addition of gypsum did not significantly affect nitrogen percentage in stems and tubers in the two successive seasons as well as in leaves in the second one while, these additions decreased significantly nitrogen percentage in leaves in the first season. The two different potassium sources were similar on nitrogen percentage stems and tubers of potato plant and this was true in the two successive seasons. Increasing potassium rate had no significant effect on nitrogen percentage in the three plant organs in the two successive seasons. These results are in agreement with those obtained Kanzikwera *et al.* (2001) and in disagreement with those of Lalitha *et al.* (2000).

Data in Table 6 indicate that the addition of gypsum did not significantly affect phosphorus percentage in potato stems, leaves and tubers in the first season as well as stems and leaves of the second season. However, significant decrease in phosphorus percentage in tubers of the second season occurred. The two different potassium sources had the same effect on phosphorus percentage of potato stem, leaves and tubers in the two successive seasons. Addition of potassium significantly decreased phosphorus percentage in potato leaves in the first season while, increasing potassium rate gave the same effect. However, increasing potassium levels had no significant effect on phosphorus percentage of potato stems and tubers in the first season as well as stems, leaves and tubers in the second one. These results are in disagreement with those obtained by Reis-Junior and Monnerat (2001) who found that the increasing K_2SO_4 fertilizer did not affect removal of potassium but increased the removal of P.

Data in Table 7 indicate that in the first season, addition of gypsum significantly decreased potassium percentage in potato leaves while, did not significantly affect it in stems and tubers. However, in the second season, addition of gypsum significantly increased potassium percentage in potato stems and leaves and did not affect it in tubers. The two different potassium sources were similar on potassium percentage of potato leaves, stems and tubers and this was true in the two successive seasons.

In the first season increasing potassium rate, did not

Table 6: Main Effect of gypsum application, potassium source and level on total phosphorus percentage of potato plant at harvest

Season	Season 2000/2001			Season 2001/2002		
Character / Treatment	Stems	Leaves	Tuber	Stems	Leaves	Tuber
Without gypsum (A1)	0.117	0.150	0.152	0.131	0.131	0.185
With gypsum (A2)	0.124	0.155	0.151	0.122	0.139	0.166
L.S.D 0.05	n.s	n.s	n.s	n.s	n.s	0.012
K_2SO_4 (B1)	0.119	0.153	0.148	0.127	0.133	0.172
KCl (B2)	0.122	0.153	0.155	0.126	0.137	0.179
L.S.D 0.05	n.s	n.s	n.s	n.s	n.s	n.s
Level K kg. K_2O/fed.						
0 (C1)	0.119	0.165	0.141	.127	0.128	0.173
48 (C2)	0.126	0.151	0.160	0.121	0.139	0.176
96 (C3)	0.121	0.144	0.155	0.125	0.133	.178
144 (C4)	0.116	0.151	0.149	0.133	0.140	0.175
L.S.D 0.05	n.s	0.008	n.s	n.s	n.s	n.s

Table 7: Main Effect of gypsum application, potassium source and level on total potassium percentage of potato plant at harvest

Season	Season 2000/2001			Season 2001/2002		
Character / Treatment	Stems	Leaves	Tubers	Stems	Leaves	Tubers
Without gypsum (A1)	4.536	4.198	2.843	3.981	3.823	2.536
With gypsum (A2)	5.134	3.573	2.549	5.094	4.231	2.448
L.S.D 0.05	n.s	0.419	n.s	0.349	0.403	n.s
K_2SO_4 (B1)	4.957	3.798	2.700	4.458	4.042	2.514
KCl (B2)	4.713	3.973	2.692	4.618	4.011	2.470
L.S.D 0.05	n.s	n.s	n.s	n.s	n.s	n.s
Level K kg. K_2O/fed.						
0 (C1)	4.450	3.563	2.645	3.993	3.752	2.340
48 (C2)	4.603	4.093	2.852	4.391	4.343	2.467
96 (C3)	4.971	3.795	2.565	4.704	4.012	2.606
144 (C4)	5.316	3.092	2.533	5.063	4.000	2.556
L.S.D 0.05	n.s	n.s	n.s	0.714	0.365	0.196

Gypsum rate: 1 metric ton/fed

Table 8: Main Effect of gypsum application, potassium source and level on total carbohydrates and starch percentage of potato plant at harvest

Season	Season 2000/2001		Season 2001/2002	
Character / Treatment	Total carbohydrates (%)	Starch (%)	Total carbohydrates (%)	Starch (%)
Without gypsum (A1)	84.55	66.09	77.43	54.44
With gypsum (A2)	79.19	66.14	78.86	62.20
L.S.D 0.05	0.841	n.s	n.s	n.s
K_2SO_4 (B1)	82.64	67.00	75.92	58.82
KCl (B2)	81.11	65.23	80.37	57.82
L.S.D 0.05	n.s	n.s	3.42	n.s
Level K kg. K_2O/fed.				
0 (C1)	80.19	74.50	72.30	55.89
48 (C2)	81.27	66.10	80.17	62.40
96 (C3)	80.11	62.33	83.17	57.88
144 (C4)	85.91	61.52	76.55	56.40
L.S.D 0.05	n.s	5.66	6.47	5.088

Gypsum rate: 1 metric ton/fed

significantly affect potassium percentage in stems, leaves and tubers. However, in the second one, addition of 48 kg K_2O/fed. significantly increased potassium percentage in stem, leaves and tuber. Similar trend was obtained by Reis-Junior and Monnrat (2001), Tawfik (2001) and in contrast with Craighead and Matin (2003).

3.b. Total carbohydrates and starch percentage in tubers

Data in Table 8 indicate that addition of gypsum significantly decreased total carbohydrate percentage in the first season only while did not significantly affect starch percentage in the first season as well as carbohydrate and starch percentage in the second one. Addition of potassium chloride was superior to potassium sulphate for total carbohydrate percentage in the second season only while, the two potassium sources had the same effect on carbohydrate and starch percentage in the first season as well as starch percentage in the second one. In first season, addition of increasing potassium rates had no significant effect on total carbohydrate but decreased starch percentage. In the second season it increased carbohydrates as will as starch contents. However, increasing potassium rates from 48 to 144 kg K_2O/fed. had no more effect than 48 kg K_2O/fed. These results were in disagreement with those obtained by LuJianwi *et al.* (2001) and in contrast Abdel Gader *et al.* (2003).

REFERENCES

AbdelGadir A. H., M. A. Errebhi, H. M. Al-Sahan and M. Ibrahim (2003). The effect of different levels of Additional potassium on yield and industrial qualities of Potato (*Solanum tubersum L.*) I an irrigated arid region Ammer. J. of potato Res. 80: 219-222

Awad, E. M, E. A. A. Tartoura, H. M. Foly, and A. I. Abdel-Fattah. 2002. Response of potato growth, yield and quality to Farmyard menure, sulphur and gypsum levels application. Tanta University J. of Agric. Research. 28, 3 (1) 24-39.

Black, C. A. (ed.) 1965. Methods of soil analysis. American Society of agronomy, Inc. Publisher, Madison, Wisconsin, U.S.A.

Craighead, M. D. and R. J. Martin, 2003. Fertilizer responses in potatoes on overview of past revens down research. Agronomy New Zealand. 33: 15 – 25.

Davenport, J. R. and E. M. Bentley. 2001. Does potassium fertilizer form, source and Time of application influence potato yield and quality in the Columbia Basin? Amer. J. of Potato Res. 78, 311-318.

Dogras, C., A. Siomos and C. Psomakelis. 1991. Suger and dry matter changes in potatoes stored in a clamp in a mountainous region of Northern Greece. Potato Res., 34: 211-214.

Fisher, R. A. 1960. The design of experiments.7th ed. Oliver and Boyd. Edinburgh. UK

Jackson, M. L. 1958. Soil Chemical analysis. Prentice Hall Inc Englewood Cliffs, New Jersey USA.

Janardn- Singh, SK. Bansal, and J Singh. 2000. Relative effect of two sources of potassium on yield and economics of potato production in an inceptisol of weastern U.P. Journal of Potassium Research, 16: 1- 4, 52 - 54.

John, M. K. 1970. Calorimetric determination of phosphorus in soil and plant material with a ascorbic acid. Soil Sci. 109: 219-220.

Kamar M. E. and A. Omar. 1987. Effect of gypsum, sulfur and some microelements on yield and quality of potato. Journal Agric. Sci. Mansoura Univ. 12 (4): 892-899.

Kanzikwera C. R., J. S. Tenywa, D.S.O. Osiru, E. Adipala, and A.S. Bhagsari. 2001. Interactive effect of nitrogen and potassium on dry matter and nutrient partitioning in true potato seed mother plant. Fifth International Congress of the African Potato Association 28 May-2 June 2000, Kampala, Uganda. African Crop Science J. 9:1 127-146.

Lu-Jinwei, Chen Fang, Xu Yousheng, Wan Yunfan, Liu-Dong Bi, Lu J. W. Chen F., Xu Ys, Wan Yf, and Liu. DB. 2001. Sweet potato response to potassium. Better Crops International 15 (1): 10-12.

Michel US, J. K. Gilles, P. A. Hamilton, and F Smith. 1956. Colorimetric methods for determination of sugar and related substances. Analytical chemistry. 28 (3): 350.

Negrila, C., C. E. Negrila, M. Negrila, S. Pienescu, V. Constantin, and D. Constantin. 1994. The effect of potassium nitrate fertilizer application on potato and sugarbeet crops. Problem de Agrofitotehnie Teoretica Si Aplicata 16: 1, 55, 70.

Nogueira, F. D., J. C. De Padua, PTG. Guimaraes, M.B. De Paula, E.B. Silva, J.G. De Padua, and M.B. De Paula. 1996. Potato yield and quality under potassium and gypsum levels in south eastern Brazil.

Oktay, M., H. Akdemir, H. Hakerlerler, M. E. Irget, H. Atil, and Y. Ari. 1997. Effect of applying different forms and rates of potassium fertilizer on yield and some quality characteristics of potatoes. Eye Universities Ziraat Fakultesi Dergisi. 34: 1-2, 81 – 88.

Olsen, S. R., C. V. Cole, F. S. Watanabe, and L. A. Dean. 1954. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. U. S. Dept. Agric. Circ. 939.

Piper, C. S. 1950. Soil and plant analysis. Inter-Science publishers. Inc. New York.

Reda, F. 1970. Some methods of quantitive determinations of some organic components in plant materials. "Starch" determination by colorimetric method. Egypt. Agric. Cont. 132.

Reis-Junior, R. A. and P. C. R. Fontes. 1996. Tuber quality in potatoes cv. Baraka as a function of potassium fertilizer rate. Horticulture Brasileira. 14 (2): 170 – 174.

Reis-Junior, R. A. and P. H. Monnerat. 2000. Nutrient concentration in potato stem, petiole and leaflet in response to potassium fertilizer. Sciential-Agricola., 57 (2): 251-255.

Reixota, J. R., C. A. P. Garcia, and J. F. Martins. 1996. Yield of Potatoes cv. Achat as a function of rates of NPK and B. Horticultura Brasileira. 14(2): 232 – 235.

Schippers, P. A. 1968. The influence of nitrogen and potassium application on yield and specific gravity of four potato varieties. Eur. Potato J., 11 (1): 23 – 33.

Shahid-Umar, Moinnddin, and Umar-S. 2001. Effect of sources and economic returns. Better crops international 15 (1): 13 – 15.

Singh, V. N. and S. P. Singh. 1995. Effect of potassium application on yield and yield attributes of potato. Journal of potassium Research, 11 (3 – 4): 338 – 343.

Tawfik A. A. 2001. Potassium and calcium nutrition improves potato production in drip-irrigated sand soil. African Crop Science Journal., 9 (1): 147-155.

Westermann, D. T. and Tidall T. A. 1998. Potassium fertilization of Russet Burbauk potato. Better crops with plant food, 82 (2): 8-9.

Yogesha H. R., C. Ramachandra, S. Bhaskar, and G. Janardhan. 1999. Effect of potassium levels on growth and yield of potato in hill zone of Karnataka. Current Research University of Agricultural Sciences Bangalore., 28 (9-10): 123-134

تأثير التسميد البوتاسى و إضافة الجبس على البطاطس فى الأراضى الرملية المستزرعة حديثاً

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أجريت هذه الدراسة خلال مواسم ٢٠٠٠/٢٠٠١ – ٢٠٠١/٢٠٠٢ لدراسة بعض مصادر التسميد البوتاسى (كبريتات البوتاسيوم و كلوريد البوتاسيوم) و مستوياته على النمو و التحليل الكيميائى على مختلف أجزاء النبات و جودة الدرنات و محصول البطاطس عند الحصاد تحت تأثير إضافة الجبس فى الأراضى المستزرعة حديثاً فى محطة بحوث البساتين بالقصاصين بمحافظة الإسماعيلية فى العروة الخريفى.

تم إضافة مصادر البوتاسيوم (K_2So_4 48% K_2O – KCl 60 % K_2O) تحت مستويات (صفر ، ٤٨ ، ٩٦ ، ١٤٤ كجم/ بو٢ أ / فدان) بإضافة و بدون إضافة الجبس بمعدل ١ طن/ فدان. و كانت أهم النتائج كالتالى:

* بإضافة الجبس أعطى زيادة معنوية فى الوزن الطازج للأوراق و النبات الكلى و الوزن الجاف للساق لكل نبات و معدل المادة الجافة فى الساق و عدد الدرنات و الوزن الطازج للدرنات بالجرام و حجم الدرنات للنبات الواحد (سم^3) و المحصول الكلى (كجم/ م^2) و كذلك بالطن/فدان. بينما إضافة كلوريد البوتاسيوم كان هناك زيادة معنوية فى معدل الكربوهيدرات الكلية فى محصول الدرنات.
* و زيادة مستويات البوتاسيوم أعطى زيادة معنوية لوزن الدرنة الواحدة و حجم الدرنة الواحدة و معدل البوتاسيوم الكلى فى الساق و الأوراق و الدرنات و معدل الكربوهيدرات الكلية فى الدرنات بينما كان هناك تناقص معنوى فى معدل النشا الكلى فى الدرنات.