Effect Of Soil Moisture Content And Potassium Fertilization On Growth And Chemical Composition Of Two Maize Cultivars (*Zea Mays* L.) Grown On Sandy Soil

Magda A. Hussein and R.A. Milad
Soil & Agricultureal Chemistry Dept., Faculty of Agriculture (Saba Bacha), Alexandria University

ABSTRACT

This investigation was carried out, using pot experiment, to study the effect of soil moisture content, potassium fertilizer levels and sources on maize (*Zea mays* L.) growth and nutrients contents of two maize cultivarsSingle Cross 10 and Three Way Cross 310 grown in sandy soil. Also, the effects of these factors on the amounts of available K in soil were described. The experiment was conducted in split-split plot design with three replications. The main plots were assigned to three soil moisture contents (100, 75 and 50% of field capacity). The sub plots were devoted to four potassium levels (zero, 15, 30 and 45 kg/fed). Three potassium fertilization sources, i.e., chloride, sulphate and nitrate besides a mixture of the three sources by rates of 1:1:1 were arranged within the sub-sub plots.Under the non-water stressed treatment (100% of field capacity), the highest potassium level (45 kg/fed.) and potassium nitrate or sulphate produced the highest plant growth characters (dry weight and chlorophyll). High potassium fertilizer levels (30 or 45 kg/fed.) were effective to over come the adverse effects of soil moisture content especially at 50% of field capacity on the studied characters of the two maize cultivars. However, maize cultivar T.W.C.310 was adversely affected by reducing soil moisture content than S.C.10 cultivar. Analysis of variance indicated also significant effects of soil moisture content, potassium fertilization levels and potassium fertilizer sources on nutrients content in both corn cultivars. Analysis of variance indicated also significant effects of soil moisture content, potassium levels and potassium sources on available K in soil.The findings obtained in this study suggest that the amount of available K in soil can readily changed by adjusting both the levels of K-fertilizer and the levels of soil moisture. Also, selecting the suitable K source has a beneficial effect for better plant growth. Potassium nitrate produced the highest values of the studied growth characters.

INTROUCTION

It is obvious that water limits crop growth and development. The plant's response to water stress is related to its metabolic activity, morphology, stage of growth, and yield potential. El-Zainy (1981) studied water stress effect on the content and organization of chlorophyll in mesophyll and bundle sheath chloroplasts of maize, and reported that with holding water, the leaf chlorophyll content dropped slowly and rewatering maize plants increased chlorophyll accumulation in the leaves.

Ragab *et al.* (1986) stated that water stress could affect chlorophyll content of corn leaves. Schussler and Westgate (1991) concluded that maize crop have been adversely affected by water deficit especially during reproductive stage. Abou-Ellil (1992) revealed that maize plants subjected to drought at tasselling and milk ripe stages gave pronounced decrease in biological and grain yields.

El-Beshbeshy (1983) stated that K-fertilizer increased the grain and straw yield of corn and wheat. Another study carried out by Aly *et al.* (1999) showed that application of K_2SO_4 at rates of 100 and 150 mg K/kg soil increased chlorophyll content in maize leaves. El-Bana and Gomaa (2000) stated that there was significant increases in maize grain yield by 12.95 and 15.20% with increasing K levels from 25 to 50 kg K_2O/fed., respectively.

According to Nicholaids *et al.* (1985) several growers have continued to use the more expensive sulphate source of potassium rather than chloride. Howard *et al.* (1998) evaluated KNO_3, K_2SO_4, $K_2S_2O_3$ and KCl as potassium sources and found that yield from the four sources has higher values than the untreated plants and yields with KNO_3 were 4% higher than those of the other three K sources. Kochian and Lucas (1988) indicated that SO^{-2}_4 uptake is slow compared to that for other inorganic anions such as Cl^-, and this can limit K^+ uptake.

Mottram (1985) reported that cumulative dry matter yield increased with increasing K rate under adequate water than under water stress at various times. He added that water use efficiency increased with increasing K rate and tended to be higher with non stressed than stressed maize plants. Plants well supplied with K responded to water stress by immediate stomatal closure, whereas closer in K deficient plants was slow and inefficient. Pramachandra *et al.* (1993) concluded that higher levels of K fertilizer application may be beneficial for maize plants to tolerate water stress conditions. Li *et al.* (1996) showed that K increased growth of maize and decreased the negative effects of water stress due to improving plant water content and stomatal resistance. Vilela and Bull (1999) showed that water stress had no effects on the contents of K, Ca and Mg in maize leaves, however, the highest K rate promoted high concentration of K and low of Ca and Mg. The present study was conducted to evaluate the effect of soil moisture content and potassium fertilization (rates and sources) on dry weight, chlorophyll and nutrients contents of two cultivars of maize (*Zea mays* L.). Also, the effect of these treatments on the amount of available K in soil was evaluated.

MATERIALS AND METHODS

Pot experiment was conducted using a sandy soil collected from the upper 30 cm layer of a conventionally cropped field from Al-Bostan, El-Behera governorate. The soil was analyzed, using the methods described by Black (1965) and Page *et al.*, (1982), for the determination of soil physical and chemical properties and the data obtained are recorded in Table (1).

Plastic pots of 30 cm diameter and 45 Cm height were filled with 10 Kg of air-dried soil, leaving 5 cm free upper space for irrigation application. Five seeds of maize (*Zea mays* L) of the two cultivars: single cross (S.C.10) and three ways cross (T.W.C.310) were seeded on July 24th and the seedlings were thinned to 3 plants per pot after three weeks.

Soil samples were taken after one month from sowing and the amount of available potassium in the soil was determined by extraction with ammonium acetate and K was measured photometrically using flame photometer (Chapman and Pratt (1961).

Table (1). The main physical and chemical properties of the used soil .

Soil properties	Values
Particle-size distribution:	
Sand %	92.80
Silt %	5.40
Clay %	1.80
Texture class	Sandy
Saturation percentage, %	16.00
Field capacity, %	9.50
Wilting point	2.50
EC (1 : 1 water extract), dS/m	0.30
pH (1:1 water suspension)	8.50
Organic matter, %	0.15
$CaCO_3$ %	3.58
Water soluble cations, meq/100 g soil :	
Ca^{++}	0.27
Mg^{++}	0.13
Na^{+}	0.14
K^{+}	0.03
Water soluble anions, meq/100 g soil :	
$CO_3^{=} + HCO_3^{-}$	0.37
Cl^{-}	0.20
$SO_4^{=}$	0.12
Available N, mg/kg	20.00
Available p, mg/kg	5.00
Available K, mg/kg	40.00

Each pot had received a based nutrients of P (1.5 g/pot super phosphate), before sowing and N (3.582 g/pot NH_4NO_3) in two equal doses (after thinning and after 45 days from sowing). The design of the experiment was a split-split plot with three replicates. The moisture regimes

(100% (M1), 75 % (M2) and 50 % (M3) of water field capacity) were arranged as the main plots and were applied after thinning and after 21 days from sowing. The K treatments included four rates (0, 15, 30 and 45 Kg/fed.) and arranged at random within the sub-plots and applied in a single dose after thinning. The K sources were KCl, K_2SO_4, KNO_3 and a mixture of KCl, K_2SO_4 and KNO_3 at ratio of 1:1:1 and were arranged within the sub-sub plots.

Samples of maize plants (each of a plant/pot) were taken when the plants aged 75 days. Before plant sampling, total chlorophyll content in leaves was digital determined using Chlorophyll meter (SPRD-502) by Minolta Camera Co. (1989). At each plant harvest, the fresh weight per pot was measured and the plant was washed with distillated water, oven dried at 65°C for 48 hours and the oven-dried weight was measured. The oven-dried plant material was ground and a certain weight was wet digested with H_2SO_4-H_2O_2 (Chapman and Pratt (1961) and the following determinations were carried out in the digested solution: total potassium using flame photometer, total phosphorus (colorimeterically using vanadomolydate-phosphoric method) and total nitrogen (colorimetrically by the Nessler'method).

The obtained data were statistically analyzed for ANOVA and L.S.D. values were calculated to test the differences between the studied treatments according to Steel and Torrie (1980).

RESULTS AND DISCUSSION

A-Growth characters:

Dry weight:

Table 2 showed that soil moisture content, potassium fertilization rates or potassium sources had significant effects on dry weight of S.C.10 maize cultivar only but not for T.W.C.310 cultivar. Only soil moisture content X potassium rates interaction for S.C.10 plants had significant effect on S.C.10 dry weight. Table (3) showed that decreasing soil moisture content from 100% of field capacity to 50% of field capacity decreased significantly plant dry weight of the two maize cultivars. However, maize cultivar T.W.C.310 was adversely affected by reducing soil moisture content than S.C.10 cultivar. This is indicated by calculating the relative decrease (RD%) of the dry weight of both which was higher for T.W.C.310 than for S.C.10 (Fig. 1). These results could be due to the function of water as a reagent in photosynthesis and in hydrolytic processes such as a starch digestion (Kramer, 1963). Similar results were obtained by Kolev *et al.* (1998), Gencoglan and Yazar (1999) and Essa (2003).

With regard to the effect of potassium, it is clear that the highest rate (45 kg/fed) produced the hightest plant dry weight for the two cultivars (Fig. 2). Woodruff *et al.* (1987) referred the increase of plant dry weight due to high potassium fertilization rates to the essential role of potassium in carbohydrate metabolism and starch translocation in plants. However, maize T.W.C.310 cultivar showed higher response to K fertilization than S.C.10 cultivar with respect to dry weight.

In connection to potassium sources, K-nitrate produced the highest dry weight followed by K-Chloride. Miley and Oosterhius (1994) reported that K-nitrate source increased growth and yield. Similar results were obtained by Howard *et al.* (1998) and Mohamed (1998).

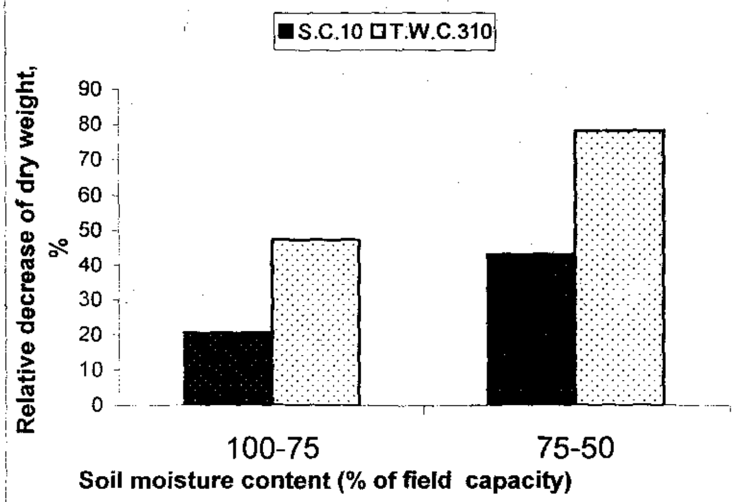

Fig: 1. The relationship between relative decrease of dry weight (%) and the soil moisture content, %

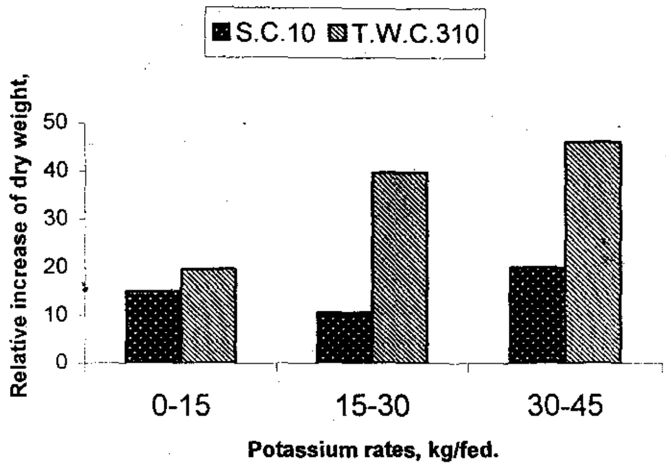

Fig:2. The relationship between relative increase of dry weight (%) and potassium rates (kg/fed.)

With respect to soil moisture content X potassium fertilization interaction (Table 4), application of 45 kg K/fed. at the highest soil moisture content (100% of field capacity) produced the highest dry weight (108.62 gm) for S.C.10 cultivar. The plants under 50% of water field capacity without potassium application gave the lowest dry weight (38.73 gm). On the other hand, potassium application to soil with moisture contents at 50% of water field capacity reduced the adverse effects of water shortage on plant dry weight.

The increasing percentages in plant dry weight under 50% water field capacity were 50.60, 57.40 and 27.20%, respectively, under K fertilizer rates of 15, 30 and 45 kg /fed. respectively compared to non K fertilization treatment. These results showed the importance of potassium, for compensation in adequate soil moisture, on plant growth (Yapa *et al.*, 1991 and DeKov and Velichkov, 1992).

Table (2). Mean squares of chlorophyll content, dry weight and available-K of S.C.10 and T.W.C.310 maize cultivar plants.

S.O.V.	d.f	S.C.10		T.W.C.310		S.C.10 soil	T.W.C.310 soil
		Dry weight (g/plant)	Total chlorophyll	Dry weight (g/plant)	Total chlorophyll	Available K (mg/Kg)	
Rep.	2	9127.90	53.88	4010	17.95	1068.22	29.26
Moisture content (A)	2	20860**	12.25*	168030**	3087.7**	3089.24*	2978.01**
Error a	4	820.688	1.014	3737.69	35.32	340.46	13.99
K rates (B)	3	1236.1*	78.41**	1608n.s	94.32**	3824.04**	5422.56**
A x B	6	1038.3*	26.12*	1441n.s	70.78**	643.2n.s	414.3 n.s
Error b	18	354.31	9.43	544.00	14.4	628.20	840.01
K sources (C)	3	5842.9**	50.46**	666 n.s	22.37*	6043.24**	4889.22**
A x C	6	488 n.s	14.1 n.s	506 n.s	13.5 n.s	471.1 n.s	301.3 n.s
B x C	9	384 n.s	15.9 n.s	675 n.s	12.9 n.s	263.0 n.s	381.9 n.s
A x B x C	18	204 n.s	12.6 n.s	182 n.s	10.4 n.s	518.9 n.s	772.2 n.s
Error C	72	419.56	8.184	415.24	7.48	692.83	766.74

n.s. : Not significant
*, ** : Significant at 0.05 and 0.01 probability levels, respectively

Chlorophyll content

The analysis of variance of total chlorophyll content (Table 2) showed that the main effects of soil moisture content and potassium rates and sources had significant effects on total chlorophyll in leaves of two maize cultivar S.C.10. With regard to first and second order interactions, only soil moisture content X potassium rates had significant effect on total chlorophyll content in leaves of two cultivars.

Table (3). Means of dry weight (g/plant) and total chlorophyll content (mg/gm), available-K (mg/Kg soil) of S.C.10 and T.W.C.310 maize cultivar and the amount of available-K in soil plants.

Treatments	Dry weight		Total chlorophyll		Available K	
	S.C.10	T.W.C.310	S.C.10	T.W.C.310	S.C.10	T.W.C.310
Soil moisture content (% of Field capacity)						
100	96.41	150.2	21.41	34.11	108.0	109.12
75	76.29	78.93	21.19	21.68	117.0	123.45
50	54.72	32.75	20.45	19.11	123.7	122.53
$L.S.D._{0.05}$	16.24	34.65	0.57	3.37	2.12	10.45
K-rates (kg/fed.)						
0	67.96	69.00	19.12	22.54	110.9	108.32
15	78.27	82.65	20.67	25.86	102.1	110.66
30	75.25	96.55	21.74	25.64	122.1	126.50
45	81.73	100.97	22.53	25.80	129.9	127.99
$L.S.D._{0.05}$	9.32	--	1.52	1.80	14.35	12.41
K-sources						
KCl	78.43	90.50	22.62	25.15	111.3	108.17
K_2SO_4	61.41	86.12	21.19	23.98	105.7	109.84
KNO_3	91.78	91.37	20.20	25.88	132.7	136.49
1:1:1	71.60	81.19	20.05	24.84	115.3	118.87
$L.S.D._{0.05}$	9.62	--	1.34	1.29	13.01	12.37

*Means followed by the same letter (s) are not significantly different according to $L.S.D._{0.0}$

Table 3 showed that decreasing soil moisture content, from 100 to 50% of field capacity, decreased total chlorophyll content by 4.5 and 44% for S.C.10 and T.W.C.310 maize cultivars, respectively, Several authors reported decreases in total chlorophyll content under water stress condition (Nomir, 1994; Moursi, 1997 and Gutierrez-Rodriguez *et al.*, 1998). According to Virgin (1965), the pigment formation mechanism localized to the chloroplasts is sensitive to the changes in water content whereas the photochemical transformation of protochlorophyll to chlorophyll is little influenced.

Table (4). Means of chlorophyll content (mg/gm), dry weight (g/plant) and potassium content (%) of S.C.10 and T.W.C.310 maize plants as affected by soil moisture content x K rates interactions.

Moisture content (% of Field capacity)	K-rates (kg/fed.)	S.C.10			T.W.C. 310	
		Dry weight	Chlorophyll	K-content %	K-content %	CHlorophyll
100	0	84.76	18.76	3.58	3.53	31.84
	15	101.44	22.38	3.20	3.96	37.25
	30	90.81	22.23	3.80	3.54	34.69
	45	108.62	22.29	4.20	4.12	20.69
75	0	80.40	19.05	3.45	2.79	20.69
	15	75.04	20.43	4.49	4.09	20.21
	30	94.00	22.75	3.13	3.88	24.00
	45	95.70	22.53	3.83	3.95	21.80
50	0	38.73	19.55	3.24	3.99	15.09
	15	58.33	19.21	4.58	4.64	20.13
	30	60.95	20.24	4.44	3.38	18.24
	45	60.88	22.79	4.52	4.53	22.98
$L.S.D._{0.05}$		16.46	2.30	0.06	0.18	3.35

Table 3 showed that increasing potassium from 0 up to 45 kg K/fed . increased total chlorophyll content from 19.12 to 22.53 mg/g and from 22.54 to 25.80 mg/g for S.C.10 and T.W.C.310 maize cultivars respectively. With respect to potassium sources, the K-chloride surpassed significantly the other sources of potassium for total chlorophyll content of S.C.10 and T.W.C.310 maize cultivars. This could be explained on the basis that chloride anion has more higher absorption rate than the other K-sources (Kochian and Lucas, 1988). Also, chloride influences the plant's water relations and has no effect on metabolism (Von Braunscheig, 1986). However, K-nitrate produced the highest total chlorophyll content (25.88 mg/g) followed by chloride and mixture of the three sources (25.15 and 24.84 mg/g, respectively) for T.W.C.310 maize cultivar but not for S.C.10 cultivar.

With regard to the first order interactions, Table 4 showed the effect of soil moisture content X potassium rate on total chlorophyll contents of S.C.10 and T.W.C.310 cultivars. Generally, increasing potassium levels up to 45 kg/fed. increased the chlorophyll content at any of the three levels of soil moisture espacially at 50 % of field capacity. This holds true because potassium application increased water use efficiency especially under non stressed maize plants (Mottram, 1985 and Premachandra *et al.*, 1991).

The last research group added that water stressed plants imposed greater adaptation to water deficit at higher potassium fertilizer levels.Dekov and Velichkov (1992) reported that high potassium rates reduced the adverse effects of water stress and reduced the ultrastructural damage to chlorophlasts caused by water stress.

B-Nutrients content:

Table 5 showed that both soil moisture content and potassium rates had significant effects on K, P and N contents in the two maize cultivars. However, potassium sources had significant effects on those characters except P of T.W.C.310. With regard to the interaction effects, only the soil moisture content X potassium rates had significant effects on potassium content of the two cultivars.

Means of nutrients contents (Table 6) showed that potassium, phosphorus and nitrogen in S.C. 10 and T.W.C.310 cultivars increased significantly with decreasing water content from 100% of water field capacity to 50% of field capacity. Ashraf and Rehaman (1999), Vilela and Bull (1999) and Melendez *et al.* (2001) obtained similar results.

Table (6) indicated also that increasing potassium rates up to 45 kg/fed. significantly increased potassium and nitrogen contents in the plants of the two maize cultivars. The highest potassium (4.18 and 4.3%) and nitrogen (2.39 and 2.38 %) contents were found at K rate 45 kg//fed for T.W.C.310 cultivar while the highest K of T.W.C.310 was obtained at K rate 30 kg /fed.. These increases of plant potassium content of the two cultivars may be due to the positively correlation between that character and potassium soil test (Zou *et al.*, 1999). However, potassium fertilization led to significant reductions of phosphorus content of the two maize cultivars.

Table (5). Mean squares of K, P and N contents (%) for S.C.10 and T.W.C.310 maize hybrids plants.

S.O.V.	d.f	K	P	N	K	P	N
		S.C.10			T.W.C.310		
Rep.	2	0.015	0.006	0.003	0.041	0.004	0.0054
Soil moisture content (A)	2	6.86**	0.697**	0.049**	2.689**	0.487**	0.0518**
Error a	4	0.010	0.004	0.001	0.077	0.004	0.0001
K rates (B)	3	8.814**	0.258**	2.232**	6.055**	0.123**	2.190**
A x B	6	3.120**	0.10 n.s	0.001 n.s	1.691**	0.003n.s	0.0001 n.s
Error b	18	0.005	0.012	0.001	0.044	0.005	0.0004
K sources (C)	3	1.324**	0.365*	0.315**	1.245**	0.18 n.s	0.3364**
A x C	6	0.01 n.s	0.09 n.s	0.002 n.s	0.07 n.s	0.09 n.s	0.001 n.s
B x C	9	0.01 n.s	0.19 n.s	0.002 n.s	0.04 n.s	0.08 n.s	0.001 n.s
A x B x C	18	0.01n.s	0.20 n.s	0.002 n.s	0.04 n.s	0.06n.s	0.0001 n.s
Error C	72	0.006	0.103	0.001	0.032	0.071	0.0004

n.s. : Not significant *** and ** : Significant at 0.05 and 0.01 probability levels, respectively**

With respect to potassium fertilizer source effects, Table (6) showed that potassium chloride produced the highest plant potassium contents (3.98 and 4.08 % for the two maize cultivars S.C.10 and T.W.C.310, respectively). Increasing potassium content with potassium chloride might be due to the stimulation effect of chloride on potassium uptake compared with that of sulphate anion (Magat and Goh, 1988). On the other hand, K_2SO_4 produced the highest phosphorus concentrations (0.77 and 0.38 % for S.C.10 and T.W.C.310 maize cultivars, respectively). These results might be due to the local acidity effect of sulphate anion on the soil solution. However, potassium nitrate produced the highest nitrogen contents (2.34 %) of two cultivars followed by potassium sulphate (2.20 and 2.19 %). The interactions between soil moisture content and potassium application rates (Table 4) showed significant effects on potassium content. Decreasing of soil moisture content and increasing potassium fertilizer rates increased potassium content in corn plants. It was reported that increasing potassium content could overcome the deleterious effects of soil moisture stress (Yapa *et al.*, 1991). However, Premachandra *et al.* (1993) revealed that higher rates of potassium fertilizer may be beneficial for maize plants to tolerate water stress condition.

Table (6). Means of K, P and N contents (%) for S.C.10 and T.W.310 plants.

Treatments	K	P	N	K	P	N
	S.C.10			T.W.C310		
Soill moi moisture moisture content (% of field capacity)						
100	3.44	0.53	2.17	3.79	0.21	2.161
75	3.72	0.74	2.23	3.68	0.31	2.217
50	4.19	0.74	2.22	4.13	0.41	2.219
$L.S.D._{0.05}$	0.06	0.04	0.02	0.16	0.04	0.001
K-rates (kg/fed.)						
0	3.09	0.76	1.84	3.43	0.40	1.83
15	4.09	0.70	2.28	3.60	0.28	2.28
30	3.79	0.68	2.32	4.33	0.27	2.31
45	4.18	0.54	2.39	4.20	0.29	2.38
$L.S.D._{0.05}$	0.04	0.05	0.01	0.10	0.04	0.01
K-sources						
KCl	3.98	0.59	2.14	4.08	0.22	2.13
K_2SO_4	3.75	0.77	2.20	3.96	0.38	2.19
KNO_3	3.87	0.75	2.34	3.73	0.35	2.34
1:1:1	3.54	0.57	2.15	3.69	0.29	2.12
$L.S.D._{0.05}$	0.04	0.15	0.01	0.08	--	0.01

Means followed by the same letter (s) are not significantly different according to $L.S.D._{0.05}$

C-Available potassium in the soil:

Mean square of available potassium in the soil of S.C.10 or T.W.C.310 maize cultivars (Table 2) showed that soil moisture content, potassium fertilization rates and potassium sources had significant effects on the amount of available K in soil. With regard to the soil of S.C.10 cultivar, data in Table (3) showed that decreasing soil moisture content from 100% to 50% of field capacity increased significantly the amount of available potassium in the soil. Under adequate soil moisture content (100% of field capacity), available potassium was 108.02 mg/kg soil. However, this value was 123.72 mg/kg soil under the lowest soil moisture content (50% of field capacity). Such behaviour may be referred to the effective role of soil moisture level on the availiability of K, maize plant growth and potassium uptake. With respect to potassium fertilization rates, data in Table (3) showed significant increase of available potassium in soil. Increasing percentage of available potassium was 17.18 % as a result of increasing potassium application from zero to 45 kg/fed. soil. It is clear from Table 1 that the original soil contained lower amount of available K (40 mg/kg soil) than the critical level of available K in soil (170 mg/kg soil) according to Merwin and Peech (1951).Therefore, the maize growth and K content in plants were increased with increasing K application rate. With respect to potassium fertilizer sources, data in Table (3) revealed that potassium nitrate surpassed the other potassium sources for the available potassium in soil and was 132.70 mg/kg in soil of S.C.10 cultivar and was 136.49 % in soil of T.W.C.310 maize cultivar.

Table 3 showed that decreasing soil moisture content from 100% of field capacity to 50 % of field capacity significantly increased available potassium in soil. Concerning potassium fertilization rates, data in Table (3) revealed that potassium application to corn plants especially by high rates (30 or 45 kg/fed.) significantly increased available potassium in soil. With regard to potassium fertilizer sources, data in Table (3) showed that potassium nitrate significantly increased the level of available potassium in soil compared with the other three potassium sources.

The overall goal of this work is to find strategies that growers can use to improve the efficiency of K use for maize crop while safeguarding the environment and maintaining profitability. The finding obtained so for suggest that the available potassium in soil can readily altered by adjusting the rate and the soil moisture level. Also, selecting the suitable potassium source have a beneficial effect for better plant growth. Potassium nitrate suppressed the other potassium sources for most of the studied characters for the two maize hybrids. More agronomic work is needed to test this possibility under field conditions.

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الملخص العربي

تأثير محتوى رطوبة الأرض والتسميد البوتاسي على النمو والتركيب الكيميائي لصنفين هجين ذرة تنمو في أرض رملية

ماجدة أبوالمجد حسين علي ، رمضان علي ميلاد ،

قسم الأراضي والكيمياء الزراعية – كلية الزراعة – سابا باشا – جامعة الإسكندرية

أجريت هذه الدراسة والتي تضمنت تجربة أصص بهدف دراسة تأثير كل من المحتوى الرطوبي للتربة ومستويات وصور السماد البوتاسي على نمو نبات الذرة ومحتوى النبات من العناصر وذلك لاثنين من هجن الذرة الشامية هما هجين فردي ١٠ وهجين ثلاثي ٣١٠ ثم زراعتهما في أصص مملوءة بتربة جيرية رملية جلبت من منطقة البستان بالنوبارية . وقد استخدم تصميم القطع المنشقة مرتين في ثلاث مكررات في كلا التجربتين وقد وزعت معاملات المحتوى الرطوبي للتربة (١٠٠ ، ٧٥ ، ٥٠%) من السعة الحقلية عشوائيا على القطع الرئيسية في حين وزعت مستويات السماد البوتاسي الأربعة وهي صفر ، ١٥ ، ٣٠ ، ٤٥ كجم/فدان عشوائيا على القطع الفرعية – أما صور السماد البوتاسي (كلوريد ، سلفات ، نترات ، مخلوط بنسب متساوية من الصور الثلاثة) فقد احتلت القطع تحت الفرعية . أعطت المعاملة ١٠٠% من السعة الحقلية وكذلك إضافة أعلى معدل من السماد البوتاسي (٤٥ كجم / فدان) خاصة على صورة نترات أو سلفات أعلى قيم للوزن الجاف والكلوروفيل . توضح النتائج أن إضافة مستويلت عالية من السماد البوتاسي بمعدل ٣٠ أو ٤٥ كجم / فدان خاصة تحت مستوي محتوى رطوبي ٥٠% من السعة الحقلية أدت إلى تقليل التأثيرات السلبية للإجهاد الرطوبي على نباتات كلا الهجينين في الصفات الثلاث . كان هناك تأثيرا معنويا للمحتوى الرطوبي ومستويات ومصادر التسميد البوتاسي على محتوى كلا الهجينين من العناصر الغذائية. أثر المحتوى الرطوبي ومستويات ومصادر التسميد البوتاسي معنويا على البوتاسيوم القابل للاستفادة لنباتات الهجين الفردي والثلاثي. وعموما فإن النتائج المتحصل عليها من هذه الدراسة تقترح أن البوتاسيوم القابل للأستفادة في التربة من الممكن لأن يتغير بضبط مستوى السماد البوتاسي ومستوى الرطوبة في التربة وايضا باختيار المصدر المناسب من البوتاسيوم له تأثير مفيد في الحصول على أفضل نمو نباتي وكان من الواضح أن نترات البوتاسيوم اعطت القيم الأعلى لمعظم الخصائص المدروسة.