Effect of irrigation intervals and nitrogen fertilization on growth and yield of two maize hybrids

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Abstract

Two field experiments were carried out at the Research Farm of the Faculty of Agriculture, Assiut University, during 2008 and 2009 seasons, to study the effect of three irrigation intervals (15, 25 and 35 days) and three nitrogen fertilization rates (40, 80 and 120 kg/fed.) on the growth and yield of two maize hybrids (S.C. Watania 4 and T.W.C. 310). Increasing irrigation intervals significantly reduces maize growth and yield and its components as well as the percentage of protein and oil ingrains. This reduction in grain yield (76.28 and 63.07%) is due to irrigation every 35 days compared to irrigation every 15 days for the first and second seasons respectively. The two hybrids significantly differed in most of growth characters in both seasons and grain yield and its components in the second one with superiority of S.C. Watani4. Increasing N-rates significantly increased the growth of maize andgrain yieldand its components as well as the percentage of protein and oil in grains. Interaction between irrigation intervals and N-rates significantly affected grain yield/fed. in the first season and that highest yield, when irrigation every 15 days and application of 120 kg N/fed.

Key words: irrigation intervals, maize hybrids, N-rates.

Introduction

Water supply is considered to be a limiting factor for production and highly desirable to obtain high yield of maize by using the best amount of irrigation. In this connection, Moursi (12) indicated that water deficit reduced plant and ear height, ear leaf area as well as grain yield/fed. and its components. El-Murshedy (5) also indicated that water stress, during flowering stage, significantly decreased ear length, number of ears/plant, number of kernels/row and biological and grain yield/fed. formaize hybrid, whereas the number of days to 50% tasseling and silking were significantly increased under water stress. Ibrahim (8) found that prolonging irrigation intervals from 10 to 15 and 20 days significantly decreased plant height number of green leaves/plant, leaf area/plant and biological yield and grain yield/fed. and its components. Soliman (19) demonstrated that increasing irrigation intervals from 15 to 21, 28 and 35 days for some corn varieties and hybrids significantly decreased plant height as well as grain yield and its components. El-Nagar (6) found that irrigation every 10 days interval significantly increased plant height, stem diameter and grain yield and its components as well as grain protein content as compared with 18 days interval at vegetative growth stage. Abdo (1) found that increasing irrigation intervals from 14 to 21 or 28 days for maize significantly decreased grain yield/fed. and its components, but protein percentage in grain was significantly increased. Ibrahim and Hala (9) also found that shortening irrigation intervals from 10 to 14 and 18 days significantly increased protein and oil percentage in grains.

Regarding hybrids effect, Shaheen (18) showed that maize cultivar S.C.10 surpassed T.W.C. 310 and D.C.215 cultivars in all growth characters as well as grain yield/fed. and its components. Ibrahim (8) indicated that maize variety S.C.10 gave highest values of plant height, number of green leaves/plant, number of days from sowing to 50% tasseling and silking as well as biological yield and grain yield and its components with significant differences than T.W.C.310 and Giza-2. Osman (14) found significant differences between hybrids (S.C.10, S.C.2010 and T.W.C.

Nefertety) in all growth characters andgrain yield and its components, except green leaves/plant. Ahmed (2) demonstrated that hybrid S.C.Watania 4 significantly surpassed T.W.C. 320 in plant height, ear height, number of grains/row, 200-grain/weight, shelling percentage, and grain yield/fed.Nitrogen fertilization is a major factor needed for maximizing yield of maize. The positive effect of N-fertilization on growth and yield 0f maize was reported by Kassem et al. (10), Shafshak et al. (17), Salem(16), Nawar(13), Ibrahim and Hala(9) and Leilah et al.(11).

The aim of this study was to investigate the effect of irrigation intervals and nitrogen fertilization rates on growth, grain yield and its components as well as protein and oil percentage in grain of two maize hybrids under Assiut condition.

Materials and Methods

This study was carried out at the Research Farm of the Faculty of Agriculture, Assiut University, Egypt, during the summer seasons of 2008 and 2009, to study the effect of irrigation intervals, nitrogen fertilization rates on growth, yield and its components as well as protein and oil percentage of two maize hybrids. Before conducting the experiment, soil samples were taken from different places representing the experimental site throughout the root zone (0-60 m). The mean mechanical and chemical analysis of soil of the two growing seasons are presented in Table (1).The preceding crop was Egyptian clover in the first season and faba bean in the second season.

Table (1): Mechanical and chemical analysis of the experimental soil in 2008 and 2009 seasons

Season / Properties	2008 season	2009 season
Mechanical analysis		
Sand (%)	26.20	26.60
Silt (%)	24.20	23.00
Clay (%)	49.60	50.40
Soil texture	Clay	Clay
Chemical analysis		
Acidic	7.73	7.80
Organic matter (%)	1.74	1.62
Total nitrogen(%)	0.08	0.07
Total $CaCO_3$(%)	1.17	1.20

The experimental treatments were eighteen which were the combinations of three irrigation intervals, three nitrogen fertilization rates and two maize hybrids as follows:

A – Irrigation intervals:

1. Irrigation every 15 days (number of irrigations 7).
2. Irrigation every 25 days (number of irrigations 4).
3. Irrigation every 35 days (number of irrigations 3).

B – N-fertilization rates:

1. 40 kg N/fed.
2. 80 kg N/fed
3. 120 kg N/fed.

C – Maize hybrids:

1. Single Cross Watania (S.C.Watania 4).
2. Three Way Cross 310 (T.W.C. 310).

The present investigation is designed as three separate experiments for irrigation treatments and each irrigation interval designed in split-plot with four replicates. The two maize hybrids were allotted randomly to the main plots and nitrogen rates were practiced at random to the sub plots. The experimental unit was 10.5 m^2 (1/400 fedan). Before planting, all plots received 100kg calcium phosphates/fed. (15.5 % P_2O_5). In addition to 100 kg potassium sulphate (48% K_2O) was added before planting date for all plots. Planting date was 4th and 2nd of June for 2008 and 2009 seasons respectively. Maize plants were thinned to secure one healthy plant in hill prior to first irrigation, which gave a population of 20000 plants/fed. The plots were hand hoed for controlling weeds before the thinning. The other normal practices were done according to the recommendations. The characters studied were as follows:

Growth characters and flowering

1. Date of tasseling: number of days to 50% tasseling.
2. Date of silking: number of days to 50% silking.

Samples of ten plants were taken randomly from each sub-plot to determine the growth characters as follows: Plant and ear height (cm), stem diameter (cm), green leaves/plant and leaf area of topmost ear (cm^2).

Yield and yield components

1- At harvest, samples of ten ears were taken at random from each sub-plot to determine the yield components which were: ear length (cm), number of rows/ear, number of grains/row, number of ears/plant, grain weight/ear (gm), 100-grain weight (gm) and shelling percentage.
2- Biological yield (ton/fed.).
3- Grain yield: was determined by the weight of grains per kilograms of each sub-plot then converted to ton per feddan at adjusted moisture 15%.

Grain quality

1- **Protein percentage:** Protein percentage in grains was determined in random samples drawn from each sub-plot, using the technique of micro-kjeldahle apparatus according to A.O.A.C.(3) . The determined nitrogen content was then multiplied by 5.75 to calculate protein (%) in the grains.
2- **Oil percentage:** Oil percentage in grains was estimated by modified Soxhlet apparatus Bedov(4).

The statistical analysis for data was carried out according to Gomez and Gomez (7). L.S.D test at 5% significant level was used to compare the differences between treatment means.

Results and Discussion

Growth characters:

1- Response to irrigation intervals:

Results in Table (2) indicate that number of days to 50% tasseling and silking were significantly increased due to increasing the intervals of irrigation where that maximum number of days to 50% tasseling (73.17 and 75.25) and to 50% silking (80.46 and 79.83) were obtained from irrigation every 35 days for the first and second seasons respectively. It was clear that the soil moisture deficit stimulated shifting the maize plants from vegetative to reproductive stage. These results agree with those obtained by El-Murshedy (5).

The results in Table (2) reveal that plant height, ear height, stem diameter, the number of green leaves/plant and leaf area of topmost ear were significantly affected by irrigation intervals. The greatest values of growth characters were obtained when maize plant were irrigated every 15 days, whereas the minimum values were obtained from irrigation every 35 days, this may be due to the reduction in meristamtic activity, and photosynthetic accumulation under condition of water stress when maize plants were irrigated every 35 days resulting in a decrease in the growth of plant. These results are in accordance with those reported by Ibrahim (8) and Moursi (12) for plant and ear height, number of green leaves/plant and leaf area of topmost ear. Also these results agree with El-Nagar (6) for stem diameter character.

2- Response to varietal differences:

Results in (Table 2) showed that maize hybrids had no significant effect on the number of days to 50% tasseling and silking and the number of green leaves/ plant in both seasons. The result on number of leaves/ plant agree with that obtained by osman (14). The results in (Table 2) indicate that the two hybrids significantly differed in plant height, ear height and stem diameter in both seasons and leaf area of topmost ear in the second season with superiority of S.C.Watania 4 in these characters. These results may be attributed to genetic differences between hybrids and its interaction with different environmental condition prevailing during the growth seasons. These results are similar to those reported by Osman (14) and Shaheen (18).

3- Response to N-rates:

The results in Table (2) show that number of days to 50% tasseling and silking were gradually and significantly increased by increasing N-rates The nitrogen might have encouraged the meristamatic activity and increases the vegetative growth. These results agree with those obtained by Kassem et al. (10) who found increasing N-rate from 0 to 30, 60, 90 and 120 kg/fed. Significantly increased number of days to 50% tassling and silking . Also, Shafshak et al.(17) found that the number of days to 50% tassling and silking was significantly increased by increasing N-level from zero to 45,90, and 135 kg/fed.

Results presented in Table (2) show that nitrogen fertilization rates significantly affected growth characters in both seasons. The tallest plants (199.33cm and 206.63 cm) and the maximum height of ear (99.96cm and 98.33 cm) as well as the thickness stems (2.27cm and 2.53 cm) were at highest N-arte of 120 Kg N/fed. in the first and second seasons, respectively. The results also indicate that the increasing N-rate significantly increased the number of green leaves/plant and leaf area of topmost ear to reach the highest values at the highest nitrogen rate. The superiority of growth characters at high N-rate may be due to the role of nitrogen in stimulating the build up of amino acids and growth hormones, this in turn acts positively in cell division and enlargement. The obtained results agree with those obtained by Leilah (11) and Nawar (13). Also, Salem (16) indicated that the increasing N-rate from 60 to 120 kg/fed caused significant increase in plant height, ear height and stem diameter.

Table (2): Effect of irrigation intervals, hybrids and N-rates on growth characters number of days to 50% tasseling and silking of maize in 2008 and 2009 seasons

Characters / Treatments	Days to 50% tasseling	Days to 50% silking	Plant height (cm)	Ear height (cm)	Stem diameter (cm)	No. ofgreen leaves / plant	Leafarea of topmost ear (cm^2)
2008 season							
Irrigation intervals							
Every 15 days	62.33	66.29	231.25	108.83	2.27	15.23	763.60
Every 25 days	65.88	71.83	218.50	103.13	2.19	14.75	733.56
Every 35 days	73.17	80.46	148.25	70.96	2.03	13.98	657.33
L.S.D at 5%	4.19	4.12	8.72	7.91	0.08	0.55	29.19
Hybrids							
S.C.Watania	66.11	71.78	206.25	96.83	2.49	14.66	718.61
T.W.C. 310	68.14	73.94	192.42	91.78	2.13	14.65	717.72
L.S.D. at 5%	N.S	N.S	13.69	2.88	0.05	N.S	N.S
N-rate (kg/fed.)							
40	66.09	71.46	186.63	89.58	2.05	14.61	682.48
50	67.13	72.88	192.92	93.38	2.16	15.06	717.95
120	68.17	74.25	199.33	99.96	2.27	14.30	754.05
L.S.D. at 5%	1.62	1.81	2.31	2.08	0.04	0.22	14.11
2009 season							
Irrigation intervals							
Every 15 days	63.46	68.04	220.21	103.92	2.52	16.48	762.43
Every 25 days	67.63	71.75	206.42	95.00	2.37	15.88	656.46
Every 35 days	75.25	79.83	165.04	75.38	2.29	15.13	615.55
L.S.D. at 5%	3.26	3.70	22.13	10.66	0.09	0.49	90.97
Hybrids							
S.C.Watania	68.25	72.39	207.69	93.75	2.45	15.63	703.80
T.W.C. 310	69.31	74.03	186.75	89.11	2.33	16.03	652.49
L.S.D at 5%	N.S	N.S	8.61	1.47	0.06	N.S	26.56
N-rate (kg/fed.)							
40	67.13	71.75	186.08	84.67	2.24	15.31	657.63
80	68.67	72.88	198.96	91.29	2.40	15.75	679.27
120	70.54	75.00	206.63	98.33	2.53	16.43	697.55
L.S.D. at 5%	1.19	1.28	3.50	1.79	0.04	0.19	19.64

4- Interactions effect:

It is observed from the results in Table (3) that interaction between maize hybrids and N-rates had significant effect on the number of days to 50% tasseling in the first season. The earliest plants (65.50 days) were for S.C. Watania 4 fertilized by 40 kg N/fed, whereas the latest plants (69.50 days) were for T.W.C. 310 fertilized by 120 kg N/fen. While all the first order interactions, as well as the second order interaction, had no significant effect on the number of days to 50% silking. The results in (Table 3) indicate that interaction between maize hybrids and nitrogen rates significantly affected a number of green leaves/plant in the second season only, the greatest number in this season was (16.75) obtained from T.W.C. 310fertilized with 120kgN while the lowest one (15.25) was obtained from S.C. Watania 4 fertilized by 40 kg N. Results in Table (3) show that leaf area of topmost ear was significantly affected by interaction between maize hybrids and nitrogen rates in the first season, the highest value (765.10 cm2) was obtained by S.C. Watania 4 at N-rate of 120kg N/fed, whereas the lowest value of 674.28 cm2 was for S.C. Watania 4 at 40 kg N/fed.

On the other hand, all the first order interactions and the second order of interaction did not significantly affect days to 5% silking and plant and ear height as well as stem diameter in both seasons.

Table (3): Effect of interaction between hybrids and N-rates on the number of days to 50% tasseling, leaf area of topmost ear and number of green leaves/plant of maize in 2008 and 2009 seasons

Season	2008			2009		
N-rates (kg/fed.) Hybrids	40	80	120	40	80	120
Number of days to 50% tasseling						
S.C.Watania 4	65.50	66.00	66.83	66.50	67.92	70.33
T.W.C. 310	66.67	68.25	69.50	67.75	69.42	70.75
L.S.D. at 5%	1.88			N.S		
Number of green leaves/plants						
S.C. Watania 4	14.55	15.15	14.27	15.25	15.53	16.10
T.W.C. 310	14.67	14.97	14.32	15.37	15.97	16.75
L.S.D. at 5%	N.S			0.27		
Leaf area of topmost ear (cm^2)						
S.C. Watania 4	674.28	716.43	765.10	684.93	702.05	724.43
T.W.C. 310	690.68	719.47	743.00	630.33	656.48	670.66
L.S.D. at 5%	19.95			N.S		

Yield components

1- Response to irrigation intervals:

Results in Table (4) reveal that all yield components were significantly affected by irrigation intervals. It is clear from the results that prolonging irrigation intervals from 15 to 25 and 35 days significantly reduced maize yield components. These reductions in ear length, number of rows/ear and number of grains/row, when irrigation every 35 days, compared with irrigation every 15 days were 8.54, 4.91 and 45.69% in the first season being 18.29, 12.73 and 31.31% in the second season. The respective reductions in the number of ears/plant, ear grains weight and 100-grain weight were 10.91, 52.19 and 20.87% in the first season and 14.05, 45.76 and 13.67% in the second season. These results may be due to the effect of sufficient available water when plants irrigated every 15 days which increasedphotosynthesis , dry matter accumulation , cell division

and elongation during vegetative and reproductive stages as well as during grain filling stage. Similar results were also found by El-Murshedy (5), El-Nagar (6), Ibrahim (8) and Soliman (19).

2- Response to varietal differences:

Results in Table (4) indicate that the two hybrids were significantly differed in a number of ears/plant in both seasons and ear length, number of rows/ear, number of grains/row, 100-grain weight and ear grain weight in the second season only, but they had no significant effect on shelling percentage. It is observed that S. C. Watania 4 gave the highest values of yield components and this superiority over T.W.C. 310 may be due to its superiority in growth characters. These results are in harmony with those recorded by Ibrahim (8), Osman (14) and Shaheen (18).

3- Response to N-rates:

There was significant response to N-rates regarding yield components in both seasons except shelling percentage which significantly responsd to N-rates in the first season only (Table 4). Application of 120 kg N/fed. significantly increased yield components over the rates of 40 and 80 kg N/fed. These increases in ear length number of rows/ ear and number of grains row over 40 kgN /fed. were 14.31 8.00 and 20.98% in the first season being 14.54 5.33 and16.19% in the second season respectively. The respective increase in the number of ears plant , 100- grain weight and ear grains weight were11.11 7.22 and 35.71 % in the first season and 18.45 17.37 and 24.39 %in the second one. It could be concluded that the highest N-rate (120 kg N/fed.) is most effective in increasing yield components of maize. These results could be attributed to the increase in plant growth as well as dry mater assimilation during grains filling stage. Similar results reported by Salem (16) who found that increasing N-rate from 60 to 120 kg/fed. Significantly increased the number of ears/plant, ear length, number of grains in row, ear grains weight, 100-grain weight and shelling percentage. Shafshaket al.(17) also found that increasing N-rate from zero to 45, 90 and 135 kg/fed. significantly increased number of ears/ plant, ear length, 100- grain weight and shelling percentage.

Table (4): Effect of irrigation intervals, hybrids and N-rates on yield components of maize in 2008 and 2009 seasons

Shelling percentage	100-grain weight (gm)	Ear grains weight (gm)	No. ofears/ plant	No.of grains/ row	No. ofrows/ear	Ear length (cm)	Characters / Treatments
2008 season							
							Irrigation intervals
83.47	43.51	165.58	1.10	43.49	12.44	21.08	Every 15 days
81.56	39.30	153.58	1.06	39.40	12.81	20.75	Every 25 days
69.19	34.43	79.17	0.98	23.62	11.82	19.28	Every 35 days
2.65	2.35	14.00	0.04	3.40	0.51	0.95	L.S.D. at 5%
							Hybrids
78.62	38.51	131.39	1.06	35.99	12.30	18.71	S.C.Watania
77.52	39.65	134.17	1.03	35.07	12.41	19.64	T.W.C. 310
N.S	N.S	N.S	0.03	N.S	N.S	N.S	L.S.D. at 5%
							N-rate (kg/fed.)
75.68	37.67	113.17	0.99	31.88	11.91	17.82	40
78.37	39.19	131.58	1.05	36.07	12.27	19.35	80
80.17	40.39	153.58	1.10	38.57	12.89	20.37	120
1.05	0.92	7.37	0.04	1.32	0.27	0.58	L.S.D. at 5%

2009 season							
							Irrigation intervals
72.26	49.38	221.54	1.21	47.37	13.43	23.13	Every 15 days
74.32	45.33	183.08	1.14	41.78	12.46	21.13	Every 25 days
70.25	42.63	120.17	1.04	32.54	11.72	18.90	Every 35 days
6.34	1.53	26.18	0.07	2.11	0.97	1.27	L.S.D. at 5%
							Hybrids
72.39	46.14	180.89	1.15	41.34	12.64	21.52	S.C.Watania
72.15	45.42	168.97	1.11	39.78	12.43	20.59	T.W.C. 310
N.S	0.64	3.88	0.02	0.51	0.10	0.38	L.S.D. at 5%
							N-rate (kg/fed.)
72.48	39.08	155.46	1.03	37.43	12.20	19.67	40
72.68	44.33	175.96	1.14	40.76	12.55	20.96	80
71.66	45.88	193.38	1.22	43.49	12.85	22.53	120
N.S	0.66	4.69	0.03	0.85	0.10	0.60	L.S.D at 5%

4- Interactions effect:

There was an interaction effect between irrigation intervals and N-rates regarding the number of ears/plant in both seasons, 100- grain weight and the number of grains row in the second season (Table 5). The results revealed that the maximum values of these traits were obtained with irrigation each 15 days and application 120 kg N/fed. while the lowest ones resulted from the irrigation each 35 days with application of 40 kg N/fed.

Table (5): Effect of interaction between irrigation intervals and N-rates on the number of ears/plant in 100- grain weight and number of grains/row of maize in 2008 and 2009 seasons

2009			2008			Season
120	80	40	120	80	40	N-rates (kg/fed.)
Number of ears/plant						
1.38	1.20	1.05	1.21	1.08	1.00	Every 15 days
1.20	1.19	1.04	1.09	1.06	1.03	Every 25 days
1.09	1.04	1.00	1.00	1.00	0.94	Every 35 days
0.05			0.07			L.S.D. at 5%
100- grain weight (gm)						
50.63	50.00	47.50	44.82	43.56	42.16	Every 15 days
46.00	45.50	44.50	40.29	39.00	38.62	Every 25 days
44.75	42.13	41.00	36.05	35.46	32.23	Every 35 days
0.14			N.S			L.S.D. at 5%
Number of grains/row						
49.98	46.93	45.20	45.93	44.48	40.07	Every 15 days
43.60	42.13	39.60	41.77	39.80	36.63	Every 25 days
36.90	33.23	27.50	28.01	23.93	18.93	Every 35 days
1.46			N.S			L.S.D. at 5%

Biological and grain yield (ton /fed.)

1- Response to irrigation intervals:

Results in Table (6) reveal that irrigation intervals significantly affected biological and grain yield/fed. in both seasons. Increasing irrigation intervals from 15 to 25 or 35 days caused significant reduction in biological and grain yield in both seasons. This reduction in biological yield was 26.78 and 60.29% in the first season and was 25.30 and 54.3% in the second season respectively. The respective reduction in grain yield/fed. was 29.01 and 76.28% in the first season being 31.02 and 63.07% in the second season. The reduction in biological and grain yield under intervals irrigation every 35 and 25 days compared with irrigation every 15 days due to the reduction in photosynthesis surface which in turn resulted in decrease in metabolic process and yield components. These results for biological yield were confirmed by these reported by El-Murshedy (5) and Ibrahim (8). The results for grain yield agree with those obtained by Abdo(1), El-Murshedy (5), El-Nagar(6), Ibrahim(8), Moursi (12) and Soliman (19).

2- Response to varietal differences:

Results in Table (6) indicate that the two hybrids significantly differed in biological yield in both seasons and grain yield in the second season .S.C.Watania 4 surpassed T.W.C. 310 by 10.08 and 13.50% in biological yield and by 2.26 and 11.13% in grain yield in the first and second season, respectively. The superiority of S.C. Watanai 4 could be due to its superiority over T.W.C 310 in growth characters and yield components. Similar results were recorded by Ibrahim (8) on biological yield and by Ahmed (2), Osman (14) and Shaheen (18) on grain yield.

3- Response to N-rates:

Results in Table (6) indicate that biological and grain yield/fed. were significantly affected by N-rates. Application of 120 kg N/fed. gave the highest values of biological yield (10.8 and16.28 ton) and grain yield(1.79 and 2.66 ton) for the first and second seasons, respectively, with significant increase over 40 kg N/fed. 39.00 and 33.44% in biological yield being 33.09 and 38.30% in grain yield for the first and second seasons respectively. This increase over 80 kg N/fed. rate was 16.88 and 18.31% in biological yield and 14.35 and 17.98% in grain yield for the first and second seasons, respectively. Such increase in biological yield with the increase in N-rate is attributed to the increase in growth characters and yield components. Also, this increase in grain yield at high N-rate is due to the increase in yield components. We could conclude that yield components require high N to obtain high grain yield/fed. The increased grain yield of maize due to application of high N was reported by Ibrahim and Hala (9), Kassem et al. (10), Leilah et al. (11), Nawar (13) and Salem (16). They found that the increasing of N- rate up to 120 kg significantly increases maize grain yield. Also, Rehman (15) found that highest biological and grain yield/hectar were obtained at high N-rate of 225 kg.

4- Interactions effect:

All interactions were insignificant on biological and grain yield fed. in both seasons except the interaction between irrigation intervals and N-rates which had significant effect on grain yield in the first season (Table 7). The highest grain yield of 2.71 ton/fed. was recorded with irrigation every 15 days at N–rate of 120 kg/fed. while the lowest grain yield of 0.44 ton /fed. was recorded by N-rate of 40 kg/fed. and irrigation every 35 days.

Protein and oil percentage

1- Response to irrigation intervals:

The results of Table (6) indicate that protein and oil percentage in grains were significantly affected by irrigation intervals. The results reveal that the highest percentage of protein (10.97 and 11.27%) and oil (4.15 and 4.35%) in grains in the first and second seasons respectively were obtained under irrigation every 15 days, while the lowest ones were obtained under irrigation every 35 days. This effect could be attributed mainly to the excessive water stress in the root zone causing a nutritional imbalance. This result for protein percentage was on line of that obtained by

El Nagar (6). Also, these results for oil percentage agree with those obtained by Ibrahim and Hala(9).

2- Response to varietal differences:

Results in Table (6) reveal that there is no significant difference between the two hybrids in the two seasons in regard to protein and oil percentage in grains.

3- Response to N-rates:

Results in Table (6) show that protein and oil percentage in grains were significantly increased with increasing N-rate. Using 120 kg N/fed, gave the highest values of the two characters. This increase in protein percentage, when nitrogen was increased, may be due to the increase in the N-uptake by plants which consequently increased zein content. The increase in oil percentage in grain, due to increasing N-rate, may be attributed to increasing photosynthetic accumulation. Similar findings in this respect were mentioned by Ibrahim and Hala (9) who found that increasing N-rate up to 120kg/fed. significantly increases crude protein percentage and oil percentage in grains.

Table (6): Effect of irrigation intervals, hybrids and N-rates on biological yield, grain yield, protein and oil percentage of maize in 2008 and 2009 seasons

Oil percentage (%)	Protein percentage (%)	Grain yield (ton/fed.)	Biological yield (ton/fed.)	Characters / Treatments
2008 season				
4.15	10.97	2.48	13.07	Every 15 days
3.51	10.51	1.71	9.57	Every 25 days
2.35	9.88	0.57	5.19	Every 35 days
0.84	0.23	0.47	1.97	L.S.D. at 5%
				Hybrids
3.41	10.43	1.58	9.72	1- S.C.Watania
3.25	10.48	1.55	8.83	2- T.W.C. 310
N.S	N.S	N.S	0.45	L.S.D. at 5%
				N-rates (kg/fed.)
2.84	10.19	1.34	7.77	40
3.29	10.47	1.56	9.24	80
3.87	10.70	1.79	10.80	120
0.21	0.11	0.09	0.43	L.S.D. at 5%
2009 season				
4.35	11.27	3.33	19.17	Every 15 days
3.36	10.35	2.29	14.32	Every 25 days
2.19	9.27	1.23	8.76	Every 35 days
0.95	0.56	0.79	2.45	L.S.D at 5%
				Hybrids
3.14	10.28	2.40	14.97	1 - S.C.Watania
3.46	10.32	2.16	13.19	2- T.W.C. 310
N.S	N.S	0.19	0.77	L.S.D at 5%
				N-rate (kg/fed.)
2.86	9.87	1.93	12.20	40
3.36	10.41	2.26	13.76	80
3.69	10.61	2.66	16.28	120
0.21	0.19	0.13	0.89	L.S.D. at 5%

4- Interactions effect:

The results in Table (7) reveal that interaction between irrigation intervals and N-rate significantly affected protein percentage in both seasons and oil percentage in the first season only. The highest protein and oil percentage were obtained under irrigation every 15 days and applying 120 kg N/fed. whereas the minimum ones were when irrigation was every 35 days with application of 40 kg N/fed.

Table (7): Effect of interaction between irrigation intervals and N-rates on grainyield/fed., protein percentage and oil percentage of maizein2008 and 2009 seasons

2009			2008			Season
120	80	40	120	80	40	N-rates (kgfed) irrigation intervals
Grain yield / (ton/fed.)						
3.72	3.19	3.07	2.71	2.42	2.09	Every 15 days
2.70	2.34	1.84	1.94	1.69	1.49	Every 25 days
1.57	1.25	0.88	0.70	0.57	0.44	Every 35 days
N.S			0.15			L.S.D. at 5%
Protein percentage						
11.65	11.30	10.87	11.24	10.91	10.76	Every 15 days
10.55	10.39	10.10	10.69	10.48	10.36	Every 25 days
9.64	9.55	8.63	10.17	10.02	9.45	Every 35 days
0.33			0.20			L.S.D. at 5%
Oil percentage						
4.79	4.44	3.82	4.92	3.97	3.56	Every 15 days
3.63	3.45	3.01	3.96	3.43	3.13	Every 25 days
2.65	2.18	1.75	2.73	2.48	1.83	Every 35 days
N.S			0.36			L.S.D. at 5%

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تأثير فترات الري والتسميد النيتروجيني على صفات النمو والمحصول لهجينين من الذرة الشامية

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الملخص

أُجريت تجربتان حقليتان في المزرعة البحثية لكلية الزراعة جامعة أسيوط خلال الموسمين 2009/2008 لدراسة تأثير ثلاثة فترات ري (15، 25 35 يوما) وثلاثة مستويات تسميد نيتروجيني (40، 80 و120 كجم N/فدن) على صفات النمو والمحصول ومكوناته لهجينين من الذرة الشامية (هجين فردي وطنية4 وهجين ثلاثي 310). وقد أدت زيادة فترات الري إلى نقص معنوي في صفات النمو ومحصول الحبوب ومكوناته وكذلك نسبة البروتين ونسبة الزيت حيث بلغ النقص في محصول الحبوب عند الري كل 35 يوماً مقارنة بالري كل 15 يوما 76.28 و63.07% للموسمين الأول والثاني على التوالي. وأظهر الهجينان اختلافاً معنوياً فيمعظم صفات النمو للموسمينفي حيت كان هذا الاختلاف معنوياً في الموسم الثاني فقط في محصول الحبوب ومكوناتهوقد تفوق الهجين الفردي. وأوضحت النتائج ظهور زيادة معنوية في قيم صفات النمو ومحصول الحبوب ومكوناته ونسبة البروتين والزيت عند زيادة معدل التسميد النيتروجيني. وقد أثر التداخل بين فترات الري ومعدلات التسميد النتروجيني معنويا على محصول الحبوب/فدان في الموسم الأول حيث تم الحصول على أعلى محصول من معاملة الري كل 15 يوما وإضافة 120 كجم نيتروجين/فدان.

الكلمات المفتاحية: فترات الري، هجن ذرة شامية، معدلات تسميد نيتروجيني.