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EFFECT OF SOIL MOISTURE DEPLETION ON GROWTH, YIELD, AND YIELD COMPONENTS OF SOME MAIZE VARIETIES

BY

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ABSTRACT

Five maize varieties (S.C. 10, T.W.C 310, Giza 2, S.C. 152 and T.W.C. 352) were evaluated under irrigation various treatments of 40, 60 and 80% of the Available Soil Maisture Depletion (ASMD) a clay fertile soil in the Res. and Agric. Exper. Cen. of the Fac. of Agric at Moshtohor, during 1998 and 1999 seasons. Maize varieties showed highly significant differences in most of the studied traits. In general, Giza 2 was the earliest variety, while S.C. 152 was the latest one, S.C. 10 surpassed the other four varieties in ear weight, ear length, number of grains/row, kernels weight/ear, 100-grain weight, grain yield, crude protein and oil production as well as total carbohydrate production, while, S.C. 352 recorded the maximum ear diameter, Whereas, S.C. 152 and Giza 2 varieties recorded the lowest values in the two seasons.

Results indicated that increasing ASMD from 40 to 60 and up to 80% decreased number of days to 50% tasseling and silking. All studied charateristicns of growth, yield and yield components were negatively affected by increasing ASMD. Crude protein yield, oil yield and carbohydrate yield were decreased by increasing ASMD. Generally, the highest yield was produced when maize plants irrigated at 40% of ASMD. Whereas, the lowest yield was recorded at 80% of ASMD. This was true in the two growing seasons.

Interaction between maize varieties and ASMD significantly affected all of studied growth characters, yield and its components in the two seasons. It could be concluded that under the circumstances of this study, S.C. 10 maize variety, could be recommended for higher maize productively and quality when irrigated at 40% of ASMD in Kalubia Governorate, Egypt.

INTRODUCTION

Maize (Zea mays L) is one of the most important cereal crops in Egypt. It ranks the third of the world cereal crops and it is used mainly for human consumption and animal feed. Therefore, efforts are focused for increasing productivity of such crop by growing new varieties of hight potentialities. Meanwhile, irrigation is considered among the important factors in cultural practices plays, a great role in maize production. More attention should be pad to maintain the water resources by minimizing the losses, decreasing the water consumption and cultivating more adapted varieties to water stress.

However, maize crop is known to be sensitive to irrigation at different growth stages, that have been adversely affected by water deficits especially during the critical reproductive stage. In respect to water stress, several researchers noticed reduction in yield and its components as well as grain quality (Gomaa, 1981, El-Kalla, 1985; Salwau, 1985; El-Sabbagh, 1993, and Meki, 1995). Moreover, Chen-Jun and Junying (1996) noticed that grain yield decreased when maize plants were exposed to water stress for 7 days at booting, flowering and filling stages.

Many investigators studied the relationship between varieties and maximizing yield of maize under the Egyptian conditions, (Abdul-Galil *et al.*, 1990; Gouda *et al.*, 1992, El-Sabbagh, 1993; Mekei, 1995; Badr *et al.*, 1997; Ibrahim, 1997; El-Sheikh, 1998 and El-Sheikh, 1999). They found great differences in grain yield of different maize varieties. Single and double crosses outyielded open-pollinated varieties. The objective of the present study was to investigate the response of some maize varieties to water stress.

MATERIALS AND METHODS

This study was conducted at the Research and Experimental Station of the Faculty of Agriculture at Moshtohor, Zagazig Univ. (Benha), Kalubia Governorate, Egypt during 1998 and 1999 seasons to find out the effect of some maize varieties in relation to growth, yield and its components under soil water stress conditions.

The preceding crop was berssem clover for the two seasons. The design of the experiment was split plot with four replications. Irrigation treatments were assigned at random in the main plots, whereas maize varieties were randomly devoted to the sub plots. Experment included 15 treatments which were the combination of three levels of irrigation and five maize varieties.

The area of the experimental plot was 16.8 m^2 (5.6 x 3 m) which consisted of 8ridges of 70 cm apart and 3 meters length. The distance between hills was 30cm. plots which were isolated using a meter width as an allway to avoid the effects of the overlapping and interference of the applied irrigation treatments. Sowing dates were June 13 in 1998 and 1999 seasons.

Phosphorous fertilizer was applied at a rate of 30 kg P_2O_5/faddan in from calcium superphosphate (15.5% P_2O_5) during soil operation. Plants were thinned to single plant per hill before the first irrigation Nitrogen fertilizer was applied in from of ammonium nitrate (33.5% N) at a rate of 105 kg N/Fed. In the two doses, the first third of the dose was at planting and the second dose (2/3) was applied before the first irrigation. When moisture content of the soil reached 40,60 and

80% of Available Depletion Soil Moisture starting after the first basic irrigation, the treatments were applied as follows:

A) Irrigation treatments:

1- Irrigation at 80% available soil moisture depletion (ASMD),
2- Irrigation at 60% available soil moisture depletion (ASMD),
3- Irrigation at 40% available soil moisture depletion (ASMD).

B) The grown maize varieties:

1- Single cross 10 (S.C.10),
2- Three-way cross 310 (T.W.C.310),
3- Giza 2 (a composite cv.),
4- Single cross152 (S.C.152)Yellow cv,
5- Three-way cross 352 (T.W.C.352) Yellow cv.

These varieties were kindly provided and supplied by National Maize Research Program, A.R.C. Chemical contents of maize seed before sowing are presented in Table (1).

Table (1): Chemical contents of maize original seed

Varieties	Crude Protein(%)	Oil(%)	Total Carbohydrate(%)
S.C.10	8.79	6.49	68.58
T.W.C.310	7.97	6.13	67.51
Giza 2	7.52	6.63	65.92
S.C.152	9.45	4.90	66.83
T.W.C.352	8.96	5.32	64.56

Other cultural practices were followed as recommended for growing maize.

Field capacity and wilting point of the soil were determined according to the methods described by Gomma (1992). The value of field capacity was 41.5% and wilting point was 17.9% soil moisture. Available water content was 23.6% (value of field capacity-wilting point).

Between irrigation's starting from the base one, soil samples at a depth of 30 cm were taken with an auger to determine the moisture content %. After achieving the required soil moisture of 40,60 and 80%, re-watering was done up to field capacity by irrigation till the two-third of ridge.

Time of tasseling and silking was determined as number of days from planting to 50% tasseling and 50% silking on the whole plot basis Also, the following vegetative growth data were recorded for ten plants after 85 days from planting: plant height (cm), ear height (cm) and stem diameter (cm).

The following data were recorded on ten ears after harvest: ear weight (cm), ear/length (cm), ear/diameter (cm), number of rows/ear, number of grains/row, grain weight/ear (g),and 100-grain weight (g), Grain yield (ton/fad) was estimated from the three middle ridges of each experimental plot on the basis of 15.5% grain moisture content.Oil percentage was determined using Soxhlet apparatus according to the A.O.A.C., (1990), then the oil yield was estimated. Nitrogen percent was determined according to the improved Kjeldahl method (A.O.A.C., 1990). Crude protein percentage was obtained by multiplying nitrogen percentage by 6.25, then crude protein yield was estimated in Kg/fed. Total carbohydrate content was determined in grains according to Dubios *et al.* (1951). Then yield of total carbohydrates of maize grains in kg/fed was estimated.

The analysis of variance of the data was carried out according to procedure outlined by Sendecor and Cochran (1969). Duncan's multiple range test (1955) was used to compare between means.

RESULTS AND DISCUSSION

I- Effects of the available soil moisture depletion (ASMD) of maize on growth, yield and yield components as well as total carbohydrate, oil and crude protein production are presented in Table (2).

A) Growth characters:

A It is clear from Table (2) that exposing maize plants to soil water stress by increasing depletion of available soil moisture from 40 to 60 and to 80% significantly decreased number of days to 50% tasseling and silking. These results were true for the two groing seasons, having almost similar trend. The accelerations in number of days to 50% tasseling were 3.0, 2.85 and 5.85 days in the first season, being 1.9, 2.5 and 4.4 days in the second season, respectively, as the available soil moisture depletion increased from 40 to 60, from 60 to 80 and from 40 to 80%.

Regarding the effect of available soil depletion on silking, it was more or less identical to tasseling behavior preciously presented. The number of days to 50% silking was 64.95, 62.45 and 59.65 days for the first season. Similar trend was recorded in the second season (65.15, 63.20 and 61.10 days). These results could be explained by the effect and the role of water far stimulating and activating the cell division and cell enlargement operations for the tissue of the tasseling and silking reproduction organs. This is a natural process for shorting life cycle of the plants as away for existence and survival under the adverse conductions of the induced water shortage. These results confirm what was recorded by Khedr (1986) and El-Sabbagh (1993) who found that increasing ASMD from 40 to 60 and up to 80, significantly delayed the time of silking. On the other hand, Mekei (1995) found that number of days to 50 tasseling and silking was insignificantly affected by increasing ASMD levels.

Results in Table (2) showed that the increase in ASMD significantly decreased the plant height, ear height and stem diameter in the two growing season, respectively. Shortest plants and ear heights as well as stem diameter of maize plants were produced at the severe soil water stress for the 80% ASMD with significant differences if compared with the other 40% or 60 ASMD. However, the increase in ASMD from 40% to 60%, induced a non significant reduction in plant height and ear height in both seasons. These results are in agree with those obtained by El-Kalla (1985), and El-Shaffeei (1993). They noticed that plant height and ear height were significantly decreased when exposed to water stress.

Table (2): Effect of Available Soil Moisture Depletion (ASMD) on growth, yield and its components as well as chemical constituents of maize during the two growing seasons.

Irrigation treatments	Available soil Moisture Depletion (ASMD)					
	40%	60%	80%	40%	60%	80%
Characters	First season (1998)			Second season (1999)		
A) Growth characters						
Days to 50% tasseling	62.90 a	59.90 b	57.05 c	62.85 a	60.95 b	58.45 c
Days to 50% silking	64.95 a	62.45 b	59.65 c	65.15 a	63.20 b	61.10 c
Plant height (cm)	291.9 a	286.6 a	262.0 b	278.5 a	266.5 a	239.4 b
Ear height (cm)	159.9 a	153.1 a	137.6 b	136.4 a	131.4 a	117.1 b
Stem diameter (cm)	2.32 a	2.09 b	1.87 c	2.23 a	2.01 b	1.78 c
B)Yield and its components.						
Ear weight (g)	205.6 a	167.2 b	141.5 c	193.7 a	176.8 ab	160.0 b
Ear length (cm)	18.45 a	17.42 b	16.65 c	17.66 a	17.32 ab	16.12 b
Ear diameter (cm)	4.46 a	4.22 b	4.06 c	4.40 a	4.22 b	4.07 c
Number of rows/ear	14.28 a	13.98 a	13.09 a	13.16 a	13.35 a	13.11 a
Number of grains/row	43.75 a	41.68 b	39.85 c	39.94 a	39.51 a	35.10 b
Grain weight/ear (g)	171.5 a	138.5 b	113.7 c	158.8 a	144.1 b	116.3 c
100-grain weight (g)	33.56 a	31.23 b	29.88 c	30.53 a	28.23 b	25.82 c
Grain yield (ton/fed)	4.00 a	3.00 b	2.27 c	3.82 a	2.70 b	1.97 c
C) Chemical constituents.						
Crude protein production (kg/fed)	341.6	256.2	193.9	326.2	230.6	168.2
Oil production (kg/fed)	236.0	177.0	133.9	225.4	159.3	116.2
Total carbohydrate production (kg/fed)	2667.2	2000.4	1513.6	2547.2	1800.4	1313.6

B) Yield and its components:

Data in Table (2) clearly showed significant differences among the available soil moisture depletions (ASMD) in ear characters of maize plants as ear weight (g), ear length, ear diameter, number of grains/row and grain weight/ear in each of the two growing seasons, except number of rows/ear in both seasons.

It could be noticed that the effect of the applied ASMD was obviously clear for the first season as compared with the other one. From the above set of data, it could be noticed that ear weight, ear length and ear diameter were significantly affected by increased ASMD, from 40, to 60 and up to 80%, ear weight, ear length and ear diameter were continuously dereased. These results were true in the two growing seasons.

In the first season the significant reduction in ear weight, ear length and ear diameter continued as ASMD increased from 40, to 60 and up to 80%. The highest values were recorded at (40%) and the lowest at (80%) ASMD with significant differences. The differancs in ear weight and ear length between the highest (80%) and medium 60% and between the medium and lowest (40%) ASMD were not significant. These results agree with those obtained Salwau (1985), and Samia. El-Marsfawy, (1991). They reported that ear diameter significantly decreased by reducing number of irrigation.

Number of rows/ear was not significantly affected by the applied ASMS (40, 60 and 80%) in the two growing seasons (Table 2). This results could be explained by the standard initial inherited characteristics which could not be easily modified according to available soil moisture status that was applied (40, 60 and 80% ASMD). These results agree with thase obtained by Salwau (1985) and Khedr (1986).

Results in Table (2) showed significant decrease in the number of grains/row of maize plants. as the ASMD increased from 40 to 60 and up to 80%,. The respective value of such parameter was 43.8, 41.7 and 39.9 in the first season, being 39.9, 39.5 and 35.1 in the second season. However, the difference in number of grains/row was insignificant between the lowest (40%) and medium (60%) ASMD in the second season. The obtained reduction in number of grains/row as the ASMD increased indicates the important role of an adequate soil moisture for appropriate pollination and fertilization that will end up by proper kernel formation, which will improve the number of grains/ear according to the specifications of the particular variety. Similar results was obtained by Samia. El-Marsfawy, (1991).

Data presented in Table (2) indicated that as the ASMD increased from 40 to 60 and up to 80%, grain weight/ear significantly and continuously decreased. The respective grain weight/ear was 171.5 138.5 and 113.7 in the first season, and 158.8, 144.1 and 116.3 (g) in the second season. This result confirms the important role of water if it is adequate for the essential biological activities in producing appropriate growth and development of kernels on the cob. This will definitely end up with the heaviest grain weight/ear.

Concerning 100- grain weight, results in Table (2) showed that the lowest applied ASMD'S (40%) produced the heaviest grains, whereas, the medium ASMD (60%) caused 7.5% reduction of such weight in the two growing seasons with significant differences. Meanwhile, the highest ASMD (80%) caused a slight further reduction in 100-grain weight as compared with medium one (60%). The greatest reduction in grain weight was obtained when comparing the effect of the lowest (40%) and highest (80%) ASMD which was about 12.3 and 18.2% in the first and second season, respectively with significant differences. Similar results were obtained by El-Kalla *et al.* (1985), when they exposed maize plants to water stress of 20,40,60, and 80% ASMD.

Regarding grain yield (ton / fed), the obtained data in Table (2) showed that highest grain yield production was obtained at the lowest soil moisture status of 40% ASMD where grain yield was 4.00 and 3.82 ton/fed in the first and second seasons, respectively. Grain yield was reduced by 44% and 48% in the first and second seasons, respectively, as the soil moisture status reduced from 40 to 80% ASMD. Moreover, as the ASMD increased from 40 to 60 and from 60 to 80%, the respective reduction in grain yield was 25.0% and 24.6% in the first season, being 29.0 and 27.0% in the second season with significant differences (Table 2). Such drastic effect of the available soil moisture on grain yield production of maize was obviously clear, which represent the vital role of water in all of the essential biophysochemical processes required for growth and development.

It should be pointed out that the applied soil water status of 40% ASMD which was responsible for producing the highest grain yield was responsible for enhancing and stimulating the previously discussed yield component parameters such ear weight, ear length and ear diameter number of rows/ear, number of grains/row, grain weight/ear and 100-grain weight.

All of these yield components were strongly participated in producing the highest grain yield production.

These results confirm what was obtained by Sinclair *et al.* (1990) who found that maize grain yield decreased substantially as water deficit increased. Also, Nesmith and Ritchic (1992) found that imposing maize plant for 18-21 days without water caused a loss of 15-25% in grain yield. In addition, Samia. El-Marsafawy, (1995) reported a decrease in grain yield as water stress increased. Moreover, Chen-Jun and Junying (1996) noticed that grain yield decreased when maize plants were exposed to water stress for 7 days at booting, flowering and filling stages.

C) Chemical constituents:

Results in Table (1) showed that crude protein yield decreased as the ASMD increased in the two seasons. As the ASMD increased from 40 to 60 and up 80%, crude protein yield was 341.6, 256.2 and 193.9 kg/fed. in the first season, respectively, being 326.2, 230.6 and 168.2 kg/fed. in the second season.

These results confirm what was obtained by Gomaa (1981) and El-Shafeei (1993), who found that crude protein yield in maize grains was significantly decreased by increasing water stresses. On the other hand, Salwau (1985) and Khedr (1986) showed that crude protein yield was insignificantly affected by reducing number of irrigations.

It is clear from Table (2) that oil production of maize substantially decreased as the induced soil water stress increased Available soil moisture depletion of 40,60 and 80% produced 236.0, 177.0 and 133.9 kg of oil per fed. in the first season, respectively, corresponding to 225.4, 159.3 and 116.2 kg/fed. in the second season. So, it could be concluded that oil production of maize behaved in a similar manner as the cruda protein production previously discussed. in other words, both of cruda protein and oil production were decreased as ASMD increased. These results confirm what was obtained by Gomaa (1981) and El-

Sabbagh (1993), who found that irrigation at 40% ASMD produced the highest oil yield in kg/fed. On the other hand, Salwau (1985) and Khedr (1986) reported that oil percentage was insignificantly affected by reducing number of the applied irrigations.

Total carbohydrate production decreased continuously as the ASMD increased, from 40 to 60 and 80%. The respective production of the total carbohydrate was of 2667.2, 2000.4 and 1513.6 kg/fed. in the first season, corresponding to 2547.2, 1800.4 and 1313.6 kg/fed for the second season (Table 2). This result confirm what obtained by El-Kalla *et al*. (1985) who found that higher total carbohydrate was produced by the lowest ASMD.

It is obviously clear that crude protein yield, total carbohydrate and oil production decreased continuously as soil moisture stress increased, whereas, the lowest total crude protein, carbohydrate and oil production were obtained at the highest ASMD (80%).

From the basic concept of water stress physiology on crop plants adaptation, plants under severe water stress may consume its restored crude protein, carbohydrate and oil contents in the respiring operations as a first respiring substrate. So, the net result is the reduction in protein, carbohydrate and oil as a basic respiring energy.

II) Varietal performance:

A) Growth characters:

Days to 50% tasseling and silking differed significantly among the maize genotypes in the first and second seasones (Table 3). Giza 2 was the earliest variety and S.C. 152 maize variety was the latest one. However, the other cultivars were fluctuated in between without specific trend where the differences were almost ignorable. These results were acceptable sinse each variety represents its own behavior according to genetical structure in the grown environment. Such results are in agree with those obtained by Gouda *et al*. (1992) and Mekei (1995) who found that Giza 2 cv was the earliest cultivar in time of 50% tasseling and silking as compared with other varieties.

Regarding plant height, ear height and stem diameter (Table, 3). There were significant differences among maize varieties in the two growing season. These results indicate that there is enough genetic variation among the five varieties for the main growth characters. The data indicate that, S.C. 10 and T.W.C. 310 varieties gave the highest values of plant height, ear height and stem diameter, whereas, Giza 2 variety produced the lowest values of plant height in the two seasons and ear height in the first season only. While, S.C. 152 recorded the lowest ear height in the second season. S.C. 152 maize variety was of the thinnest stems as compared with the other four varieties. Similar results were obtained by El-Sabbagh (1993), El-Sheikh (1998) and El-Sheikh (1999) who reported that T.W.C. 310 gave the tallest plant height and ear height, whereas S.C. 10 gave the highest total number of leaves/plant and ear leaf area followed by D.C. Taba, then T.W.C. 310 and Giza 2.

Table (3) Growth characters, yield and its components as well as chemical constituents of some maize varieties during the two growing seasons.

Varieties	S.C.10	T.W.C.310	Giza 2	S.C. 152	T.W.C. 352	S.C. 10	T.W.C. 310	Giza 2	S.C. 152	T.W.C. 352
Characters	**First season (1998)**					**Second season (1999)**				
A) Growth characters										
Days to 5% tasseling	61.00 a	59.08 b	57.92 c	61.17 a	60.58 a	61.17 ab	60.75 b	58.92 c	61.67 a	61.25 ab
Days to 50% silking	63.50 a	61.58 b	59.92 c	63.75 a	63.00 a	63.50 a	63.33 a	61.25 b	64.08 a	63.58 a
Plant height (cm)	298.0 a	2830 ab	267.8 c	282.1 ac	268.3 c	281.7 a	275.1 a	235.3 c	261.7 b	253.7 b
Ear height (cm)	159.2 a	153.0 ab	145.1 b	145.4 b	148.4 b	139.3 a	137.4 a	119.8 c	116.6 c	128.4 b
Stem diameter (cm)	2.16 a	2.14 a	2.12 a	1.92 b	2.12 a	2.03 a	2.07 a	2.06 a	1.87 b	2.02 a
B) Yield and its components										
Ear weight (g)	199.5 a	177.6 b	152.5 c	153.1 c	174.1 b	206.5 a	177.4 b	162.8 b	161.0 b	176.5 b
Ear length (cm)	19.22 a	18.53 a	16.51 bc	17.20 b	16.08 c	18.34 a	18.04 a	16.35 c	17.12 b	15.31 d
Ear diameter (cm)	4.26 b	4.17 b	4.25 b	4.14 b	4.41 a	4.29 a	4.17 b	4.20 b	4.17 b	4.34 a
Number of rows/ear	12.91 e	13.38 d	13.82 c	14.22 b	16.11 a	12.25 c	12.63 c	13.20 b	13.39 b	14.90 a
Number of grains/row	47.35 a	45.80 a	36.29 c	39.63 b	39.63 b	42.76 a	38.11 b	35.97 b	37.83 b	36.27 b
Grain weight/ear (g)	171.2 a	143.5 b	126.9 c	127.0 c	137.4 bc	164.6 a	141.1 b	133.6 c	129.4 c	129.9 c
100-grain weight (g)	33.28 a	31.36 bc	31.06 c	30.02 d	32.08 b	32.31 a	28.40 b	28.01 b	25.49 bc	26.90 c
Grain yield (ton/fed)	3.83 b	2.97 bc	2.84 bc	2.72 c	3.09 b	3.17 a	2.91 c	2.58 d	2.46 e	3.03 b
C) Chemical constituents										
Crude protein production (kg/fed)	336.7	236.7	213.6	257.0	276.9	278.6	231.9	194.0	232.5	271.5
Oil production (kg/fed)	248.6	180.1	180.3	133.3	164.4	205.7	178.4	171.1	120.5	161.2
Total carbohydrate production (kg/fed)	2626.6	2005.1	1872.1	1817.8	1994.9	2174.0	1964.5	1872.1	1644.0	1956.2

Increased superiority of plant growth of hybrids may be due to their larger photosynthizing surface expressed in larger leaf area/plant and higher L.A.I than the open-pollinated cultivars. Thus, the hybrids could record higher total dry weight/plant (Abdul-Galil *et al.*, 1990a).

B) Grain yield and its components:

Mean performances of the tested maize genotypes for grain yield and its components in the two growing seasons are shown in Table (3).

As for ear characteristics, as ear weight, ear length, ear diameter, number of rows/ear as well as number of grains/row and grain weight per ear, results indicated clearly that Singl Cross 10, produced the highest values of ear weight and ear length as compared with the other ones with significant differences in the two seasons. Whereas, Giza 2 and S.C. 152 varieties recorded the lowest ear weight in the first and second season, respectively. The shortest ear length was obtained from T.W.C. 352 in the two growing seasons. Maize variety T.W.C. 352 was of the thickest ears also, it has the highest number of rows/ear in both seasons with significant differences. Moreover, S.C. 152 and S.C. 10 recorded the lowest values of ear diameter and number of rows/ear in the first and second season, respectively. S.C. 10 gave the highest values in number of grains/row and grain weight/ear as well as 100-grain weight compared with the other varieties. Giza 2 recorded the lowest number of grains/row in both seasons and grain weight per ear in the first season, whereas S.C. 152 produced the lowest grain weight/ear in the second season. Also, S.C. 152 significantly produced the lowest 100-grain weight in the two season. The present results are in agreement with those reported by Badr *et al.*, (1997) and El-Sheikh (1999) who found that S.C. 10 surpassed the other tested maize varieties in 100-kernel weight and grain yield/plant. Also Ibrahim (1997) showed that single crosses had higher total dray matter and grain yield than the open-pollinated varieties.

Concerning grain yield (ton/fed) of maize varieties (Table 3), data showed significant differences among the tested varieties in the two growing seasons. Results show that S.C. 10 variety was the highest in grain yield and S.C. 152 was of the lowest one. Differences in grain yield between varieties according to the previously presented ranking order was significant in the second season. Whereas, in the first season the differences in grain yield were not significant between T.W.C. 352, T.W.C 310 and Giza 2 varieties as well as between T.W.C 310, Giza 2 and S.C. 152 cultivated varieties. Yield increase of S.C. 10 expressed its superiority over the other tested varieties in ear weight, ear length, number of grains/row, grain weight/ear and 100-grain weight. It may be due to the increase of the metabolites translocated from leaves to the ear as sink of maize plant. The superiority of S.C. 10 over the open-pollinated varieties in mainly due to the better growth and development of plants. Similar results were obtained by Mekei (1995), Badr *et al.* (1997) and El-Sheikh (1999) who reported that S.C. 10 and T.W.C. 310 were superior than Giza 2 in grain yield.

C) Chemical constituents:

Data presented in Table (3) showed that S.C. 10 variety produced the highest values of crude protein, oil production and total carbohydrate production (kg/fed.) than any of the grown maize varieties, in the two seasons. Whereas, the lowest values of crude protein was produced from Giza 2 in both seaons. In the two seasons the lowest values of oil production and total carbohydrate production were obtained from S.C. 152. The superiority of S.C.10 is mainly due to the increase of grain yield. These results agree with those obtained by El-Sheikh (1999) who reported that S.C. 10 ranked first in its uptake of N, P, K and total carbohydrates in grain than other varieties.

III- The interaction effect:

Results in Table (4) summarized the significant interaction effect of ASMP and maize varieties on the studied traits under investigation during each of the two seasons.

Table (4): The obtained significant interaction effects between maize varieties and ASMD treatments, showing the highest response values recorded for the studied characters during the two growing seasons.

Characters	First season (1998)		Second season (1999)	
	Treatments	Highest values	Treatments	Highest values
Days to 50% tasseling	S.C. 10 x 40% ASMD	64.00	S.C. 10 x 40% ASMD	63.50
Days to 50% silking	S.C. 10 x 40% ASMD	66.00	S.C. 10 x 40% ASMD	66.00
Plant height (cm)	S.C. 10 x 40% ASMD	317.0	S.C. 10 x 40% ASMD	306.0
Ear height (cm)	S.C. 10 x 40% ASMD	176.0	S.C. 10 x 60% ASMD	148.8
Stem diameter (cm)	T.W.C. 352 x 40% ASMD	2.37	T.W.C. 352 x 40% ASMD	2.27
Ear weight (g)	S.C. 10 x 40% ASMD	253.6	S.C. 10 x 40% ASMD	217.8
Ear length (cm)	T.W.C. 310 x 40% ASMD	20.45	T.W.C. 310 x 40% ASMD	19.48
Ear diameter (cm)	T.W.C. 352 x 40% ASMD	4.59	T.W.C. 352 x 40% ASMD	4.52
Number of rows/ear	T.W.C. 352 x 80% ASMD	16.5	T.W.C. 352 x 60% ASMD	14.95
Number of grains/ row	S.C. 10 x 40% ASMD	48.85	S.C. 10 x 40% ASMD	43.92
Grain weight/ear (g)	S.C. 10 x 40% ASMD	218.9	S.C. 10 x 40% ASMD	186.9
100-grain weight (g)	S.C. 10 x 40% ASMD	36.20	S.C. 10 x 40% ASMD	36.06
Grain yield (ton/fed)	S.C. 10 x 40% ASMD	4.92	S.C. 10 x 40% ASMD	4.26

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تأثير الإجهاد المائى على نمو ومحصول خمسة أصناف من الذرة الشامية

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أجريت هذه الدراسة فى محطة البحوث والتجارب الزراعية – بكلية الزراعة بمشتهر محافظة القليوبية خلال موسمى ١٩٩٨، ١٩٩٩م. بهدف دراسة تأثير الإجهاد المائى على صفات النمو والمحصول ومكوناته لخمسة أصناف من الذرة الشامية. وهى (هجين فردى ١٠، هجين ثلاثى ٣١٠، جيزة ٢، هجين فردى ١٥٢، وهجين ثلاثى ٣٥٢).

استخدام تصميم القطع المنشقة مرة واحدة فى أربع مكررات وزعت معاملات الرى فى القطع الرئيسية والأصناف فى القطع الشقية.

وكانت معاملات الرى ثلاث معاملات وهى كالآتى: الرى عند مستوى٤٠%، ٦٠% و ٨٠% من الماء الميسرة وكانت أهم النتائج كما يلى:

الصنف جيزة ٢ كان مبكرا عن باقى الأصناف فى موعد التزهير بينما الهجين الفرد ١٥٢ كان متأخرا فى موعد ظهور النورة المذكورة والمؤنثة خلال الموسمين.

تفوق صنف الذرة هجين فردى ١٠ على باقى الأصناف فى معظم الصفات مثل طول النبات والكوز، سمك الساق وصفات الكوز (وزن وطول الكوز وعدد الحبوب ووزن حبوب الكوز وزن الـــ ١٠٠ حبة) أيضا تفوق فى محصول الحبوب (طن/فدان) وكذلك محصول البروتين، الزيت، الكربوهيدرات خلال الموسمين على التوالى ثم جاء بعده فى الترتيب هجين ثلاثى ٣٥٢ بينما أعطى الهجين الفردى ١٥٢، جيزة ٢ اقل محصول.

أدى الرى عند مستوى ٤٠% من الماء الميسر إلى زيادة معنوية فى جميع صفات وهى طول النبات، ارتفاع الكوز وسمكه وكذلك صفات الكوز، وزن وطول الكوز، سمك الكوز وعدد حبوب ووزن حبوب الكوز، وزن الـــ ١٠٠ حبة ومحصول الحبوب. أيضا مكونات المحصول محصول البروتين، الزيت، الكربوهيدرات وذلك مقارنة بالمستوى ٨٠%. بينما أدى الرى عند مستوى ٨٠% من الماء الميسر إلى اقل النتائج تحت الدراسة فيما عدا صفة التبكير فى موعد ظهور النورة المذكورة والمؤنثة.

تحت ظروف هذه الدراسة يمكن القول بأنه يمكن تحقيق أعلى محصول من حبوب الذرة الشامية ومحصول بروتين ومحصول زيت وكربوهيدرات وذلك بزراعة هجين فردى ١٠ والرى عند مستوى ٤٠% من الماء الميسر.