RESPONSE OF TWO MAIZE (*Zea mays* L.) GENOTYPES FOR SOME WATER STRESS AND NITROGEN FERTILIZATION TREATMENTS

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ABSTRACT

Two field experiments were conducted during 2006 and 2007 successive seasons at the experimental Farm of Fayoum Fac. of Agric., to quantify the single and combined effects of different irrigation intervals (10, 15 and 20 days) and rates of nitrogen fertilization (100,120 and 140 kg N/fed.) on growth, yield and yield components of two maize genotypes, i.e.(single- cross 10) and (three way cross 310). The results indicated that S.C.10 gave the highest values of most studied characters, especially plant height,100 grain weight and grain yield (kg/fed.) where the values were 245 (cm), 35.97 (g) and 2475.37 (kg), respectively.

Application of 10 days (I_1) significantly increased plant height, ear length ear diameter, 100-grain weight and grain yield/feddan. Using the rate of 140 kg N /fed.(N_3) significantly increased plant height, leaf area, number of rows /ear, number of grain,100-grain weight and grain yield/feddan by values of 262 (cm), 2678 (cm^2), 13.30 (row), 44.64 (grain), 37.53 (g) and 2565.17(kg) surpassing 100 (N_1) and 120 kg N/fed. (N_2).The results also indicated that planting S.C.10 and T.W.C. 310 under 10 day (I_1) gave the lowest number of days to 50% tasseling and silking traits.

Key words: Maize hybrids, irrigation intervals, nitrogen fertilization

INTRODUCTION

Maize is one of the most important cereal crops used for human consumption and many other purposes such as animal feeding and various industrial intentions. Recently, the national policy is to mix wheat flour (80 %) with maize flour (20 %) in making bread all over the country in order to reduce wheat grain imports. Therefore, in recent years, great efforts have been directed to increase maize production by planting high yielding genotypes under improved cultural practices. Such efforts reflected in a visible national improvement in maize productivity. However, at Fayoum Governorate, this productivity is still relatively low because of some farmers are frequently cultivate maize using their own types with unsuitable dose of nitrogen fertilization especially in the areas suffering from irrigation water shortage. Factors such as varieties / hybrids, irrigation intervals and rates of nitrogen fertilization plays a great role in maize production. It is very important to determine the best irrigation interval, dose of nitrogen fertilization and the high yielding potential hybrids for maximizing of grain yield.

The S.C.10 surpassed T.W.C.310 in plant height and leaf area (**Atta-Allah, 1996 and Sharaan *et al.*, 2002 a**). Short irrigation interval increased plant height and leaf area/plant (**El-Ganayni, 2000**) while missing one irrigation significantly reduced plant height and area of leaves (**Abo-El-Kheir and Mekki, 2007**). Increasing irrigation intervals caused a reduction in no. of days to 50% tasseling and silking (**Ashoub *et al*, 1996 and Sharaan *et al.*, 2002a**), and grain yield (El-

Ganayni, 2000). Single- cross-10 had superiority in grain yield over the three way cross 310 **(El- Sheikh, 1999 and Sharaan *et al*, 2002 b).**Growth and grain yield of different maize varieties increased with increasing in N levels **(Sharar *et al*, 2003).**

The present investigation was designed to study the responses of two maize hybrids to different irrigation intervals and nitrogen doses. In addition to determine the best combination among the studied of factors to produce the maximum yield under Fayoum condition.

MATERIALS AND METHODS

Two field experiments were carried out at the farm of Fayoum Fac. of Agric., during 2006 and 2007 seasons to study the responses of two maize genotypes to different irrigation intervals and nitrogen doses. A split-split-plot design with four replications was used. The soil was clayey with pH value of 7.5, organic mater of 1.63%, available nitrogen, phosphorus and potassium (30.22, 6.90 and 591 ppm), respectively. The experimental treatments were as follows:

Genotypes (main-plots):
G_1:Single cross 10 (S.C.10).
G_2 :Three way cross 310 (T.W.C.310).

Irrigation intervals (sub-plots):
I_1: irrigation every 10 days.
I_2: irrigation every 15 days.
I_3: irrigation every 20 days.

Nitrogen fertilization (sub-sub-plot):
N_1:100 kg N/feddan.
N_2:120 kg N/feddan.
N_3:140 kg N/feddan.

The plot size was 21 m^2 (6.0 x 3.5 m) containing five ridges of 6.0 m length and 0.70 m width. Plots were isolated by border from all sides to avoid the effect of lateral movement of irrigation water. Calcium super phosphate (15.5 % P_2O_5) was added during field preparation at the rate of 100 kg / feddan. Nitrogen fertilization (Ammonium nitrate 33.5% N) was applied in two equal doses (before the first and second irrigation). Irrigation interval treatments were practiced after the second irrigation. Seeding rate was 15.0 kg / feddan and grains were planted on May 28th and June 4 th in first and second seasons, respectively. The other recommended cultural practices for growing maize were adopted from planting till harvesting. The studied characters were plant height (cm),leaf area /plant (cm^2), number of days to 50% tasselling, number of days to 50% silking, ear diameter (cm),ear length (cm), number of rows/ear, number of grains/ row, 100 grain weight (g) and grain yield (kg/fed.), the later trait was adjusted to 15.5% moisture content.

The obtained data were subjected to analysis of variance and the means were compared using LSD (0.05), according to **Gomez and Gomez (1984).**

RESULTS AND DISCUSSION

1-Growth measurements

Data presented in Table (1) indicate that plant height and leaf area per plant were significantly affected by genotypes, irrigation intervals, nitrogen fertilization. While their interaction effects on both traits were insignificant indicating that they acted independently. Maize genotypes showed significant were differences in plant height and leaf area per plant but each genotype had superior trait, where G_1 (S.C.10) had the tallest plant (245 cm) compared with G_2, while G_2 (T.W.C.310) had the greatest area of leaves per plant (2813 cm^2) compared to G_1. These result may be due to the genetical differences between the two genotypes and are in the same trend with those obtained by **Sharar *et al* (2003) and Amanullah *et al* (2007)** while, **Atta-Allah(1996) and Sharaan *et al* (2002 a)** found that the S.C.10 surpassed T.W.C.310 in plant height and leaf area traits.

Table 1. Average values of plant height and leaf area/plant as affected by genotypes, irrigation intervals, nitrogen fertilization and their interactions (Data are combined across seasons)

Treatments		Plant height (cm)				Leaf area / plant (cm^2)			
		Nitrogen				Nitrogen			
Genotypes	Irrigations	N_1	N_2	N_3	Mean	N_1	N_2	N_3	Mean
G_1	I_1	212	261	273	**248**	2320	2377	2436	**2378**
	I_2	214	248	261	**241**	2347	2423	2495	**2422**
	I_3	218	251	267	**245**	2362	2453	2503	**2439**
Mean		**214**	**253**	**267**	**245**	**2343**	**2418**	**2478**	**2413**
G_2	I_1	210	247	261	**239**	2721	2781	2825	**2776**
	I_2	203	240	252	**231**	2760	2811	2880	**2817**
	I_3	205	243	256	**235**	2758	2851	2926	**2845**
Mean		**206**	**243**	**256**	**235**	**2746**	**2814**	**2877**	**2813**
I_1		211	254	267	**244**	2521	2579	2631	**2577**
I_2		208	244	256	**236**	2554	2617	2688	**2619**
I_3		211	247	262	**240**	2560	2652	2715	**2642**
Mean		**210**	**248**	**262**	**240**	**2545**	**2616**	**2678**	**2613**

L.S.D 0.05 for:		
Genotypes (G):	6.80	9.67
Irrigations (I):	3.11	10.58
(G) x (I):	n.s	n.s
Nitrogen (N):	3.79	8.25
(G) x (N):	n.s	n.s
(I) x (N):	n.s	14.29
(G)x(I)x (N):	n.s	n.s

Application of I_1 treatment significantly increased plant height compared with I_2 or I_3. This result may be attributed to increased availability soil moisture with short irrigation interval. This result are in accordance with **El-Ganayni (2000) and Cakir (2004).** While application I_3 significantly increased leaf area compared with I_1 or I_2 treatments. The same trend was detected by **Yang *et al* (2009)** who reported that corn plants under more sever drought stress exhibited clear improvement for leaf area trait. Using dose of nitrogen fertilization 140 kg N/fed. (N_3) significantly increased plant height and leaf area per plant traits by 262 cm and 2678 cm^2,respectively, compared to 100 kg N/fed., and 120 kg N /fed., ($N_1$and N_2), respectively. The interaction of (IxN) was found to have a significant affect leaf area/plant **Gheysari *et al.* (2009)** supported this result.

The performance of number of days form planting to mid tasselling and silking are shown in Table (2).Analysis of data indicated that increasing irrigation intervals from 10 (I_1) to 15 (I_2) or 20 (I_3) days caused a significant increase in number of days to 50 % tasselling by 64.50, 65.31 and 65.54 and 50 % sliking by 67.46, 68.80 and 69.23, respectively.

Application of 100 Kg N/fed.(N_1) for the two hybrids gave the lowest averages of both number days to 50 % tasselling and silking compared to N_2 and N_3 rates, respectively, where N_1 caused earliness tasselling and silking traits. While the same two traits studied were not affected by the two hybrids. **Masood *et al* (2003)** found similar results.

The results presented in Table (2) reveal significant interaction between genotypes and irrigation intervals, where planting S.C.10 and T.W.C.310 under I_1 treatment gave the lowest values of number of days to 50% tasselling and silking (64.29 and 66.96 day), respectively. There was also significant interaction among the three factors, where planting maize S.C.10 under I_1 and N_2 treatments gave the lowest averages of number of days 50 % silking (66.75 days) and T.W.C.310 under I_1 and N_1 treatments gave the lowest values of the same trait (67.75 day).

Table 2. Average values of no. of days to 50 % tasselling and silking as affected by genotypes, irrigation intervals, nitrogen fertilization and their interactions (Data are combined across seasons)

		No. of days to 50 % tasselling				No. of days to 50 % silking			
Treatments		Nitrogen				Nitrogen			
Genotypes	Irrigations	N_1	N_2	N_3	Mean	N_1	N_2	N_3	Mean
G_1	I_1	63.37	64.38	65.12	**64.29**	67.25	66.75	66.87	**66.96**
	I_2	65.13	66.00	66.12	**65.75**	69.00	69.12	69.00	**69.04**
	I_3	64.25	65.75	66.62	**65.54**	68.50	68.88	70.62	**69.33**
Mean		**64.25**	**65.38**	**65.95**	**65.19**	**68.25**	**68.25**	**68.83**	**68.44**
G_2	I_1	64.00	64.87	65.25	**64.71**	67.75	68.00	68.13	**67.96**
	I_2	64.62	65.00	65.00	**64.87**	68.37	68.00	69.30	**68.56**
	I_3	64.50	65.87	66.25	**65.54**	68.75	68.87	69.75	**69.12**
Mean		**64.37**	**65.25**	**65.50**	**65.04**	**68.29**	**68.29**	**69.06**	**68.55**
I_1		63.69	64.63	65.19	**64.50**	67.50	67.38	67.50	**67.46**
I_2		64.88	65.50	65.56	**65.31**	68.69	68.56	69.15	**68.80**
I_3		64.38	65.81	66.44	**65.54**	68.63	68.88	70.19	**69.23**
Mean		**64.31**	**65.31**	**65.73**	**65.12**	**68.27**	**68.27**	**68.95**	**68.50**

L.S.D 0.05 for:		
Genotypes (G):	n.s	n.s
Irrigations (I):	0.412	0.335
(G) x (I):	n.s	0.474
Nitrogen (N):	0.380	0.338
(G) x (N):	n.s	n.s
(I) x (N):	n.s	0.585
(G) x (I) x (N):	n.s	0.828

2-Yieldcomponents

Results presented in Table (3) show that ear length and diameter of maize were significantly affected by genotypes, irrigation intervals, nitrogen fertilization. Analysis of variance indicated that genotypes differed significantly in ear length and diameter, where G_1 (S.C.10) had the widest ear diameter and tallest ear length compared to G_2 (T.W.C.310) which may be due to the genetically differences between genotypes. Similar results were obtained by **Sharaan *et al* (2002 a).**

I_1 application gave the highest values of ear length and diameter i.e. 21.66 and 4.30 cm, respectively. Planting maize with N_1 significantly decreased ear length and diameter by 20.01 and 3.93, respectively, compared with N_2 and N_3. Results in Tale (3) show that planting maize S.C.10 and T.W.C.310 under I_1 gave the longest ear (22.06 and 21.27) and widest diameter (4.45 and 4.14) values, respectively. Whereas, the lowest values were 21.59 and 20.52 (for ear length) 4.24 and 4.01 (for ear diameter), respectively resulted from planting G_1 and G_2 under I_2 treatment.

Table 3. Average values of ear diameter and length as affected by genotypes, irrigation intervals, nitrogen fertilization and their interactions (Data are combined across seasons).

		Ear diameter (cm)				Ear length (cm)			
Treatments		Nitrogen				Nitrogen			
Genotypes	Irrigations	N_1	N_2	N_3	Mean	N_1	N_2	N_3	Mean
G_1	I_1	4.17	4.47	4.72	**4.45**	20.97	22.00	23.20	**22.06**
	I_2	3.95	4.27	4.50	**4.24**	20.46	21.45	22.85	**21.59**
	I_3	3.97	4.33	4.55	**4.33**	20.78	21.76	23.02	**21.85**
Mean		**4.03**	**4.36**	**4.59**	**4.33**	**20.74**	**21.74**	**23.02**	**21.83**
G_2	I_1	3.90	4.15	4.37	**4.14**	20.12	21.37	22.32	**21.27**
	I_2	3.80	4.02	4.20	**4.01**	18.75	20.80	22.00	**20.52**
	I_3	3.78	4.06	4.28	**4.04**	18.97	21.11	22.10	**20.73**
Mean		**3.83**	**4.08**	**4.28**	**4.06**	**19.28**	**21.09**	**22.14**	**20.84**
I_1		4.04	4.31	4.55	**4.30**	20.55	21.69	22.76	**21.66**
I_2		3.88	4.15	4.35	**4.12**	19.61	21.13	22.43	**21.05**
I_3		3.88	4.20	4.42	**4.19**	19.88	21.44	22.56	**21.29**
Mean		**3.93**	**4.22**	**4.44**	**4.19**	**20.01**	**21.42**	**22.58**	**21.34**

	Ear diameter	Ear length
L.S.D 0.05 for:		
Genotypes (G):	0.062	0.132
Irrigations (I):	0.035	0.122
(G) x (I):	0.049	0.173
Nitrogen (N):	0.065	0.217
(G) x (N):	n.s	n.s
(I) x (N):	n.s	0.307
(G) x (I) x (N):	n.s	n.s

Results in Table (4) show that the highest number of rows /ear (12.93) and number of grains /row (43.27) were obtained from planting maize S.C.10 compared with those of T.W.C.310, i.e., 12.51 and 40.14, respectively. The application of I_1 treatment gave the highest number of rows/ear (12.89) and number of grains/ row (42.40).

Table 4. Average values of number of rows/ear and number of grains/ row as affected by genotypes, irrigation intervals, nitrogen fertilization and their interactions (Data are combined across seasons).

		Number of rows/ear				Number of grains/ row			
Treatments		Nitrogen				Nitrogen			
Genotypes	Irrigations	N_1	N_2	N_3	Mean	N_1	N_2	N_3	Mean
G_1	I_1	12.77	13.05	13.55	**13.12**	42.22	43.35	45.80	**43.79**
	I_2	12.20	12.80	13.30	**12.77**	40.80	42.20	45.07	**42.69**
	I_3	12.35	12.92	13.42	**12.90**	41.76	42.78	45.45	**43.33**
Mean		**12.44**	**12.92**	**13.42**	**12.93**	**41.59**	**42.78**	**45.44**	**43.27**
G_2	I_1	12.12	12.60	13.27	**12.66**	37.17	41.22	44.65	**41.01**
	I_2	11.87	12.30	13.12	**12.43**	35.50	39.77	43.25	**39.51**
	I_3	11.97	12.40	13.15	**12.51**	36.32	40.50	43.60	**40.14**
Mean		**11.99**	**12.43**	**13.18**	**12.53**	**36.33**	**40.50**	**43.83**	**40.22**
I_1		12.45	12.83	13.41	**12.89**	39.70	42.29	45.23	**42.40**
I_2		12.04	12.55	13.21	**12.60**	38.15	40.99	44.16	**41.10**
I_3		12.16	12.66	13.29	**12.70**	39.04	41.64	44.53	**41.74**
Mean		**12.21**	**12.68**	**13.30**	**12.73**	**38.96**	**41.64**	**44.64**	**41.75**

L.S.D 0.05 for:	Rows/ear	Grains/row
Genotypes (G):	0.081	0.82
Irrigations (I):	0.108	0.26
(G) x (I):	n.s	n.s
Nitrogen (N):	0.140	0.63
(G) x (N):	n.s	0.89
(I) x (N):	n.s	1.09
(G) x (I) x (N):	n.s	n.s

Data given in Table (4) reveal that the N_3 treatment gave the highest number of rows/ear and grains/row traits. The results showed that S.C.10 and T.W.C.310 planted under N_3 treatment produced the highest performance of number of rows 13.42, 13.18 and number of grains 45.44 and 43.83, respectively. Whereas, the genotypes produced the lowest values of the two traits under N_1 treatment.

Data illustrated in Table (5) show that 100-grain weight and grain yield / feddan of S.C.10 outyielded those of T.W.C.310,whereas the values were 35.97 (g) and 2475.37 (kg),respectively. These observations are in full agreement with those of **El- Sheikh (1999) and Sharaan *et al* (2002 b)**. Results indicated that I_2 caused significant decrease in 100- grain weight and grain yield /feddan,i.e.34.98 and 2244.93, respectively compared with I_1 treatment. This result may be attributed to the effect of moisture deficit on dry matter accumulation and translocation of metabolites to grains. These results are in harmony with those found by **Mahmood *et al* (2000),Abo-El- Kheir and Mekki (2007)** who came the same conclusion. The highest values of 100-grain weight and grain yield/feddan, i.e. 37.53 and 2595.17, respectively, were obtained from N_3 treatment while the lowest values i.e. 32.89 and 1946.90; were obtained from N_1, respectively. In this respect, **Alam *et al* (2003), Masood *et al* (2003) and El-Hendawy *et al* (2008)** found that the increasing levels of nitrogen improved the yield and yield components. The interactions of first and second order between the studied variables not attained the level of significance for all cases.

Table 5. Average values of 100-grain weight and grain yield /feddan as affected by genotypes, irrigation intervals, nitrogen fertilization and their interactions (Data are combined across seasons)

		100-grain weight (g)				Grain yield /feddan(kg)			
Treatments		Nitrogen				Nitrogen			
Genotypes	Irrigations	N_1	N_2	N_3	Mean	N_1	N_2	N_3	Mean
G_1	I_1	33.80	36.15	38.57	**36.17**	2116.21	2639.22	2888.18	**2547.87**
	I_2	33.28	35.66	38.19	**35.71**	2041.45	2513.17	2664.36	**2406.33**
	I_3	33.75	36.02	38.29	**36.02**	2053.07	2586.75	2775.96	**2471.93**
Mean		**33.61**	**35.94**	**38.35**	**35.97**	**2070.24**	**2579.71**	**2776.17**	**2475.37**
G_2	I_1	32.55	34.75	37.10	**34.80**	1900.38	2304.21	2467.10	**2223.90**
	I_2	31.74	34.59	36.41	**34.25**	1740.78	2138.50	2371.31	**2083.53**
	I_3	32.22	34.41	36.64	**34.42**	1829.52	2249.16	2404.37	**2161.02**
Mean		**32.17**	**34.58**	**36.72**	**34.49**	**1823.56**	**2230.62**	**2414.26**	**2156.15**
I_1		33.18	35.45	37.84	**35.49**	2008.30	2471.72	2677.64	**2385.88**
I_2		32.51	35.13	37.30	**34.98**	1891.12	2325.84	2517.84	**2244.93**
I_3		32.99	35.22	37.47	**35.22**	1941.30	2417.96	2590.17	**2316.47**
Mean		**32.89**	**35.26**	**37.53**	**35.23**	**1946.90**	**2405.17**	**2595.21**	**2315.76**

L.S.D 0.05 for:		
Genotypes (G):	0.25	52.76
Irrigations (I):	0.16	20.97
(G) x (I):	n.s	n.s
Nitrogen (N):	0.41	39.14
(G) x (N):	n.s	n.s
(I) x (N):	n.s	n.s
(G) x (I) x (N):	n.s	n.s

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إستجابة هجينين من الذرة الشامية لبعض معاملات الإجهاد المائى والتسميد النيتروجينى

فوزى سيد عبد السميع– محمد دسوقى حسن دويدار– سمير كامل على اسماعيل

قسم المحاصيل – كلية الزراعة – جامعة الفيوم – مصر

أقيمت تجربتان حقليتان بمزرعة كلية الزراعة بالفيوم خلال عامى ٢٠٠٦، ٢٠٠٧ وذلك لتقدير التأثير الفردى والمشترك لثلاث فترات للرى (٢٠، ١٥، ١٠ يوم) و ثلاث معدلات للتسميد النيتروجينى (١٤٠، ١٢٠، ١٠٠ كجم نيتروجين للفدان) على النمو والمحصول ومكوناته لهجينين من الذرة الشامية (هجين فردى ١٠،هجين ثلاثى ٣١٠).

* أوضحت النتائج تفوق الهجين الفردى ١٠ لمعظم الصفات تحت الدراسة وخصوصاً ارتفاع – وزن المائة حبة ومحصول الحبوب للفدان حيث كانت القيم لهذه الصفات ٢٤٥سم، ٣٥,٩٧جم، ٢٤٧٥,٣٧كجم على الترتيب.
* أعطت معاملة الرى كل ١٠ أيام زيادة معنوية فى صفات طول النبات – طول الكوز– قطر الكوز– وزن المائة حبة ومحصول الحبوب للفدان.
* أشارت النتائج إلى أن تطبيق المعدل ١٤٠ كجم نيتروجين للفدان قد أعطى أعلى القيم لصفات طول النبات– مساحة أوراق النبات– عدد الصفوف للكوز– عدد الحبوب فى الصف – وزن المائة حبة والمحصول من الحبوب للفدان بالمقارنة بالمعدلين الاخرين وكانت القيم (٢٦٢سم، ٢٦٧٨سم٢، ١٣,٣٠ صف، ٤٤,٦٤ حبة، ٣٧,٥٣ جم، ٢٥٩٥,١٧ كجم/للفدان) على التوالى.
* أظهرت النتائج أيضاً أن زراعة الهجين الفردى ١٠ والثلاثى ٣١٠ مع الرى كل ١٠ أيام أعطى أقل القيم فى عدد الايام لظهور ٥٠% من النورات المذكرة و٥٠% من النورات المؤنثة فى حين كانت زراعة نفس الهجن مع الرى كل ١٠ أيام والمعدل ١٢٠ كجم نيتروجين أظهرت أقل القيم فى عدد الأيام لظهور ٥٠ % من الأزهار المذكرة.
* يتضح من إجمالى النتائج أن التأثير الفردى للعوامل تحت الدراسة كان واضحا على الصفات المدروسة أكثر من التأثير المشترك (التفاعل) الذى لم يصل إلى حد المعنوية فى معظم الصفات – كذلك يجب أن يؤخذ فى الاعتبار دراسة المستويات العالية من التسميد النيتروجينى مع الرى كل ١٠ أيام مع الهجين الفردى ١٠ حيث استجاب هذا الهجين للمستوى العالى ١٤٠ كجم نيتروجين للفدان وأعطى نتائج مرضية من خلال هذه الدراسة.