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Effect of planting dates and nitrogen fertilizer rates on growth, yield and its components of yellow maize hybrids (Zea mays L.)

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ABSTRACT

A field experiment was carried out at a Private Farm in Shiba-El-Nakaria Village Destrict, Sharkia Governorate, Egypt during the two successive growing summer seasons of 2023 and 2024 to investigate the effect of three planting dates i.e. 1st May, 15th May and 30th May and four nitrogen fertilizer rates, i.e. 0, 70, 100 and 130 KgN/fed. on yield and its attributes for three yellow maize hybrids, i.e. single cross 168 (S.C.168), 176 (S.C.176) and payoneer 444 (S.C.444) under model Delta conditions in Sharkia Governorate. Results indicated that sowing date on 1st May produced a largest ear leaf area (cm^2), leaf area index (L.A.I), plant height (cm), ear height (cm), number of ears/plant, number of ears (m^2), ear length (m), ear diameter (cm), number of rows/ear, number of grain/rows, ear weight (g), 100-grain weight (g), straw yield (ton/fed), grain yield (ton/fed) and biological yield (ton/fed) followed by sowing date at 15th May, respectively. The sowing date on 30th May gave the lowest values in this concern. The obtained results indicated that the three maize hybrids differed significantly in all studied traits in the two growing seasons, whereas SCP444 hybrid gave the highest values in all studied traits except 100-grain weight, the hybrid S.C.176 gave the heavest value. Results also showed that significantly increased in all studied traits with increasing the application of nitrogen fertilizer rates from 0 up to 130 KgN/fed.

Positive and highly significant correlation coefficient between grain yield and all studied characters i.e. No of ear/plant, No of ear (m^2), ear length (cm), ear diameter (cm), No of rows/ear, No of grain/rows, ear weight (gm), straw and biological yield (ton/fed) while 100-grain weight (g) was insignificantly correlated.

Conclusively: It be concluded that sowing date at 1st May, Bayoneeer (S.C.P. 444) variety and 130 KgN/fed. caused an increased in growth in maize and yield and its components..

Keywords: *Growth – Nitrogen fertilizer – Hybrids – Maize*

1. INTRODUCTION

Maize (Zey mays L.) is one of the most important cereal crops in the world, it ranks the third wheat and rice. It also is an essential cereal crop which grown in the summer or at late summer seasons in Egypt. It is essentially used as animal and poultry feed and recently the maize flour has been recommended to be mix with wheat flour to overcome the shortage of wheat production in Egypt. It also forms the bases for several industries, such as starch, fractose and corn oil, as well as main component (about 70%) of animal feed. In Egypt the annually cultivated area with maize is about 1.5-2 million fed. approximately in the summer season. Thus a great attention should be paid to raise its productivity per unit area. This can be achieved through development of high yielding hybrids (three way and single cross hybrids) and by a package of proper agronomic practices to maximize the productivity of the used hybrids. Among these proper practices are the sowing dates and nitrogen fertilization, since they are among the limiting factors for maize production. The environmental changes associated with different planting dates which have agreated effect on yield and other agronomic characters of maize plants. Identifying the most appropriate time for maize planting dates is so important to face the climate changes. Sowing date can play a major role in determining the grain yield, quality, seed germination and understanding whole phonological stage in many regions. Some researched pointed out that especially (Elsabagh et al., 2021), studied the response of three yellow maize hybrids (SC 2088, SCP3444 and SC168) to six planting dates (15th March, 1st 1th April, 15th April, 1st May, 15th May and

1th June). The main results were as follows: Planting maize seeds on 1st or 15th of May gave the highest values of studied traits [plant height (cm), ear length (cm), No of grains row, ear weight (g), grain weight/ear (g), 100-grain weight (g), fodder yield (ton/fed) and grain yield (kg/fed)] and productivity compared to the other planting dates during both seasons. Meanwhile SC P3444 hybrid was superior to the other hybrids in all the studied traits in both growing seasons. Regarding the interaction effect, between planting dates and yellow maize hybrids were significantly differences of 100-grain weight in both seasons and plant height, ear grains weight and grain yield fed-1 in the second season. It could be concluded that under the conditions of the experiment, planting SCP3444 hybrid and planting maize seeds on 1st or 15th of May is recommended. Hegab et al. (2019) in Egypt, indicated that the highest values of plant height. Leaf area index, weight of 100 grains and grain yield/fed. were recorded by the 1st May sowing date followed, by the 1st of June sowing dates. The lowest values were obtained by the late sowing date (1st of July). Salama (2019) in Egypt, too sowing on 1st of May produced the highest significant amount of fresh yield (41.51 ton/ha. in average). However, sowing on 1st of July resulted in the production of significantly lower yield (24.54 ton/ha. in average). In this connection maize hybrids differ in grain yield attributes as reported by

Gomaa *et al.* (2017), Nassar *et al.* (2017), Awdalla *et al.* (2018), Al-Shumary *et al.* (2019), Khalil *et al.* (2019) and Afolabi *et al.* (2020).

Nitrogen is a key element in maize nutrition, therefore, an adequate supply of nitrogen is essential for optimum yield. Nitrogen is a vital for most plant metabolic, stalk elongation and photosynthesis. Nitrogen is the most important nutrient required in the greatest quantities for maize grain yield **(Bender, 2013**) and is the most frequently limited nutrients for maize production **(Ciampitti, 2012)**. **El-Gizawy (2020)** demonstrated that increasing nitrogen level to 120 K/N/fed. increased plant height, ear length, ear diameter, No. grains/row, ear weight, ear grains weight, 100-grain weight, forage yield fed and grain yield/fed. Similar results were obtained by **Emhemed *et al.* (2016), Hassan (2018), Sharma *et al.* (2019),** and **Absy and Abdel-Lattif (2020)**.

The present investigation aimed to study the effect of three planting dates i.e.: 1st May, 15th May and 30th May and four nitrogen fertilization rates i.e.: 0.0, 70, 100 and 130 kgN/fed on yield and its attributes for three yellow maize hybrids, i.e. single cross (168 (S.C. 168), 176 (S.C. 176) and payoneer 444 (S.C. 444) under middle Delta conditions in Sharkia Governorate.

2. MATERIALS AND METHODS

The field experiment was carried out at Private Farm in Shiba-Elnakaria village, Zagazig Destrict, Sharkia Governorate, Egypt during the two successive growing summer seasons of 2023 and 2024 in the same sit under agronomy branch supervision, Plant Production Department, Faculty of Technology and Development, Zagazig University, Zagazig, Egypt.

This investigation aimed to study the effect of three planting dates, i.e. 1st May, 15th May and 30th May and four nitrogen fertilization rates i.e.: without application, 70, 100 and 130 kgN/fed. on growth and yield and its attributes for three yellow maize hybrids, i.e. single cross (168 S.C.168), (176 S.C. 176) and payoneer 444 (S.C.444) under middle Delta conditions in Sharkia Governorate.

Table (i): Mechanical and chemical analysis of the experimental fields.

Soil content	2023 season	2024 season
Mechanical analysis:		
Sand %	17.6%	17.7%
Silt %	21.5%	21.35%
Clay %	60.9%	60.95%
Soil Texture	Clay loam	Clay loam
Chemical analysis:		
Available N ppm	18.1 ± 0.1	18.3 ± 0.1
Available P ppm	19.2 ± 0.55	19.7 ± 0.55
Available K ppm	350	351.5
PH	7.85	7.80

According by **Acode to Jackson. M.L (1973)**

Table (ii): The monthly average temperature and relative humidity (%) during 2023 and 2024 growing seasons.

Season	Month	Temperature (C°)		Relative humidity
		Max.	Min.	%
2023	May	34.63	17.61	46.39
	June	38.332	20.50	45.75
	July	41.66	22.25	41.87
	August	39.19	23.46	46.31
2024	May	34.29	17.77	42.45
	June	30.00	22.07	41.29
	July	40.67	23.89	45.89
	August	43.06	24.39	40.14

Meteorological data obtained from the meteorological at *Zagazig Sharkia Governorate*, A.R.E.

The experiments were layed out in a split- split plot design with three replicates in the two growing seasons. Sowing dates were arranged in the main plots, while maize hybrids were allotted in the sub-plots and the nitrogen fertilizer rates were randomly distributed in the sub-sub-plots. Nitrogen fertilizer was in form of urea (46% N) , and was added in two equal splitting doses. The first one was applied just before the second irrigation. Nitrogen fertilizer (urea) was added in four batches for each agricultural season 2023 and 2024, one quarter at planting, the second quarter 25 days after planting, the third quarter 40 days after planting, and the last quarter 55 days after planting. Calcium superphosphate (15.5% P_2O_5) at the rate of 100 Kg/fed and potassium sulphate (K_2SO_4) at the rate of 50 Kg/fed were added abisical fertilization in the two season nitrogen fertilizer rates (urea 0, 70, 100 and 130 kg/N fed.)) were added after plowing and dividing the experimental plots. The first quantity was added at planting, the second batch after 25 days of planting, the third batch after 40 days of planting, and the fourth batch after 55 days of planting, just before sowing during preparation. The other agronomic practices prevailing in the region were followed. Harvest time of the three sowing dates were undertaken after 110 days from sowing. Some training plots were infected with armyworm and were controlled with the chemical pesticide Vanti 24% SC at a rate of 240 cm^3/fed. The area of the sub sub-plot was 10.5 m^2 (3 × 3.5 m) which included six ridges of 60 cm width and of 3 m length.

Data recorded:

The following characteristics were measured on samples each of 5 plants randomly taken from the inner four rows in each sup-sup plot (after flowering was completed).

A- Growth characteristics:

After 75 days from sowing, sample of five plants from each sub-sub-plot was randomly chosen to measure the following growth characteristics i.e.-ear leaf area cm^2, leaf area of blade only according to **Montogomery (1961)**, leaf area index (LAI), plant height (cm) and ear height (cm).

1. Ear leaf area/plant (cm^2):

It was measured according to the method described by **Montgomery (1911)** and **Framcis *et al.* (1969)**, The formula is:

Leaf area of blade = maximum width x maximum length x0.75

2. Leaf area index.

3. Plant height (m):

It was recorded as the height from the ground surface to the base of the tassel.

4. Ear height (cm).

B- Yield and yield components:

At harvest time guarded plants were taken from the 2^{nd} and 5^{th} ridges in each sub-subplot, then number of ear/plant, number of ears (m^2), ear length (cm), ear diameter (cm), number of rows/ear, number of grains/rows, ear weight (g), 100-grain weight (g), straw yield (ton/fed.), and biological yield weight (ton/fed.). Grain yield (ton/fed) at 15.5% moisture content was determined from the central two ridejes.

Statistical analysis:

The obtained data of both seasons were subjected to the proper statistical analysis according to **Snedecor and Cochran (1994)**.

Simple Correlation Coefficient:

For comparison study between yield and its components and measurements, as well as their relationship with field emergence results, the correlation coefficient among all possible test results and measurements were calculated using the method described by the program of SPSS (2020).

3. RESULTS AND DISCUSSION

Growth characteristics:

a- Effect of sowing dates:

Data in Table (1) show the effects of sowing dates, maize hybrids and N-fertilizer levels on growth of maize:

Ear leaf area, leaf area index cm (LAI), plant height (cm) and ear height (cm) were significantly affected by sowing dates. Sowing dates at 1st May was significantly superior at the mid sowing date i.e, 15th May and the late sowing date at 30th May respectively. These result are true in both seasons and their combined analysis. Plant height (cm) was significantly superior at the first sowing date in i.e 1st May compared to the mid and late sowings at 15th May and 30th May.

These results clearly indicated that there were a significant differences due to the effect of sowing dates on maize growth characteristics viz ear leaf area (cm^2), leaf area index (LAI), plant height (cm) and ear height (cm). Early and mid planting dates gave maize plant a good chance before tasseling and silking to achieve the optimum growth. This was reflected in significantly higher ear leaf area (cm^2) and leaf area index (LAI) and plant height (cm), than other characters.

These variations might be attributed to the prevailing weather conditions during maize growth particularly, temperature, and light. These results are in agreement with those obtained by **Goma *et al.* (2017), Nassar *et al.* (2017), Awadalla *et al.* (2018), Al-Shumary *et al.* (2019), Hegab *et al.* (2019), Salama (2019), Afolabi *et al.* (2020)** and **El-Sabagh *et al.* (2021)**.

b- Effect of hybrids performance:

The results reported in Table (1) indicate clearly that, there were significant differences among yellow maize hybrid in all studied traits in both growing seasons. SCP444 hybrid gave the highest values of ear leaf area (cm^2), leaf area index (LAI), plant height (cm), and ear height (cm), such results could be attributed to differences in the genetic constitution of the tested hybrids.

Table 1: Ear leaf area (cm^2), leaf area index, plant height (m) and ear height (cm) as influenced by planting dates and N-fertilization levels on some maize hybrids in the two growing seasons and the combined analysis.

Main effects and interactions	Ear leaf area (cm^2)			Leaf area index (L.A.I)			Plant height (m)			Ear height (cm)		
	First season 2023	Second season 2024	Combined	First season 2023	Second season 2024	Combined	First season 2023	Second season 2024	Combined	First season 2023	Second season 2024	Combined
Sowing date:												
May 1 (D_1)	717.00^a	580.46^a	648.73^a	6.77^a	5.99^a	6.19^a	2.59^a	2.80^a	2.69^a	136.81^a	131.63^a	134.21^a
May 15 (D_2)	571.21^b	521.76^b	545.98^b	6.45^b	5.96^b	6.20^b	2.48^b	2.75^b	2.61^c	133.41^b	133.41^b	130.76^b
May 30 (D_3)	500.12^c	465.62^c	482.87^c	6.29^c	4.84^b	5.56^b	2.71^c	2.74^c	2.72^b	129.67^c	125.08^c	127.30^c
F-test	**	**	**	**	*	*	**	**	**	**	**	**
Maize hybrid:												
S.C. 176 (H_1)	519.46^c	490.93^c	505.19^c	6.31^c	5.34^c	5.82^c	2.35^c	2.53^b	2.44^c	128.11^c	120.16^c	124.13^c

S.C. 168 (H_2)	595.89^{b}	595.89^{b}	557.09^{b}	6.46^{b}	5.57^{b}	6.01^{b}	2.55^{a}	2.88^{a}	2.71^{a}	132.81^{b}	128.11^{b}	130.46^{b}
S.C. P444 (H_3)	672.79^{a}	672.79^{a}	613.8^{a}	6.73^{a}	5.88^{a}	6.30^{a}	2.64^{a}	2.88^{a}	2.76^{a}	138.96^{a}	136.58^{a}	137.77^{a}
F-test	**	**	**	**	**	**	*	*	*	**	**	**
N-fertilization:												
0 kg N/fed. (N_0)	569.27^{d}	506.53^{d}	537.9^{d}	6.14^{d}	4.80^{d}	5.47^{d}	2.45^{c}	2.70^{c}	2.57^{c}	131.12^{c}	124.96^{d}	128.04^{d}
70 kg N/fed. (N_1)	588.29^{b}	517.06^{c}	552.67^{c}	6.37^{c}	5.32^{c}	5.84^{c}	2.46^{b}	2.71^{c}	2.58^{c}	133.14^{b}	126.77^{c}	129.95^{c}
100 kg N/fed.(N_2)	600.11^{b}	520.38^{b}	560.24^{b}	6.56^{b}	5.98^{b}	6.27^{b}	2.55^{b}	2.78^{b}	2.66^{b}	133.90^{b}	129.74^{b}	131.82^{b}
130 kg N/fed.(N_3)	626.71^{a}	541.16^{a}	583.91^{a}	6.94^{a}	6.28^{a}	6.61^{a}	2.60^{a}	2.87^{a}	2.73^{a}	135.02^{a}	131.69^{a}	133.34^{a}
F-test	**	**	**	**	**	**	*	**	*	**	**	**
Interactions:												
D x H	**	**	**	**	**	**	**	**	**	**	**	**
D x N	**	**	**	**	**	**	*	**	*	**	**	**
H x N	**	**	**	**	**	**	*	**	*	**	**	**
D x N x H	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

These results are in harmony with those obtained by **Hassaan (2018), Sharma *et al*. (2019), El-Gizawy (2020)** and **Absy and Abdel-Latif (2020)**.

c- Effect of nitrogen fertilization:

Data presented in Table (1) demonstrate clearly that the highly significant effect of nitrogen fertilizer levels on the studied growth traits in this investigation. This was the fact in two growing seasons as well as their combined analysis.

Ear leaf area (cm^2), leaf area index (LAI), plant height (cm) and ear height (cm) were increased by increasing nitrogen rates from 0 up to 130 kg N/fed. Nitrogen is the nutrient most likely to be in short supply for plant growth and the effect of nitrogen levels during that period appeared to be more pronounced on maize plant. Therefore, the final plant height was consequently increased by increasing the applied nitrogen (Table 1). The increases in plant height by increasing nitrogen rate might be attributed to the increase in internode lengthy, since the number of internodes is greatly influenced by the genetic make up of the plant. Increasing nitrogen levels up to 130 KgN/fed. significantly increased plant height and consequently ear height and also, ear leaf area (cm), which was reflected on leaf area index (L.A.I) tended to increase with increasing nitrogen doses from 0 to 130 KgN/fed. which might be attributed to the increase in both number of leaves and leaf size. These findings are also in a good agreement with those obtained by **Hassaan (2018), Sharma *et al*. (2019), El-Gizawy (2020)** and **Absy and Abdel-Latif (2020)**.

Yield and yield components:

a- Effect of sowing dates:

The results of the analysis of variance showed in (Tables 2, 3 and 4), that the sowing date significantly affected No of ears/plant, No of ear (m^2), ear length (cm), ear diameter (cm), number of rows/ear, number of grain/rows, ear weight (g), 100 grain weight (g), straw yield (ton/fed), grain yield (ton/fed) and biological yield (ton/fed) in the two growing seasons as well as in the combined analysis. Sowing dates at 1st May was significantly superior at the mid sowing date in 15th May and the late sowing at 30th May. This was true in both seasons and their combined analysis. The results revealed that yield and yield attributes of maize grain yield/unit area was highly dependent on sowing date. A reference to Tables (2, 3 and 4) it is worthy to note that presented data reveal the superior effect of first planting date 1st May on number of ears/plant, number of ears (m^2), ear length (cm), ear diameter (cm), number of rows/ear, number of grain/rows, ear weight (g), 100-grain weight (g), straw yield (ton/fed), grain yield (ton/fed) and biological yield (ton/fed). These results are in accordance with those obtained by **Hassaan (2018), Sharma *et al.* (2019), El-Gizawy (2020)** and **Absy and Abdel-Latif (2020)**.

b- Effect of hybrids:

Grain yield and yield component of number of ear/plant, number of ears (m^2), ear length (cm), ear diameter (cm), number of rows/ear, number of grain/rows, ear weight (gm), 100-grain weight (gm), straw yield (ton/fed) and biological yield weight (ton/fed) during to seasons as shown in (Tables 2, 3 and 4) were affected significantly by differences among yellow maize hybrid in all studied traits in the two growing seasons. SCP444 hybrid gave the highest values in all studied traits in the two growing seasons. These results are in accordance with those obtained by **Hassaan (2018), Sharma *et al.* (2019), El-Gizawy (2020)** and **Absy and Abdel-Latif (2020).**

Table 2: Number of ears/plant, number of ears (m^2), ear length (m) and ear diameter (cm), as influenced by planting dates and N-fertilization levels on some maize hybrids in the two growing seasons and the combined analysis.

Main effects and interactions	Number of ears/plant			Number of ears (m^2)			Ear length (m)			Ear diameter (cm)		
	First season 2023	Second season 2024	Combined	First season 2023	Second season 2024	Combined	First season 2023	Second season 2024	Combined	First season 2023	Second season 2024	Combined
Sowing date:												
May 1 (D_1)	1.47^a	1.61^a	1.54^a	7.02^a	7.33^a	7.17^a	18.11^a	18.28^a	18.19^a	8.21^a	6.95^a	7.58^a
May 15 (D_2)	1.13^b	1.58^b	1.35^b	6.52^b	6.88^b	6.7^b	17.94^b	17.38^b	17.66^b	7.71^b	6.29^b	7.00^b
May 30 (D_3)	1.08^b	1.38^b	1.23^b	6.13^c	6.30^c	6.21^c	17.24^c	17.12^c	17.18^c	6.91^c	6.17^c	6.54^c
F-test	*	*	*	**	*	**	**	**	**	**	**	**
Maize hybrid:												
S.C. 176 (H_1)	1.11^b	1.36^b	1.23^b	5.13^c	5.22^c	5.17^c	17.14^c	16.93^c	17.03^c	6.96^c	6.14^c	6.55^c
S.C. 168 (H_2)	1.16^b	1.41^b	1.28^b	6.11^b	6.52^b	6.31^b	17.97^b	17.57^b	17.77^b	7.62^b	6.52^b	7.07^b
S.C. P444 (H_3)	1.41^a	1.80^a	1.60^a	8.44^a	8.75^a	8.60^a	18.50^a	18.28^a	18.39^a	8.25^a	6.76^a	7.50^a
F-test	*	*	*	**	**	**	**	**	**	**	**	**
N-fertilization:												
0 kg N/fed. (N_0)	1.0^c	1.0^d	1.0^d	5.81^c	6.40^c	6.10^c	17.64^c	17.41^c	17.52^c	7.38^d	6.33^d	6.85^d
70 kg N/fed. (N_1)	1.14^c	1.37^c	1.25^c	6.40^b	6.51^c	6.45^b	17.82^b	17.52^b	17.67^b	7.51^c	6.41^c	6.96^c
100 kg N/fed.(N_2)	1.26^b	1.70^b	1.48^b	6.44^b	6.92^b	6.68^b	17.83^b	17.59^b	17.71^b	7.68^b	6.52^b	7.01^b
130 kg N/fed.(N_3)	1.48^a	2.03^a	1.75^a	7.59^a	7.51^a	7.55^a	18.19^a	17.84^a	18.01^a	7.87^a	6.63^a	7.25^a
F-test	*	*	*	*	*	*	**	**	**	**	**	**

Interactions:												
D x H	*	*	*	**	**	**	**	**	**	**	**	**
D x N	*	*	*	**	**	**	**	**	**	**	**	**
H x N	*	*	*	*	*	*	**	**	**	**	**	**
D x N x H	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3: Number of row/ear, number of grains/ear rows (gm), ear weight (gm) and 100-grain weight (gm) as influenced by planting dates and N-fertilization levels on some maize hybrids in the two growing seasons and the combined analysis.

Main effects and interactions	**Number of rows/ear**			**Number of grain/rows**			**Ear weight (gm)**			**100-grain weight (gm)**		
	First season 2023	**Second season 2024**	**Combined**	**First season 2023**	**Second season 2024**	**Combined**	**First season 2023**	**Second season 2024**	**Combined**	**First season 2023**	**Second season 2024**	**Combined**
Sowing date:												
May 1 (D_1)	13.32^{a}	13.80^{a}	13.56^{a}	44.33^{a}	48.66^{a}	46.49^{a}	225.73 a	222.96 a	224.34^{a}	29.58^{a}	33.25^{a}	31.41^{a}
May 15 (D_2)	10.99^{b}	11.05^{b}	11.02^{b}	42.05^{b}	45.66^{b}	43.85^{b}	215.83 b	203.16 b	209.49^{b}	28.76^{b}	32.75^{b}	30.75^{b}
May 30 (D_3)	10.50^{c}	10.72^{b}	6.91^{c}	39.31^{c}	45.41^{c}	42.37^{c}	215.20 c	185.25 c	200.22^{c}	28.13^{c}	28.77^{c}	28.45^{c}
F-test	**	**	**	**	**	**	**	**	**	**	**	**
Maize hybrid:												
S.C. 176 (H_1)	9.84^{c}	10.00^{c}	9.92^{c}	37.77^{c}	42.69^{c}	40.23^{c}	211.76 c	190.53 c	201.14^{c}	27.90^{c}	35.38^{a}	31.64^{a}
S.C. 168 (H_2)	11.55^{b}	11.86^{b}	11.70^{b}	41.77^{b}	46.11^{b}	43.94^{b}	214.27 b	200.63 b	207.45^{b}	28.71^{b}	30.26^{b}	29.48^{b}
S.C. P444 (H_3)	13.11^{a}	13.72^{a}	12.91^{a}	46.19^{a}	49.27^{a}	47.73^{a}	230.77 a	220.20 a	225.48^{a}	29.86^{a}	29.13^{c}	29.49^{c}
F-test	**	**	**	**	**	**	**	**	**	**	**	**
N-fertilization:												
0 kg N/fed. (N_0)	10.87^{d}	11.22^{c}	11.04^{c}	40.37^{d}	44.59^{d}	42.40^{d}	214^{c}	198.97 d	206.48^{c}	28.44^{c}	30.11^{c}	29.27^{c}
70 kg N/fed. (N_1)	11.39^{c}	11.48^{b}	11.43^{b}	40.96^{c}	45.62^{c}	43.29^{c}	216^{b}	202.14 c	209.07^{b}	28.71^{b}	30.42^{b}	29.56^{b}
100 kg N/fed.(N_2)	11.76^{b}	11.70^{b}	11.73^{b}	42.40^{b}	$46/37^{b}$	44.38^{b}	219^{b}	204.58 b	211.79^{b}	28.86^{b}	30.86^{b}	29.86^{b}

130 kg N/fed.(N_3)	11.99^{a}	13.03^{a}	13.03^{a}	43.92^{a}	47.51^{a}	45.31^{a}	224^{a}	209.25 a	216.62^{a}	29.31^{a}	38.30^{a}	33.80^{a}
F-test	**	**	**	**	**	**	*	**	*	**	*	*
Interactions:												
D x H	**	**	**	**	**	**	**	**	**	**	**	**
D x N	**	**	**	**	**	**	**	**	**	**	**	**
H x N	**	**	**	**	**	**	*	**	*	**	*	*
D x N x H	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 4: Straw yield (ton/fed), grain yield (ton/fed) and biological yield weight (ton/fed) as influenced by planting dates and N-fertilization levels on some maize hybrids in the two growing seasons and the combined analysis.

Main effects and interactions	**Straw yield (ton/fed)**			**Grain yield (ton/fed)**			**Biological yield (ton/fed)**		
	First season 2023	**Second season 2024**	**Combined**	**First season 2023**	**Second season 2024**	**Combined**	**First season 2023**	**Second season 2024**	**Combined**
Sowing date:									
May 1 (D_1)	3.65^{a}	3.49^{a}	3.57^{a}	3.34^{a}	2.80^{a}	3.07^{a}	6.99^{a}	6.29^{a}	6.64^{a}
May 15 (D_2)	3.50^{b}	3.46^{a}	3.48^{b}	3.14^{b}	2.74^{b}	2.94^{b}	6.64^{b}	6.20^{a}	6.42^{b}
May 30 (D_3)	3.16^{c}	3.15^{b}	3.15^{c}	2.79^{c}	2.71^{c}	2.75^{c}	5.95^{c}	5.86^{c}	5.90^{c}
F-test	**	*	**	**	**	**	*	*	*
Maize hybrid:									
S.C. 176 (H_1)	3.21^{b}	3.01^{c}	3.11^{c}	2.81^{c}	2.69^{c}	2.75^{c}	6.02^{c}	5.70^{c}	5.86^{c}
S.C. 168 (H_2)	3.64^{a}	3.31^{b}	3.47^{b}	3.04^{b}	2.74^{b}	2.89^{b}	6.68^{b}	6.05^{b}	6.36^{b}
S.C. P444 (H_3)	3.49^{a}	3.79^{a}	3.64^{a}	3.40^{a}	2.82^{a}	3.11^{a}	6.89^{aa}	6.61^{a}	6.75^{a}
F-test	*	**	**	**	**	**	**	**	**
N-fertilization:									
0 kg N/fed. (N_0)	3.37^{b}	3.17^{c}	3.27^{c}	2.92^{c}	2.73^{b}	2.82^{c}	6.29^{d}	5.90^{d}	6.09^{d}
70 kg N/fed. (N_1)	3.40^{b}	3.35^{b}	3.37^{b}	3.03^{c}	2.74^{b}	2.88^{b}	6.43^{c}	6.09^{c}	6.26^{c}
100 kg N/fed.(N_2)	3.42^{a}	3.36^{b}	3.39^{b}	3.18^{a}	2.75^{a}	2.96^{a}	6.60^{b}	6.11^{b}	6.35^{b}
130 kg N/fed.(N_3)	3.55^{a}	3.60^{a}	3.57^{a}	3.21^{a}	2.77^{a}	2.99^{a}	6.76^{a}	6.37^{a}	6.56^{a}
F-test	**	**	**	*	*	*	*	*	*
Interactions:									
D x H	**	*	**	**	**	**	*	*	*
D x N	*	**	**	**	**	**	**	**	**
H x N	**	**	**	*	*	*	*	*	*

D x N x H	NS	NS	NS	NS	NS	NS	NS	NS	NS

c- Effect of nitrogen fertilization:

In general, there was a significant increase in all studied traits and yield of maize crop with increasing the application of nitrogen fertilizer. The difference may be attributed to genetically differences between maize hybrids which play an important role for make up the available nutrient and yield of maize hybrids.

It is clear from data of Tables (2, 3 and 4) that nitrogen fertilizer rates affected all the studied traits in the present investigation. Number of ears/plant was significantly increased by each increment of nitrogen fertilization rates from 0, 70, 100 and 130 KgN/fed. The increment of (25, 48 and 75%) of number of ears/plant compared to nitrogen rate without any addition in the combined analysis. This was true in the both seasons and their combined effect. Number of ears square meter was significantly increased by nitrogen application. Any increase in nitrogen rates than 0 KgN/fed, resulted in significant increments up to 130 KgN/fed, which increased number of ears (m^2) in the combined data by 5.7, 95 and 23.8% over than these application respectively. Results showed a highly significant increase in ears length (cm) with the increases in the rate of nitrogen from 0 up to 130 KgN/fed. compared to the control treatment were (0.86, 1.08 and 2.80%) in this concern. Ear diameter (cm) was highly significantly increased by nitrogen application. Any increase in nitrogen rates than 0 KN/fed, resulted in significant increments up till 130 KgN/fed, which increased ear diameter in the combined data by 1.61, 2.34 and 5.84% over these of 0, N_1, N_2, N_3, respectively. Results in Table (3) showed a highly significantly increased in number of rows/ear with the increases in the rates of nitrogen from 70 up to 130 KgN/fed. Applying 130 KgN/fed as the average of two growing seasons gave the highest number of rows/ear (13.03) followed by 100 KgN/fed (11.73), 70 KgN/fed (11.43) than control treatment (without application) (11.04) combined effect in the both seasons. The increment of (2.31, 4.28 and 16.13%) of number of rows/ear compared to nitrogen rate without any addition in the combined analysis. Addition of nitrogen was accompanied by a significant increase in number of grain/rows. Data of the combined analysis showed a significant increase in the number of grain/rows with the increases in the rates of nitrogen from 0.0 up to 130 KgN/fed. Data in Table (3) illustrated that addition of nitrogen fertilization was significant except for ear weight (g) in the first and second seasons and their combined analysis, while the second season was highly significant. 100-grain weight (g) showed that addition of nitrogen fertilization was significant in the second seasons and their combined analysis while the first season was highly significant. Data in Table (4) showed that nitrogen fertilization rate significantly increased straw yield in both growing seasons. As an average, the increment of (3.06, 3.67 and 9.17%) for maize straw yield due to application of 70, 100 and 130 KgN/fed. respectively compared to nitrogen fertilization rate without any addition in the combined analysis. In the two seasons, addition of nitrogen application significantly increased the grain yield (ton/fed) compared to the control treatment (without application), each increment of nitrogen yielded significant increased in grain yield. This was also valid in the combined analysis. Grain yield/fed. varied significantly with the increase of N rate from 0 up to 130 KgN/fed. This might be due to the good influence of that major element (N) on the growth traits and the attributing characteristics of maize grain yield.

Biological yield of maize which included grain and straw yields (ton/fed) (total yield). In the two growing seasons was significantly increased by each increment of nitrogen fertilization levels from without application up to 130 KgN/fed. this was valid in the combined analysis. All the studied yield components characters as respond positively may be due to more nitrogen application up to 130 KgN/fed. This might be due to the good influence of that major element (N) on the growth traits and the attributing characteristics of maize grain yield (Tables 2, 3 and 4). These results are in agreement with those reported by **Hussain *et al*. (2016), Hassan (2018), Biond *et al*. (2019), El-Gizawy (2020), Absy and Abdel-Lattif (2020), Dominguea Hernandez *et al*. (2020).**

Conclusively: It be concluded that sowing date at 1st May, Bayoneeer (S.C.P. 444) variety and 130 KgN/fed. caused an increased in growth in maize and yield and its components.

The simple correlation coefficient:

The association between yield and other characters are shown in Table (5) combined data revealed that the maize grain yield/fed. was positively and significantly correlated with studied characters, i.e. number of ear/plant, number of ear (m^2), ear length cm, ear diameter (cm), number of rows/ear, number of grain/rows, ear weight (gm), straw yield (ton/fed) and biological yield (ton/fed.), while 100-grain weight (gm) was insignificantly correlated. Also, number of ear/plant showed positive and highly significant interrelationships with, number of ear (m) and biological yield (ton/fed.) while showed significant in number of grains/rows, ear weight (gm) and straw yield (ton/fed.) but this interrelationships with both ear diameter, number of grains/rows and 100-grain weight (gm) did not reach the 5% level of significance. Number of ear (m^2) showed positive and highly significant with ear length (cm), ear diameter (cm), number of grains/rows, ear weight (gm), straw yield (ton/fed) and biological yield (ton/fed), while it was insignificantly correlated with both number of rows/ear and 100-grain weight (gm). Ear length (cm) appeared significantly correlated with each of ear diameter cm, number of rows/ear, number of grain/rows, ear weight (gm), straw yield (ton/fed.) and biological yield (ton/fed.) but insignificant correlated with

100-grain weight (gm). Also, ear diameter (cm) was positively and significantly correlated with number of rows/ear, number of grain/rows, ear weight (gm), straw yield (ton/fed) and biological yield (ton/fed), except 100-grain weight (gm) was insignificantly. Number of rows/ear showed positive and significant interrelationships with number of grains/rows, ear weight (gm), straw yield (ton/fed.) and biological yield (ton/fed.), while 100-grain weight (gm) was insignificantly. Also number of grain/rows was positively and significantly correlated with ear weight (gm), straw yield (ton/fed) and biological yield (ton/fed) but 100-grain weight (gm) was insignificantly. Ear weight (gm) showed positive and significant with straw yield (ton/fed) and biological yield (ton/fed.) but insignificantly correlated with 100-grain (gm) whereas the correlation coefficient between 100-grain (gm) and straw yield (ton/fed) and biological yield (ton/fed) was negative and insignificant. Straw yield (ton/fed.) was positively and significantly correlated with biological yield (ton/fed.) Similar results were obtained by **Amin, Amal *et al*. (2003) and Atia *et al*. (2005)**.

Table (5): Simple correlation coefficients between maize grain yield (ton/fed) and its components (combined analysis).

Characters	2	3	4	5	6	7	8	9	10	11
1- Grain yield (ton/fed)	0.788**	0.895**	0.966**	0.966**	0.844**	0.962**	0.974**	0.287	0.949**	0.970**
2- Number of ear/plant	1	0.767**	0.715*	0.713*	0.616	0.762*	0.756*	0.609	0.759*	0.807**
3- Number of ear (m^2)		1	0.912**	0.839**	0.621	0.951**	0.882**	0.150	0.888**	0.944**
4- Ear length (cm)			1	0.97s9**	0.848**	0.972**	0.959**	0.213	0.965**	0.938**
5- Ear diameter (cm)				1	0.886**	0.943**	0.973**	0.300	0.945**	0.900**
6- Number of rows/ear					1	0.726*	0.843**	0.489	0.823**	0.782**
7- Number of grains/rows						1	0.945**	0.141	0.942**	0.943**
8- Ear weight (gm)							1	0.307	0.898**	0.925**
9- 100-grain weight (gm)								1	0.306	0.296
10- Straw yield (ton/fed)									1	0.944**
11- Biological yield (ton/fed)										**1**

**** Correlation is significant at the 00.01 level.**

*** Correlation is significant at the 00.05 level.**..

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