Annals of Agric. Sc., Moshtohor,
Vol. 33(2):507-524, 1995.

MAIZE GROWTH, YIELD AND YIELD COMPONENTS AS RELATED TO SOME AGRICULTURAL PRACTICES

BY

Shafshak, S.E.*; Abd El-Halim, A.A.; Rosenberger, J.L.***; Saad, A.M.M.* and Ahmed, F.A.****

* Agron. Dept., Fac. of Agric., Moshtohor, Zagazig Univ., Egypt.
** Central Laboratory for Design and Statistical Analysis, Agric. Res. Center.
*** Stat. Dept. Pennsylvania State University, USA.

ABSTRACT

Two field experiments were conducted at the Research and Experimental Center of Moshtohor, Faculty of Agriculture in 1991 and 1992 seasons. The obtained results can be summarized as follows:

Delaying planting from May to July significantly reduced growth characters; number of leaves/plant, leaf area of the topmost ear, L.A.I., plant height, ear height and stem diameter, in both seasons.

Also, delaying planting from May to July significantly reduced ear characters; ear length, ear diameter, number of rows/ear and number of kernels/row, in both seasons.

In May planting, grain yield/plant, shelling percentage and grain index outweighed those of both June planting and July planting, in both seasons.

In first season, grain yield/fed. was significantly affected by planting date. Generally, May planting outyielded both June planting and July planting, in both seasons.

In both seasons, T.W.C. 310 significantly surpassed Giza 2 concerning number of leaves/plant, leaf area of topmost ear, L.A.I., plant height, ear height. In addition, ear length, number of kernels/row, weight of 100 kernels and grain yield/plant showed the same trend

Ear diameter, number of rows/ear and grain yield/fed. of Giza 2 were significantly higher than those of T.W.C 310 in both seasons. With regard to shelling percentage no significant difference was detected between the varieties in both seasons.

Number of leaves/plant, L.A.I., plant height, ear height, stem diameter, number of rows/ear, shelling percentage and grain index were not significantly affected by nitrogen levels in both seasons, whereas, leaf area of the topmost ear, ear length, number of kernels/row and grain yield/plant were significantly affected by N level in second season only. Ear diameter was significantly affected by N level in first season only.

Grain yield/fed. was significantly affected by N level in both seasons.

The interaction between planting date and varieties was significant on plant height and grain yield/fed. in 1991 season and number of leaves/plant, stem diameter and grain yield/plant in 1992 season, also number of kernels/row was significantly affected by this interaction in both seasons.

The interaction between planting date and N-level was significant on ear diameter, grain yield/plant and weight of 100-kernels in 1991 season and leaf area of the topmost ear in 1992 season, whereas, ear length and grain yield were significantly affected in both seasons.

The interaction between varieties and N level was significant on stem diameter in 1991 season and number of leaves/plant, plant height and grain yield/fed. in 1992 season.

The effect of the 3-way interaction was significant on stem diameter, number of kernels/row and grain yield/fed. in 1992 season only.

INTRODUCTION

Maize (*Zea maize* L.) is one of the major field crops in Egypt. It is essential for human consumption and livestock. Therefore, many studies have been conducted to increase and improve the total production of maize crop.

Planting date is a limiting factor for maize production. Therefore, effect of planting date on growth and productivity of maize has received considerable attention from research workers, Bisher (1973), Ba-Momen (1981), Abdel-Gawad (1986), El-Shaer *et al.* (1987), Shams (1988), Abo El-Zahab and Rady (1990) and Nafziger (1994) found that growth characters, ear characters and grain yield and its components were greatly reduced due to late planting.

Nitrogen fertilization affected greatly the grain yield and the most of the other agronomic traits, Salem (1973), Shafshak *et al.* (1981), Faisal (1983), Gouda (1989) and Gouda *et al.*, (1992) mentioned that growth characters increased significantly as nitrogen fertilizer rates increased except leaf area of topmost ear. On the other hand, several investigators revealed that the increase in nitrogen level increased all the ear characters except number of rows/ear.

Also, several investigators illustrated that maize grain yield either per plant or per feddan increased gradually and significantly by increasing nitrogen rates up to limited levels (Salem, 1973; Abdel-Gawad, 1986 and Khalil, 1992).

Maize cultivars differed greatly in their response to nitrogen fertilization. It was noticed that maize hybrids responded more to this nutrient element than the other genotypes of maize (Gouda, 1982; Nigem 1989 and Gouda *et al.*, 1992).

The objective of this study was to investigate the influence of planting date and nitrogen fertilizer level on growth and yield of two maize varieties.

MATERIALS AND METHODS

Two field trials were conducted during 1991 and 1992 summer seasons at the Research and Experimental Center of the Faculty of Agriculture at Moshtohor, Zagazig University, Egypt. Two maize varieties, i.e. Giza 2 and Three Way Cross 310 (T.W.C. 310) and five nitrogen fertilizer levels, i.e. 30, 60, 90, 120 and 150 kg N/fed. were evaluated under three planting dates, i.e. early (May 1st), intermediate (June 1st) and late (July 1st).

The experimental design was a strip plot design for each planting date, as a single experiment with three replicates in the first season and four in the second one. Varieties were randomly assigned to the vertical strips and the nitrogen fertilizer levels were also randomly assigned to the horizontal strips. Each plot consisted of five rows of 3 m length and the plot area was 10.5 m^2. Seeds were sown in rows 70 cm apart, plant hills were 25 cm apart. Ammonium nitrate (33.5%) as nitrogen source was applied in two equal doses before the first and the second irrigations at the above stated rates of nitrogen. Irrigation was provided every 15 days. Data were collected on five plants selected randomly from three guarded rows to determine some growth characters [number of leaves/plant, leaf area of topmost ear (cm^2), leaf area index, plant height (cm), ear height (cm) and stem diameter (mm)], ear characters [ear length (cm), ear diameter (mm), number of rows/ear and number of kernels/row] and yield and related characters [grain yield/fed. (kg), grain yield/plant (g), shelling percentage (%) and weight of 100 kernels (g)].

Analysis of variance was conducted for each single experiment for each season seperately using the following model described by Millikan and Johnson (1984):

$$y_{ijk} = \mu + r_k + v_i + f_{ik} + m_j + \varepsilon_{jk} + (vm)_{ij} + e_{ijk}$$

where:

μ is a constant

r_k is the effect of the replicates.

V_i is the effect of varieties (in the vertical strips).

f_{ik} is the error term associated with varieties.

n_j is the effect of N fertilizer levels (in the horizontal strips).

g_{jk} is the error term associated with N fertilizer levels.

$(vn)_{ij}$ the the effect of the interaction between varieties and N fertilizer levels.

e_{ijk} is the error term associated with a cell experimental unit, which is the intersection of a vertical and a horizontal strip.

To study the effect of the planting dates, a combined analysis of variance was developed for the three single experiments for each season separately.

RESULTS AND DISCUSSION

A) Effect of planting date:

1. Growth characters:

Results in Table (1) show that all growth characters studied, namely, number of leaves/plant, leaf area of topmost ear, leaf area index (L.A.I.), plant height, ear height and stem diameter were significantly affected by planting date in both seasons of experimentation. Early planting on May 1 favourably affected all growth characters compared with medium and late planting in June and July, respectively.

Delaying planting from May to June, reduced number of leaves per plant, leaf area of topmost ear, L.A.I., plant height, ear height and stem diameter by 10.00%, 15.79%, 23.77%, 12.00%, 3.59% and 17.98%, respectively, in the first season, being 7.45%, 5.48%, 16.93%, 7.33%, 8.99% and 4.04%, respectively, in the second season. Whereas, delaying of planting from May to July reduced the previous characters by 15.48%, 23.75%, 33.79%, 24.92%, 20.43% and 23.84% in the second season, respectively. Similar results were obtained by Yousef (1968), Hamada (1972), Bisher (1973), Ba-Momen (1981) and Abdel-Gawad (1986) who found that growth characters were greatly reduced in late planting.

2. Ear characters:

Ear characters namely, ear length, ear diameter, number of rows/ear and number of kernels/row were significantly affected by maize planting date in both seasons (Table, 2). A marked and consistent reduction was recorded in ear characters with delaying maize planting to June and July. Delaying planting from May to June, reduced ear length, ear diameter, number of rows/ear and number of kernels/row by 8.07%, 7.83%, 3.00% and 16.91%, respectively, in the 1991 season, being 5.31%, 4.06%, 4.77% and 9.37%, respectively, in the 1992

Table 1 Effect of planting dates on some average growth characters in maize during 1991 and 1992 seasons.

Characters	Planting dates*			Mean	L.S.D 0.05
	May	June	July		
		1991			
Number of leaves per plant	14.99	13.50	12.67	13.72	0.38
Leaf area of topmost ear (cm^2)	763.15	742.67	581.97	662.60	32.78
Leaf area index	8.08	6.16	5.35	6.53	0.43
Plant height (cm)	308.80	283.73	231.87	274.80	13.43
Ear height (cm)	144.40	139.23	114.90	132.84	8.28
Stem diameter (mm)	26.93	22.09	20.51	23.18	1.41
		1992			
Number of leaves per plant	13.97	12.16	12.16	13.02	0.41
Leaf area of topmost ear (cm^2)	717.99	678.69	550.33	649.16	56.45
Leaf area index	7.09	5.89	5.19	6.06	0.40
Plant height (cm)	258.27	239.35	223.60	240.41	16.32
Ear height (cm)	116.88	106.38	98.82	107.36	8.74
Stem diameter (mm)	23.00	22.07	21.65	22.24	0.94

* All characters are significantly different among planting dates.

season. Further delaying of planting from May to July reduced the four previous ear characters by 14.51%, 9.98%, 4.53% and 30.17%, respectively, in the 1991 season, and by 23.46%, 7.04%, 8.38% and 27.22%, respectively, in the 1992 season. Similar results were reported by Bisher (1973), Ba-Momen (1981), Abdel-Gawad (1986), Shams (1988) and Abo El-Zahab and Rady (1990) who found that ear characters were greatly reduced due to late planting.

3. Grain yield and its related characters:

Grain yield and its components were markedly affected by planting date in both seasons. Differences among the yield component characters were almost all significant except those among grain yield/fed. in the 1992 season, which failed to reach the 0.05 level of significance (Table, 3). Results indicated that early planting in May favourably affected grain yield/plant, shelling percentage and grain index compared with June and July plantings. In May planting, these three traits outweighed those of June planting by 42.61%, 5.92% and 7.56% in the first season, respectively, and 40.29%, 2.55% and 3.22% in the second season, respectively. Furthermore, these three traits recorded in May planting increase of 66.65%, 14.96% and 9.60% compared with July planting in the first season, respectively. In second season the increases of the May then July planting were 46.00%, 3.14% and 18.59% for the three traits, respectively.

With regard to grain yield/fed., significant differences were quite clear in first season. On the other hand, in second season, differences in grain yield/fed. were also noted but were not sufficient to reach the 0.05 level of significance. However, May planting outyielded June planting by 24.69% and 6.53% in the two seasons, respectively. Moreover, May planting outyielded July planting by 75.38% and 42.00%, in two seasons, respectively. Results reported by Kassem (1964), Bisher (1973), Ba-Momen (1981), Abdel-Gawad 91986), El-Shaer *et al.* (1987), Shams (1988), Abo El-Zahab and Rady (1990) and Nafziger (1994) illustrated that early planting significantly increased grain yield and its components.

B) Effect of variety:

1. Growth characters:

Results in Table (4) show that the variety T.W.C. 310 was significantly superior compared with Giza 2 in all characters, namely, No. of leaves/plant, leaf area of the topmost ear, L.A.I., plant height, ear height and stem diameter in both seasons. In the first season, T.W.C. 310 surpassed Giza 2 by 8%, 8.17%, 12.52%, 3.71%, 7.86% and 11.11%, concerning number of leaves/plant, leaf area of topmost ear, L.A.I., plant height, ear height and stem diameter, respectively. In second season, T.W.C. 310 significantly surpassed Giza 2 by 5.52%, 10.43%, 16.04%, 3.39%, 10.41% and 12.01% for the previous growth characters. Similar results were obtained by Eraky *et al.* (1980), Ba-Momen (1981), Gouda (1989) and Nigem (1989). Results reported by Gouda *et al.* (1992) indicated that T.W.C. 310 was significantly superior than the composite variety Giza 2 in all vegetative growth characters.

Table 2: Effect of planting dates on average ear characters in maize during 1991 and 1992 seasons.

Characters	Planting dates			Mean	L.S.D 0.05
	May	June	July		
		1991			
Ear length (cm)	20.34	18.70	17.39	18.81	1.77
Ear diameter (mm)	51.65	47.61	46.50	48.59	1.65
Number of rows/ear	13.70	13.29	13.08	13.36	0.45
Number of kernels/row	43.36	36.03	30.28	36.56	4.98
		1992			
Ear length (cm)	20.17	19.10	15.44	18.23	2.22
Ear diameter (mm)	47.89	45.95	44.52	46.12	1.74
Number of rows/ear	13.85	13.19	12.69	13.24	0.64
Number of kernels/row	40.16	36.40	29.23	35.26	4.06

Table 3: Effect of planting dates on average grain yield and related characters in maize during 1991 and 1992 seasons.

Characters	Planting dates			Mean	L.S.D 0.05
	May	June	July		
		1991			
Grain yield/fad.(kg)	2957.17	2371.60	1686.07	2338.28	879.96
Grain yield/pl. (gm)	232.90	163.31	139.75	178.65	20.65
Shelling percentage	78.36	73.98	68.16	73.50	2.26
Wt.of 100 ker. (gm)	36.96	34.36	33.72	35.01	1.64
		1992			
Grain yield/fad.(kg)	1683.22	1579.98	1185.43	1482.88	n.s
Grain yield/pl. (gm)	190.44	135.74	130.43	152.20	13.60
Shelling percentage	72.73	70.92	70.51	71.38	0.70
Wt. of 100 ker. (gm)	34.89	33.80	29.42	32.70	3.06

2. Ear characters:

Results in Table (5) indicated that the two varieties differed significantly at the 0.05 level in ear characters, namely, ear length, ear diameter, number of rows/ear and number of kernels/row in both seasons with one exception for ear diameter in 1992 where the difference was not significant.

Results showed that ear length and number of kernels/row of T.W.C. 310 surpassed significantly Giza 2 by 12.06% and 20.74% in first season and 15.35% and 19.31% in second season. With regard to ear diameter and number of rows/ear an opposite trend was observed, where Giza 2 surpassed T.W.C. 310 by 4.16% and 9.57% in first season and 1.07% and 9.00% in second season. Similar results were obtained by many investigators who found the superiority of hybrids over the open pollinated varieties in ear characters (Eraky *et al.*, 1980; Ba-Momen, 1981; Nigem, 1989 and Gouda *et al.*, 1992).

3. Grain yield and its related characters:

Results in Table (6) showed that Giza 2 variety was higher than T.W.C. 310 by 6.11% in grain yield/fed. in first season whereas T.W.C 310 outyielded Giza 2 by 13.57% in the second season. The grain yield/plant of T.W.C. 310 significantly surpassed that of Giza 2 by 10.36% and 14.14% in both seasons. Also, the weight of 100 kernels of T.W.C. 310 was higher than that of Giza 2 with a significant difference of 5.73% in second season only.

Concerning shelling percentage, no significant difference was detected between the two varieties in both seasons. Similar results were reported by Ba-Momen (1981), Gouda (1982), Nigem (1989) and Gouda *et al.* (1992).

C) Effect of nitrogen fertilizer level:

1. Growth characters:

Results presented in Table (7) showed that the increase of N level from 30 to 150 kg N/fed. had no significant effect on all characters studied except leaf area of topmost ear in second season. Similar results were reported by Salem (1973), Shafshak *et al.* (1981), Gouda (1989) and Gouda *et al.* (1992).

2. Ear characters:

Results presented in Table 8 showed that increasing nitrogen level from 30 to 60, 90, 120 and 150 kg increased ear length by 3.72%, 1.13%, 1.24% and 0.65%, respectively in first season. The corresponding increases in second season were 5.70%, 8.57%, 9.90% and 11.69%, respectively.

Regarding ear diameter, increasing N level from 30 to 60, 90, 120 and 150 kg/fed. increased this trait by 0.02%, 0.08%, 0.88% and (-2.40%) in first season, respectively. These increases in second season were 0.04%, 1.95%, 2.20% and 2.28% for the same respective N levels for this trait.

Table 4: Effect of varieties on some average growth characters in maize during 1991 and 1992 seasons.

Characters	Varieties*		Mean	L.S.D 0.05
	Giza 2	T.W.C 310		
		1991		
Number of leaves/plant	13.51	13.94	13.73	0.40
Leaf area of topmost ear(cm^2)	636.58	688.61	662.60	22.75
Leaf area index	6.15	6.92	6.54	0.17
Plant height (cm)	269.80	279.80	274.80	3.48
Ear height (cm)	127.82	137.87	132.85	5.04
Stem diameter (mm)	21.96	24.40	23.18	1.08
		1992		
Number of leaves/plant	12.67	13.37	13.02	0.11
Leaf area of topmost ear (cm^2)	616.82	681.20	649.01	26.73
Leaf area index	5.61	6.51	6.06	0.23
Plant height (cm)	236.40	244.42	240.41	7.43
Ear height (cm)	102.05	112.67	107.36	3.96
Stem diameter (mm)	20.98	23.50	22.24	0.57

*All comparisons between Giza 2 and T.W.C. 310 are significant at 0.05.

Table 5 Effect of varieties on average ear characters in maize during 1991 and 1992 seasons.

Characters	Varieties		Mean	L.S.D 0.05
	Giza 2	T.W.C 310		
		1991		
Ear length (cm)	17.74	19.88	18.81	0.50
Ear diameter (mm)	49.58	47.60	48.59	1.69
Number of rows/ear	13.97	12.75	13.36	0.49
Number of kernels/row	33.12	39.99	36.56	1.11
		1992		
Ear length (cm)	16.93	19.53	18.23	0.78
Ear diameter (mm)*	46.37	45.88	46.13	n.s
Number of rows/ear	13.81	12.67	13.24	0.33
Number of kernels/row	32.16	38.37	35.27	1.07

*The difference between varieties is not significant at 0.05.

Table 6 Effect of varieties on average grain yield and related characters in maize during 1991 and 1992 seasons.

Characters	Varieties		Mean	L.S.D 0.05
	Giza 2	T.W.C 310		
		1991		
Grain yield/fad (kg)	2407.60	2268.90	2338.25	137.04
Grain yield/plant (gm)	169.85	45	178.65	5.88
Shelling percentage*	73.64	73.36	[illegible]	n.s
Wt.of 100 kernels* (gm)	34.86	35.16	35.01	n.s
		1992		
Grain yield/fad (kg)	1388.70	1577.10	1482.90	86.09
Grain yield/plant (gm)	141.95	162.45	152.20	11.41
Shelling percentage*	70.86	71.90	71.38	n.s
Wt.of 100 kernels (gm)	31.79	33.61	32.70	1.03

* The differences between varieties are not significant at 0.05.

Table 7 Effect of nitrogen fertilizer levels on some average growth characters in maize during 1991 and 1992 seasons.

Characters	Nitrogen levels (Kg/fad)					Mean	L.S.D* 0.05
	30	60	90	120	150		
				1991			
Number of leaves/plant	13.50	13.71	13.72	13.94	13.69	13.72	n.s
Leaf area of topmost ear (cm^2)	678.74	658.89	691.42	653.10	670.83	662.60	n.s
Leaf area index	6.68	6.51	6.41	6.50	6.56	6.53	n.s
Plant height (cm)	278.94	277.33	274.56	270.28	272.89	274.80	n.s
Ear height (cm)	134.33	129.61	132.89	131.50	135.89	132.84	n.s
Stem diameter (mm)	23.46	22.91	23.24	22.91	23.38	23.18	n.s
				1992			
Number of leaves/plant	12.88	12.99	13.19	12.88	13.15	13.02	n.s
Leaf area of topmost ear (cm^2)	615.59	641.00	672.47	643.90	672.06	649.00	31.50
Leaf area index	5.69	5.89	6.33	5.96	6.39	6.06	0.40
Plant height (cm)	240.21	241.37	239.25	241.29	239.92	240.41	n.s
Ear height (cm)	106.58	103.79	110.50	106.17	109.75	107.36	n.s
Stem diameter (mm)	22.20	21.74	22.33	22.20	22.73	22.24	n.s

Number of rows/ear showed no significant response to the increase in N level in both seasons.

Number of kernels/row increased significantly in second season by 4.05%, 10.03%, 9.97% and 13.32% when the N level increased from 30 to 60, 90, 120 and 150 kg/fed., respectively. However these increases were not significant in first season. Similar results were reported by Shafshak *et al.* (1981), Abdel-Gawad (1986) and Abo El-Zahab and Rady (1990).

3. Grain yield and its related characters:

Results in Table (9) indicate that the grain yield/fed. was significantly affected by N level in both seasons. Increasing N level from 30 to 60, 90, 120 and 150 kg/fed. increased grain yield by 8.27%, 22.55%, 11.70% and 16.58%, respectively, in first season and by 17.45, 38.26%, 32.00% and 43.97%, respectively, in second season compared with 30 kg N/fed. level. The highest grain yields/fed. were obtained at a level of 90 and 150 kg N/fed. in both seasons without significant differences between the two levels in second season.

Also, results showed that the effect of increasing N level on grain yield/plant was only significant in the second season, where raising the N level from 30 to 60, 90, 120 and 150 kg N/fed. markedly increased grain yield/plant by 9.09%, 16.98%, 19.22% and 16.14%, respectively. In the first season, the increase in N level failed to show any effect on this trait.

Neither shelling percentage nor grain index were significantly affected by N level in both seasons of experimentation. Shelling percentage was slightly increased in both seasons due to the increase in N level. Similarly, weight of 100 kernels was slightly increased in second season but without any significant difference. Similar results were reported by Salem *et al.* (1982), Abdel-Gawad (1986), Abo El-Zahab and Rady (1990) and Khalil (1992).

D) Interaction effects:

Summary of interaction effects in both 1991 and 1992 season is presented in Tables 10 and 11. These Tables showed that, except as noted, the best combinations of planting date and varieties was that of May planting and T.W.C.310 where the highest values were seen for number of leaves/plant, leaf area, L.A.I., plant height, ear height, stem diameter, ear length, number of kernels/row, shelling percentage and grain yield/plant. In the 1991 season, exceptions were given only with ear diameter where the highest value was recorded with Giza 2 and May planting, number of rows/ear which was recorded with Giza 2 and June planting, weight of 100 kernels which was obtained from Giza 2 and May planting and grain yield/fed. which was recorded with Giza 2 and May planting. In the 1992 season, exceptions were observed with stem diamter (June planting and T.W.C. 310), ear diameter (May planting and Giza 2), number of rows/ear (May planting and Giza 2) and shelling percentage (May planting and Giza 2).

Table 8 Effect of nitrogen fertilizer levels on average ear chararcters in maize during 1991 and 1992 seasons.

Characters	Nitrogen levels (kg/fad)					Mean	L.S.D 0.05
	30	60	90	120	150		
				1991			
Ear length (cm)	18.56	19.25	18.77	18.79	18.68	18.81	n.s
Ear diameter (mm)	48.73	48.74	48.77	49.16	47.56	48.59	1.10
Number of rows/ear	12.98	13.67	13.29	13.49	13.36	13.36	n.s
Number of kernels/row	36.81	36.41	37.41	36.08	36.09	36.56	n.s
				1992			
Ear length (cm)	17.03	18.00	18.49	18.63	19.02	18.23	1.08
Ear diameter (mm)	45.53	45.55	46.42	46.53	46.57	46.12	n.s
Number of rows/ear	13.12	13.05	13.24	13.33	13.47	13.24	n.s
Number of kernels/row	32.81	34.14	36.10	36.08	37.18	35.26	2.64

Table 9. Effect of nitrogen fertilizer levels on average grain yield and related characters in maize during 1991 and 1992 seasons.

Characters	Nitrogen levels (kg/fad)					Mean	L.S.D 0.05
	30	60	90	120	150		
				1991			
Grain yield/fad (kg)	2100.78	2274.53	2520.47	2346.56	2449.07	2338.28	204.89
Grain yield/plant (gm)	181.84	178.10	181.69	176.38	175.24	178.65	n.s
Shelling percentage	72.68	73.39	74.12	74.29	73.03	73.50	n.s
Wt.of100-kerneis (gm)	35.04	35.63	34.96	35.03	34.42	35.02	n.s
				1992			
Grain yield/fad (kg)	1173.74	1378.54	1622.85	1549.33	1689.88	1482.87	163.26
Grain yield/plant (gm)	135.55	147.87	158.56	161.60	157.43	152.20	19.35
Shelling percentage	70.86	71.32	71.20	71.55	71.98	71.38	n.s
Wt.of100-kernels (gm)	32.62	32.41	32.66	33.34	32.48	32.70	n.s

Table 10: Highest response value, significance, and combination of factors of the interaction effects on the studied characters of maize in 1991 season.

Characters	Interactions			
	Dates X Var.	Dates X N	Var. X N	Dates X Var. X N
Number of leaves/plant	15.29 N.S May,T.W.C 310	15.23 N.S May, 150	14.09 N.S T.W.C 310, 60	15.48 N.S May,T.W.C 310,150
Leaf area of topmost ear (cm^2)	781.67 N.S May,T.W.C 310	782.53 N.S May, 150	714.63 N.S T.W.C 310, 150	814.43 N.S May,T.W.C 310,150
Leaf area index	8.52 N.S May,T.W.C 310	8.25 N.S May, 150	7.14 N.S T.W.C 310, 30	8.77 N.S May,T.W.C 310,150
Plant height (cm)	309.00 * May,T.W.C 310	316.83 N.S May, 60	285.33 N.S T.W.C 310, 30	320.00 N.S May, Giza 2, 60
Ear height (cm)	149.47 N.S May,T.W.C 310	150.17 N.S May, 150	140.67 N.S T.W.C 310, 150	153.33 N.S May,T.W.C 310,120
Stem diameter (mm)	28.53 N.S May,T.W.C 310	27.83 N.S May, 150	25.02 N.S T.W.C 310, 30	30.67 N.S May,T.W.C 310,150
Ear length (cm)	21.94 N.S May,T.W.C 310	21.30 * May, 150	20.49 N.S T.W.C 310, 60	22.87 N.S May,T.W.C 310,150
Ear diameter (mm)	52.55 N.S May, Giza 2	52.25 * May, 60	50.89 N.S Giza 2, 120	53.47 N.S May,Giza 2, 120
Number of rows/ear	1107 N.S June, Giza 2	14.00 N.S May, 150	14.42 N.S Giza 2, 120	14.67 N.S May, Giza 2, 150
Number of kernels/row	46.71 * May,T.W.C 310	43.57 N.S May, 90	40.66 N.S T.W.C 310, 90	48.27 N.S May,T.W.C 310, 30
Shelling percentage	79.11 N.S May,T.W.C 310	80.05 N.S May, 120	74.53 N.S Giza 2, 90	81.13 N.S May,T.W.C 310,120
Weight of 100 kernels (gm)	37.28 N.S May Giza 2	38.03 * May, 90	36.75 N.S T.W.C 310, 60	39.27 N.S May, Giza 2, 90
Grain yield/plant (gm)	231.03 N.S May,T.W.C 310	243.22 N.S May, 30	191.93 N.S T.W.C 310, 150	256.00 N.S May,T.W.C 310, 3o
Grain yield/faddan (kg)	3021.9 * May, Giza 2	3643.70 * May, 90	2638.80 N.S Giza 2, 90	3730.50 N.S May, Giza 2, 90

Table 11: Highest response value, significance, and combination of factors of the interaction effects on the studied characters of maize in 1992 season.

Characters	Interactions			
	Dates X Var.	Dates X N	Var. X N	Dates X Var. X N
Number of leaves/plant	14.25 * May,T.W.C 310	14.30 N.S May, 150	13.53 * T.W.C 310, 60	14.55 N.S May,T.W.C 310,150
Leaf area of the topmost ear (cm^2)	747.52 N.S May,T.W.C 310	764.20 N.S May, 90	707.07 N.S T.W.C 310,150	799.12 N.S May,T.W.C 310, 60
Leaf area index	7.56 N.S May,T.W.C 310	7.58 N.S May, 120	6.90 N.S T.W.C 310,150	8.08 N.S May,T.W.C 310, 60
Plant height (cm)	259.65 N.S May,T.W.C 310	263.25 N.S May, 120	249.75 * T.W.C 310,120	270.75 N.S May,T.W.C 310, 60
Ear height (cm)	124.20 N.S May,T.W.C 310	123.12 N.S May, 30	113.83 N.S T.W.C 310,120	130.75 N.S May,T.W.C 310, 30
Stem diameter (mm)	23.70 * June,T.W.C 310	23.40 N.S May, 30	24.18 N.S T.W.C 310, 30	24.90 * May,T.W.C 310, 30
Ear length (cm)	21.26 N.S May,T.W.C 310	21.25 * May, 90	20.17 N.S T.W.C 310,150	23.30 N.S May,T.W.C 310, 60
Ear diameter (mm)	47.95 N.S May, Giza 2	48.38 N.S May, 120	47.17 N.S Giza 2, 150	48.65 N.S May, Giza 2, 90
Number of rows/ear	14.47 N.S May, Giza 2	14.05 N.S May, 90	14.13 N.S Giza 2, 150	14.80 N.S May,Giza 2, 90
Number of kernels/row	43.34 * May,T.W.C 310	42.55 N.S May, 90	41.00 N.S T.W.C 310,150	45.60 * May,T.W.C 310,60
Shelling percentage	72.85 N.S May, Giza 2	71.39 N.S May, 150	72.76 N.S T.W.C 310,150	74.30 N.S June,T.W.C 310,30
Weight of 100 kernels (gm)	36.02 N.S May,T.W.C 310	36.40 N.S May, 120	34.46 N.S T.W.C 310,60	37.90 N.S May,T.W.C 310,120
Grain yield/plant (gm)	207.16 * May,T.W.C 310	212.84 N.S May, 90	172.28 N.S T.W.C 310,120	225.77 N.S May,T.W.C 310,60
Grain yield/fad. (kg)	1745.8 N.S May,T.W.C 310	1848.00 N.S May, 150	1878.30 * T.W.C 310,150	2149.00 * May,T.W.C 310,150

Concerning planting date x N level, the highest values were obtained in general, by combining May planting and a level of 150, 120 or 90 kg N/fed. in the 1991 season, whereas in the 1992 season, combining May planting with each of 90, 120 or 150 kg N/fed. levels produced the highest values.

Varieties x N level interaction indicated that the best results were obtained from combining T.W.C. 310 with 150 kg N/fed. level particularly in the second season.

The second order interaction also indicated the superiority of May planting combined with T.W.C. 310 and N level from 90 to 150 kg N/fed. over the lower levels. The best results were obtained from planting in May with T.W.C. 310 and 150 kg N/fed. as far as grain yield/fed is concerned.

REFERENCES

Abdel-Gawad, M.H. (1986): Agronomic studies on field crops (corn) as influenced by environmental conditions. Ph.D. Thesis, Fac. Agric., Cairo Univ., Egypt.

Abo El-Zahab, A. and Rady, M.A. (1990): Relationship of development, growing degree days and yield in maize. Assiut J. Agric. Sci., 21(5):251-274, Egypt.

Ba-Momen, A.M. (1981): Differential yield response of corn varieties and hybrids to different sowing dates. M.Sc. Thesis, Fac. Agric., Cairo Univ., Egypt.

Bisher, M.A. (1973): Physiological response of the maize plants to planting dates. Ph.D. Thesis, Fac. Agric., Ain Shams Univ., Egypt.

El-Shaer, M.H.; Gheith, E.M.S.; Abd El-Hafeez, A.A. and Hafez, M.A. (1987): Phenology and yield of corn under modified microclimate at Giza. A.R.E. Ann. Agric. Sci., Moshtohor, 25(1):43-55, Egypt.

Eraky, A.G.; Salem, A.H. and Gouda, A.Sh.A. (1980): Vartietal response to plant density and nitrogen fertilization in maize. Zagazig J. Agric. Res. 7:147-183, Egypt.

Faisal, R.L.L. (1983): Effect of some agricultural practices on growth and yield of some maize varieties (*Zea mays* L.). M.Sc. Thesis, Fac. Agric., Moshtohor, Zagazig Univ., Egypt.

Gouda, A.Sh.A. (1982): Effect of planting density and nitrogen fertilization on growth and yield of some maize varieties. M.Sc. Thesis, Fac. Agric., Zagazig Univ., Egypt.

Gouda, A.Sh.A. (1989): Agronomic studies on maize. Ph.D. Thesis, Fac. Agric., Zagazig Univ., Egypt.

Gouda, A.Sh.A.; Abdallah, M.M. and Faisal, R.I.I. (1992): Response of some maize varieties to nitrogen fertilization. Ann. Agric. Sc., Moshtohor, 30(4):1649-1660, Egypt.

Hamada, M.A. 91972): Effect of planting dates, population density, leaf pulling and detasseling on some root and growth characters in maize. M.Sc. Thesis, Fac. Agric., Ain Shams Univ., Egypt.

Khalil, E.M.A. (1992): Effect of nitrogen, zinc and farm yard manure on yield of maize. M.Sc. Thesis, Fac. Agric. Moshtohor, Zagazig Univ., Egypt.

Milliken, D.A. and Johnson, D.E. (1984): Analysis of messy data. Van Nostrand Reinhold Co., U.S.A.

Nafziger, E.D. (1994): Corn planting date and plant population. J. Prod. Agric., 7(1):59-62.

Nigem, S.A. (1989): Varietal response to nitrogen fertilization in maize. Egypt. J. Appl. Sci. 4:127-139, Egypt.

Salem, M.S.S. (1973): Effect of preceding winter crops and fertilization on growth and yield of corn. M.Sc. Thesis, Fac. Agric., Cairo Univ., Egypt.

Shafshak, S.E.; Salem, M.S. and Roshdy, A. (1981): Response of maize to nitrogen and boron. Ann. Agric. Sc. Moshtohor, 6:3-16, Egypt.

Shams, S.M. 91988): The relationships of varieties and sowing dates on infestation with boarers and yield in corn (Zea mays, L.). Ph.D. Thesis, Fac. Agric., Moshtohor, Zagazig Univ., Egypt.

Yousef, M.E. (1968): The effect of planting dates and poulation density on growth and yield of maize. M.Sc. Thesis, Fac. Agric.. Ain Shams Univ., Egypt.

علاقة صفات النمو والمحصول ومكوناته فى الذرة ببعض المعاملات الزراعية

صلاح الدين شفشق* ، أحمد على عبدالحليم** ، جيمس ل. روزنبرجر***،
عدلى محمد مرسى سعد*، فتحى عشماوى أحمد**

* قسم المحاصيل والميكنه الزراعيه - كلية الزراعه بمشتهر - جامعة الزقازيق/فرع بنها
** المعمل المركزى للتصميم والتحليل الاحصائى - مركز البحوث الزراعيه - الجيزه.
*** قسم الاحصاء - جامعة بنسلفانيا - الولايات المتحده الأمريكيه.

أجريت تجربتان حقليتان فى مركز البحوث والتجارب الزراعية بكلية الزراعة بمشتهر فى موسمى ١٩٩١، ١٩٩٢ بهدف دراسة تأثير ميعاد الزراعة ومستويات السماد الأزوتى على نمو ومحصول صنفى الذرة الشامية جيزة ٧، وهجين ثلاثى ٣١٠. ويمكن تلخيص النتائج المتحصل عليها كالأتى:

تأثرت صفات النمو معنويا بميعاد الزراعة حيث أدى تأخير ميعاد الزراعة من مايو إلى يونيو إلى إنخفاض كل من عدد الأوراق للنبات ومساحة ورقة الكوز العلوى ودليل مساحة الأوراق وإرتفاع النبات وإرتفاع الكوز وسمك الساق. وقد أدى تأخير الزراعة من مايو إلى يوليو إلى إنخفاض الصفات السابقة.

كما أدى تأخير الزراعة من مايو إلى يونيو إلى إنخفاض معنوى فى كل من طول الكوز وقطر الكوز وعدد صفوف الكوز وعدد حبوب الصف وقد أدى تأخير الزراعة من مايو إلى يوليو إلى حدوث إنخفاض معنوى فى صفات الكوز.

كما تفوقت الزراعة فى مايو على الزراعة فى يونيو ويوليو بالنسبة لصفات محصول الحبوب للنبات والفدان ومعدل التفريط ووزن الـ ١٠٠ حبة وذلك خلال موسمى الزراعة.

تأثر محصول الحبوب للفدان معنويا بميعاد الزراعة فى الموسم الأول بينما لم تصل الفروق بين مواعيد الزراعة إلى حد المعنوية فى الموسم الثانى حيث تفوق محصول الحبوب للفدان نتيجة الزراعة فى مايو مقارنة بالزراعة فى كلا من يونيو ويوليو.

تفوق هجين ثلاثى ٣١٠ معنويا على الصنف التركيبى جيزة ٢ وذلك بالنسبة لصفات عدد الأوراق ومساحة ورقة الكوز العلوى ودليل مساحة الأوراق وإرتفاع النبات وقطر الكوز وطول الكوز وعدد حبوب الصف ومحصول الحبوب للنبات وكذلك وزن الـ ١٠٠ حبة فى الموسم الثانى والتى لم تصل إلى حد المعنوية فى الموسم الأول.

لكن بالنسبة لمحصول الحبوب للفدان تفوق جيزة ٢ معنويا فى الموسم الأول بينما هجين ثلاثى ٣١٠ تفوق معنويا فى الموسم الثانى.

كما تفوق صنف جيزة ٢ معنويا فى عدد صفوف الكوز على صنف هـ.ث. ٣١٠ وذلك فى موسمى الزراعة كما تفوق صنف جيزة ٢ على هـ.ث. ٣١٠ فى صفة قطر الكوز وذلك خلال موسمى الزراعة أيضا ولكن دون فروق معنوية.

أما بالنسبة لصفة معدل التفريط تفوق هـ.ث. ٣١٠ فى الموسم الأول بينما حدث العكس فى الموسم الثانى ولكن دون فروق معنوية.

أدت زيادة معدل التسميد الأزوتى إلى زيادة معنوية لصفتى قطر الكوز ومحصول الحبوب للفدان وذلك خلال موسمى الزراعة.

كما أدت زيادة معدل التسميد الأزوتى إلى زيادة معنوية لصفات مساحة ورقة الكوز العلوى وطول الكوز وعدد حبوب الصف ومحصول الحبوب للنبات وذلك للموسم الثانى بينما لم تصل إلى حد المعنوية فى الموسم الأول.

كما أنه لم يكن هناك تأثير معنوى لمستويات السماد الأزوتى على صفات عدد الأوراق للنبات ودليل مساحة الأوراق وإرتفاع النبات وإرتفاع الكوز وسمك الساق وعدد صفوف الكوز وأيضا معدل التفريط ووزن الـ ١٠٠ حبة خلال موسمى الزراعة.

أثر التفاعل بين ميعاد الزراعة والأصناف معنويا على عدد الأوراق للنبات وسمك الساق ومحصول الحبوب للنبات وذلك فى الموسم الثانى وعلى العكس تأثرت صفات إرتفاع النبات ومحصول الحبوب للفدان معنويا بهذا التفاعل وذلك فى الموسم الأول بينما تأثر معنويا بهذ التفاعل خلال موسمى الزراعة صفة عدد حبوب الصف.

تأثرت بهذا التفاعل معنويا صفتى طول الكوز ومحصول الحبوب فى كلا الموسمين أما مساحة ورقة الكوز العلوى فتأثرت معنويا بهذا التفاعل فى الموسم الثانى وعلى العكس صفات قطر الكوز ومحصول الحبوب النباتى ووزن الـ ١٠٠ حبة تأثرا معنويا بهذا التفاعل وذلك فى الموسم الأول.

تأثرت صفة سمك الساق فى الموسم الأول وصفات عدد الأوراق وإرتفاع النبات ومحصول الحبوب للفدان فى الموسم الثانى معنويا بالتفاعل بين الأصناف ومستويات السماد الأزوتى.

كان تأثير التفاعل بين ميعاد الزراعة والأصناف ومستويات السماد الأزوتى معنويا على صفات سمك الساق وعدد حبوب الصف ومحصول الحبوب للفدان وذلك خلال الموسم الثانى للصفات السابقة. وكانت أفضل معاملة للحصول على أفضل محصول هى زراعة هجين ثلاثى ٣١٠ المزروع فى مايو والمسمد بمعدل ٩٠-١٥٠ كجم أزوت للفدان.