RESULTS AND DISCUSSION

A: EFFECT OF NITROGEN FERTILIZER LEVEL :

I- Growth Characters :

1- Plant Height :

Results presented in Table 2 show the effect of N level on some growth characters of maize in 1991 and 1992 seasons. Plant height of maize was recorded at three different growth stages after 35 and 50 days from planting and at harvest. At these three stages, the increase in N level significantly increased plant height.

At 35 days from planting, applying N at 80, 105 and 130 kg/fed significantly increased plant height in 1991 season by 9.13, 16.83 and 22.86% compared with the check treatment (zero kg N/fed).

In 1992 season, the three N levels increased plant height by 12.92, 14.86 and 26.16 %, respectively, compared with the control.

Similarly at 50 days from planting, applying N at 80, 105 and 130 Kg/fed significantly increased maize plant height by 6.67, 11.53 and 22.86 %, respectively, over the control treatment in 1991 season. In 1992 season, the increases were 6.84, 10.03, and 12.38 % for the respective N levels. Also, at harvest a marked increase was observed with each increment of N fertilizer in both seasons. It is evident from Table 2 that applying N at 80, 105 and 130 kg /fed significantly increased plant height by 4.42, 7.59 and 10.33 %, respectively over the check treatment in 1991 season. The corresponding increases in 1992 season were 17.64, 22.17 and 28.14 %, respectively, for the three N levels.

It is quite evident that N had a great role on maize growth expressed as plant height and the increase was clear with each increment in N level in both seasons as well as at the

Table 2. Effect of N-fertilizer level on some growth characters of maize plants in 1991 and 1992 seasons.

Characters	N level (kg/fed)					
	Zero	80	105	130	Mean	L.S.D.
				1991		
Plant height at 35 days (cm)	109.07	119.03	127.43	134.00	122.38	5.71
Plant height at 50 days (cm)	203.31	216.88	226.75	226.25	218.30	7.44
Plant height at harvest (cm)	312.11	325.91	335.80	344.36	329.54	12.21
Ear height (cm)	171.82	185.21	196.46	204.78	189.56	9.01
No of leaves/plant at 35 days	8.24	8.38	8.81	8.67	8.53	0.42
No of leaves/plant at 50 days	13.49	13.71	13.79	13.81	13.70	NS
Leaf area in dm^2	55.10	65.80	68.30	69.10	64.60	3.10
			1992			
Plant height at 35 days (cm)	89.79	101.69	103.13	113.28	101.89	4.76
Plant height at 50 days (cm)	175.66	187.68	193.28	197.40	188.50	6.26
Plant height at harvest (cm)	237.92	279.88	290.66	304.88	278.33	10.32
Ear height (cm)	122.16	140.97	160.32	168.59	148.01	7.77
No of leaves/plant at 35 days	7.45	7.94	8.26	8.48	8.03	0.27
No of leaves/plant at 50 days	13.44	13.73	13.63	13.89	13.67	0.31
Leaf area in dm^2	69.70	80.60	84.20	90.40	81.20	4.20

three different growth stages. This results indicates clearly the vital role of N in plant growth as it is necessary for protoplasm formation and photosynthesis activity in all plants. It is necessary for cell division and merestimatic activity in plant organs.

The present results are in good agreement with those reported by **Hussein** et al **(1978), El-Hattab** et al **(1980), Eraky** et al **(1980), Moursi** et al **(1980), Shafshak** et al **(1981), Eraky** et al **(1982), Gouda (1982), Faisal (1983)** and **Khedr (1986)**, who found that the increase in N level significantly increased maize plant height.

2- Ear height :

Results in Table 2 show clearly that ear height was significantly increased with the increase in N level from zero to 80, 105 and 130 kg/fed in both seasons of experimentation. In 1991 season, applying N at 80, 105 and 130 kg/fed significantly increased ear height by 7.79, 14.34 and 19.18 % over the check treatment, respectively. The corresponding increases in 1992 season were 15.40, 31.24 and 38.01 %, respectively over the control treatment. It is clear that the role of N in increasing ear height was more evident in 1992 compared with 1991 season. It is worthy to note that the increase in ear height showed nearly the same pattern of response to N level as that for plant height at harvest. The present results are expected since maize plant height was markedly influenced by the increase in N level.

Similar results were also obtained by **El-Sharkawy** et al **(1976)Rathor** et al **(1976), Eraky** et al **(1980), Moursi** et al **(1980), Shafshak** et al **(1981), Eraky** et al **(1982), Gouda (1982), Faisal (1983)** and **Khedr (1986)**, who found that ear position of maize significantly increased due to the increase in N level.

3- Number of leaves per plant:

Results in Table 2 show the effect of N fertilizer level on number of leaves/plant which was recorded twice after 35 and 50 days from planting.

It is evident from the table that the increase in N level significantly increased number of leaves after 35 days in both seasons, and after 50 days from planting only in the second season. Applying N at 80, 105 and 130 kg/fed increased leaves number/plant over the check treatment after 35 days from planting by 1.70, 6.92 and 5.22 %, respectively in 1991 season. The corresponding increases in leaves number/plant at this stage being 6.58, 10.87 and 13.83 % in 1992 season, for the respective N levels. At 50 days from planting no significant differences were detected in number of leaves/plant in the first season where the differences in this character were too slight to reach the level of significance. On the other hand, significant differences were observed in 1992 season where increase of 2.16, 1.41 and 3.35 % were recorded due to applying N at 80, 105 and 130 kg/fed compared with the control, respectively. It is worthy to note that the significant increase in this character was only recorded between the highest N level (130 kg/fed) and the control treatment, whereas all other differences were below the level of significance.

The present results indicate a favorable effect of N application on number of leaves/ plant. It is worthy to note that this character was encouraged by N application as a result of an increase in the number of functioning leaves which is negatively affected under N deficiency of the check treatment. Similar results were also reported by **Yakout (1977), Hussein et al (1978), Khalil (1978), Ibrahim et al (1979), Ragheb (1979), Adel-Gawad et al (1980), Eraky et al (1982), Gouda (1982), Faisal (1983), Mourad et al (1986) and Faisal (1989)** who found that the increase in N level significantly increased the number of active leaves/plant.

4 - Area of the topmost ear leaf:

Results in Table 2 show that the increase in N level significantly increased area of topmost ear leaf in both seasons.

In 1991 season, applying N at 80, 105 and 130 kg/fed significantly increased leaf area over the check treatment by 19.42, 23.96 and 25.40 %, respectively. The corresponding increase being 15.64, 20.80 and 29.70 % in 1992 season for the respective N levels. The present results are a good evident for the role of N in plant life. The encouraging of vegetative growth of maize plant expressed in terms of a marked increase in leaf area is a good manifestation of the role of N as an essential element for all plants, particularly cereals.

The present results are in agreement with those reported by **Yakout (1977), Abdel-Galil et al (1979), Michail and Shalaby (1979), Shafshak et al (1981), Eraky et al (1982), Mourad et al (1986), Gouda (1989) and Gouda et al (1992)** who found that increasing N level markedly increased leaf area of maize plant.

II. Agronomic Characters :

1- Days to 50% tasseling:

Results in Table 3 showed that the increase in N level significantly reduced number of days to 50 % tasseling in both seasons.

In 1991 season, applying N at 80, 105 and 130 kg/fed significantly reduced days to 50 % tasseling by 2.61, 4.04 and 6.43 days, compared with the check treatment, respectively. The corresponding reduction in 1992 season for the same N levels were 2.41, 3.93 and 5.91 days, respectively. All differences in tasseling date were significant and the highest N level induced the greatest earliness in tassseling.

This result indicates clearly the role of N in the formation of sexual organs in maize plant and in enhancing an early flowering through an increase in the meristematic activity.

Similar results were also reported by **Salem (1973), Hussein et al (1978), Abdul-Galil et al (1979), Eweida et al (1979), Abdul-Gawad et al (1980), El-Hattab et al (1980), Eraky et al (1982), Faisal (1983), Khedr (1986), Mourad et al (1986), Younis et al (1990) and Gouda et al (1992)** who found that the time to 50 % tasseling was decreased by increasing N fertilizer level.

Table 3. Effect of N-fertilizer level on flowering date and some agronomic characters in 1991 and 1992 seasons.

Characters	N level (kg/fed)				Mean	L.S.D.
	Zero	80	105	130		
			1991			
Days to 50 % tasseling	57.38	55.88	55.06	53.69	55.50	0.67
Days to 50 % silking	60.56	59.13	58.19	56.76	58.66	0.65
Barren plants (%)	7.88	8.44	3.69	2.38	4.84	1.00
No of ears per plant	0.89	0.96	1.03	1.04	0.98	0.04
			1992			
Days to 50 % tasseling	57.19	55.81	54.94	53.81	55.44	0.66
Days to 50 % silking	60.31	59.00	58.38	57.00	58.67	0.59
Barren plants (%)	6.31	5.13	4.38	2.88	4.67	0.64
No of ears per plant	0.93	1.01	1.06	1.08	1.02	0.05

2- Days to 50 % silking :

Results in Table 3 showed clearly that N application significantly decreased number of days from planting to 50 % silking in both seasons of experimentation.

In 1991 season, applying N at 80, 105 and 130 kg/fed significantly decreased days to 50 % silking by 2.36, 3.91 and 6.29 days compared with the control treatment. The corresponding reduction in days to 50 % silking were 2.17, 3.20 and 5.49 days for the same N levels in 1991 season, respectively. This result is a clear illustration for the role of N in building sexual organs for maize plant. It is evident that N fertilizer encouraged the meristematic activity and increased the vegetative growth which pushed maize plants towards earlier silking. Similar results were also obtained by **Salem (1973), Abdul-Galil et al (1979), Eweida et al (1979), Abdel-Gawad et al (1980), El-Hattab et al (1980), Eraky et al (1982), Abdel-Gawad et al (1983), Abdel-Gawad (1986), Khedr (1986), Mourad et al (1986), Younis et al (1990) and Gouda et al (1992)** who recorded marked reduction in number of days to 50 % silking due to the increase in N level.

3- Percentage of barren plants :

Results in Table 3 showed clearly that increasing the N level significantly reduced percentage of barren plants in both seasons. The lowest barrenness was recorded with the highest N level (130 kg/fed), being 2.3 and 2.88 % in the first and second season, respectively. The barrenness percentage was reduced by applying 130 kg/fed by 5.5 % in 1991 and 3.43% in 1992 compared with the check treatment.

The present results show clearly the effect of N on the prolificacy of maize plants since N has a major role in building up the sexual organs of all cultivated plants in addition to its role in the vegetative growth of maize plants. Consequently, a good supply of N markedly reduced barrenness to reach a minimum percentage.

Similar results were also reported by **Sharma (1978), Salem (1973), Shafshak et al (1981) and Sayed Ahmed (1983)** who found that the increase in N level significantly reduced the percentage of barren stalks of maize.

4- Number of ears per plant :

Data presented in Table 3 showed clearly that the increase in N level significantly increased number of ears/plant in both seasons of experimentation.

In 1991 season, the application of 80, 105 and 130 kg N/fed significantly increased number of ears/plant by 7.87, 15.73 and 16.85 %, respectively compared with the control. In 1992 season, the increase in number of ears/plant was 8.6, 13.98 and 16.13 % for the three respective N levels. Most of the differences in this character among the different N levels reached the level of significance in both seasons.

The present results are quite expected since N significantly reduced barren plant percentage leading in turn to an increase in ears number/plant. In addition, N seems to increase the number of two-eared plants in maize. It could be concluded that a good supply of N will certainly increase the prolificacy of maize plant. Similar results were also reported by **Abdel-Galil (1970), Lashin and Ali (1977), Sharma (1978), El-Hattab et al (1980) and Anderson et al (1984)** who found that the increase in N level markedly increased ears number per maize plants.

III. Ear Characters :

1- Ear Length :

Results presented in Table 4 showed that N significantly influenced ear length in both seasons where marked increases in this trait were recorded with the increase in N level.

Table 4. Effect of N-fertilizer level on ear characters in 1991 and 1992 seasons.

Characters	N level (kg/fed)				Mean	L.S.D.
	Zero	80	105	130		
			1991			
Ear length (cm)	17.33	18.69	19.01	19.44	18.62	0.63
Ear diameter (cm)	4.16	4.35	4.44	4.54	4.37	0.15
Ear weight (g)	189.88	218.69	233.75	254.88	224.30	11.57
No. of rows per ear	12.50	13.00	13.75	14.00	13.31	0.82
			1992			
Ear length (cm)	18.92	19.79	20.10	20.80	19.90	0.33
Ear diameter (cm)	4.44	4.70	4.86	4.84	4.71	0.68
Ear weight (g)	211.63	253.11	274.44	286.38	258.94	13.46
No. of rows per ear	13.13	13.13	13.38	13.63	13.31	NS

In 1991 season, applying N at 80, 105 and 130 kg/fed significantly increased ear length by 7.85, 9.69 and 12.18 %, respectively compared with the control treatment.

In 1992 season, the corresponding increases were 4.60, 6.24 and 9.94 % for the same respective N levels.

It is clear that an increase in ear length was recorded with each increment in N level in both seasons.

This result is a good manifestation for the role of N as an essential element in building maize ears. The increase in ear length is mainly due to the positive effect of N on the growth of maize which in turn is reflected on the yield components.

Similar results were also obtained by **Salem (1973), Hussein et al (1978), Mahgoub (1979), El-Hattab et al (1980), Eraky et al (1980), Shafshak et al (1981), Faisal (1983), Gouda (1989) and Gouda et al (1992)** who recorded marked increase in ear length with the increase in N application level.

2- Ear Diameter :

Data presented in Table 4 showed that N application significantly increased ear diameter in both seasons of experimentation. In 1991 season, applying N at 80, 105 and 130 kg/fed significantly increased ear diameter by 4.57, 6.73 and 9.13 % over the check treatment, respectively. In 1992 season, the increases in ear diameter were 5.86, 9.46 and 9.01 % over control for the three respective N levels. It is clear that N application significantly increased ear size of maize through increasing length and diameter of the ear. The contribution of N in increasing ear size, which is the fundamental component of grain yield is clearly illustrated. This result is mainly due to the encouraging effect of N on the vegetative growth of maize plant. Similar results were also reported by **El-Hattab et al (1980), Eraky et al (1980), Gouda (1982), Kamel et al (1986-a) and Khedr (1986)** who found marked increase in ear diameter as a result of the increase in N fertilizer level.

Results reported by **Gouda (1982), Eraky et al (1982), Faisal (1983) and Khedr (1986)** showed that the increase in N level significantly increased number of rows/ear which agreed with the first season results. On the other hand, the results of the second season are in line with those reported by **Nour-El-Din et al (1976), Abdel-Gawad et al (1976), Khalil (1978), Mahgoub (1979), Shafshak et al (1981), El-Agamy et al (1986) and Younis et al (1990)** who found that N application had no significant effect on number of rows/ear.

IV. Grain Yield And Its Components :

1- Weight of 100 kernels :

Results in Table 5 showed that the increase in N level significantly influenced 100-kernel weight in both seasons of experimentation.

Table 5. Effect of N-fertilizer level on grain yield and some of its components in 1991 and 1992 seasons

Characters	N level (kg/fed)					
	Zero	80	105	130	Mean	L.S.D.
			1991			
Weight of 100 kernels (g)	27.76	29.92	31.45	32.93	30.52	0.79
Shelling percentage	84.46	84.54	84.58	85.61	84.79	0.88
Grain yield (kg/fed)	2536.80	3004.10	3198.80	3468.20	3051.90	288.40
			1992			
Weight of 100 kernels (g)	35.73	36.89	39.02	39.85	37.87	0.92
Shelling percentage	85.40	86.38	87.48	87.72	86.75	1.00
Grain yield (kg/fed)	3046.10	3669.80	4023.60	4534.60	3818.50	331.80

In 1991 season, applying N at 80, 105 and 130 Kg/fed significantly increased 100-kernel weight by 7.9, 13.3 and 18.6 %, respectively compared with the check treatment.

Similarly, in 1992 season, the three N levels induced increases of 3.25, 9.21 and 11.53 % in 100-kernel weight over the control treatment, respectively. The differences in grain index among the different N levels were almost significant.

The present results indicate clearly that N application induced an increase in grain plumbness of maize showing the major role of this vital nutritive elements. These results are mainly due to the positive effect of N on growth, ear characters and grain formation.

Similar results were also reported by **Salem (1973), Adel-Gawad et al (1974), Abdel-Gawad et al (1983), Faisal (1983) and Moursi et al (1983)** who found that the increase in N level induced marked increase in 100-kernel weight.

2- Shelling percentage :

Data presented in Table 5 showed clearly that the increase in N level significantly affected shelling percentage in both seasons. It is clear that the effect of N on this trait was more evident in the second season. In 1991 season, shelling percentage was significantly increased only at the highest N level (130 kg N/fed) compared with the check treatment, whereas the lower N levels did not induce any apparent effect on this trait. On the other hand, in 1992 season applying N at 105 and 130 kg/fed significantly increased shelling percentage compared with the zero and 80 kg/fed levels. The application of 80, 105 and 130 kg N/fed increased shelling percentage by 0.98, 2.08 and 2.32, respectively.

The present results show a positive effect of N as the major nutritive element on shelling percentage as an important yield component character. A good supply of N will increase grain index in maize.

These results are in good agreement with those reported by **El-Hattab et al (1980), Gouda (1982), Khalifa et al (1983) and Abdel-Gawad (1986).**

3- Grain yield (kg/fed) :

Results in Table 5 show clearly that N application significantly increased grain yield per fed in both seasons of experimentation. In 1991 season, applying N at 80, 105 and 130 kg/fed significantly increased grain yield by 18.42, 26.10 and 36.74 %, respectively overthe control level. Also, in 1992 season, applying the three mentioned N levels significantly increased grain yield by 20.48, 32.09 and 48.87 % compared with the check treatment.

It is clear from Table 5 that the effect of N on grain yield was more evident in the second season compared with the first one. In the second season, all differences in grain yield between every two N levels were significant. On the other hand, in 1991 season the significant differences in grain yield were detected between the control treatment and the three other N levels, as well as between 80 and 130 kg N/fed whereas the differences between 80 and 105 kg N/fed as well as between 105 and 130 kg N/fed were below the level of significance.

The present results indicate clearly the prominent role of N on maize grain yield and the high response of this trait to N. The effect of N on maize grain yield is the outcome of its effect on plant height, number of leaves/plant, leaf area, reduction of barrenness, increasing maize prolificacy, ear size, number of rows/ear, grain index and shelling percentage. It could be concluded that N has a vital role on grain yield of maize and a grain yield of about 3.5 t/fed in the first season and 4.5 t/fed in the second one was obtained when N was applied at 130 kg/fed.

The present results are in agreement with those reported by **Abdel-Gawad et al (1980), Eraky et al (1980), Shafshak et al (1981), Gouda (1982), Faisal (1983), El-Agamy et al (1986)** and **Kamel et al (1986)** who found marked increases in maize grain yield due to N application. Also, the present results coincide with those reported by **Abdel-Hady et al (1987), Genaidy et al (1987), Gouda (1989) and Younis et al (1990)** who found that a significant increase was recorded in maize grain yield resulting from the application of 120, 160, 120 and 90 - 120 kg N/fed, respectively.

V. Chemical content of leaves and grain of maize :

1- N content in leaves :

Results in Table 6 show clearly that in both seasons, the increase in N level significantly increased N content in maize leaves.

Applying N at 80, 105 and 130 kg/fed significantly increased N percentage in leaves by 0.38, 0.41 and 0.66 over the check treatment in 1991 season, respectively. The corresponding increases for the respective N levels in 1992 season were 0.25, 0.39 and 0.57. The differences in N percentage among the different N levels were almost significant in the first season, whereas, in the second season the only significant difference was detected between the check treatment and the highest N level (130 kg/fed). The increase in N percentage in leaves is quite expected and the results coincided with those reported by **Hussein et al (1974), Shafshak et al (1981), Genaidy et al (1987) and Mahgoub (1979)** who found that the increase in N level significantly increased N content in the leaf of the topmost ear.

2- Phosphorus content in leaves :

Results presented in Table 6 show that the increase in N level had no appreciable effect on P percentage in the leaf of the topmost ear in both seasons.

Very slight increases in P % were observed due to N application but those increases were far below the level of significance. It could be concluded that no relevance was detect-ed between N application and P content in maize leaves. However, other investigators found that the increase in N level induced an increase in P content in maize leaves (**Blancher, 1987; Orabi and Abdel-Aziz, 1982 and Genaidy et al , 1987**).

Table 6. Effect of N-fertilizer level on chemical content of leaves and grains of maize in 1991 and 1992 seasons.

Characters	N level (kg/fed)				Mean	L.S.D.
	Zero	80	105	130		
			1991			
N % in leaves	1.00	1.38	1.41	1.66	1.36	0.12
P % in leaves	0.550	0.563	0.575	0.588	0.569	NS
K % in leaves	0.640	0.613	0.606	0.575	0.609	NS
N % in grains	1.09	1.31	1.35	1.42	1.29	0.08
P % in grains	0.490	0.520	0.530	0.560	0.525	NS
K % in grains	0.360	0.450	0.480	0.500	0.450	0.024
Protein % in grain	6.840	8.21	8.60	8.68	8.08	0.489
			1992			
N % in leaves	1.59	1.84	1.98	2.16	1.89	0.431
P % in leaves	0.463	0.481	0.506	0.506	0.489	NS
K % in leaves	0.444	0.531	0.525	0.575	0.519	0.048
N % in grains	1.32	1.50	1.66	1.89	1.59	0.11
P % in grains	0.40	0.48	0.58	0.57	0.51	0.11
K % in grains	0.36	0.400	0.440	0.510	0.430	0.039
Protein % in grain	8.23	9.39	10.36	11.79	9.94	0.668

3- Potassium content in leaves :

Data in Table 6 indicated that the increase in N level favorably affected potassium content in maize leaves only in the second season, whereas in the first season, no any effect was detected. In 1992 season, applying N at 80, 105 and 130 kg/fed increased K percentage in the leaf of topmost ear by 0.087, 0.081 and 0.131 compared by the check treatment, respectively.

This result indicates the importance of a good supply of N on the absorption of the other nutritive elements.

This effect may be due to the effect of N on the vegetative growth which contributes for a higher uptake of the available nutrients and achieve a nutritional balance of the major elements in plant organs. A higher N content will lead in turn in a higher content of other available elements.

Results reported by **Genaidy et al (1987)** showed that the increase in N level had no significant effect on K percentage in maize leaves.

4- Nitrogen content in grain :

Results presented in Table 6 show clearly that the increase in N level significantly increased N content in maize grain in both seasons of experimentation. In 1991 season, applying N at 80, 105 and 130 kg/fed significantly increased N % in grain over the check treatment by 0.22, 0.26 and 0.33, respectively. In 1992 season, the three respective N levels induced significant increases in N% of 0.18, 0.34 and 0.57, respectively.

This marked increase in N content in grain is a direct result of the higher N content in maize leaves as well as vigorous growth resulting from a good supply of N as the most important nutritive element.

This result is in agreement with those reported by **Kranz and Chandler (1954), Ashghari et al (1984) and Moll et al (1987)** who found that the application of N significantly increased N content in grain.

5- Phosphorus content in grain :

Results presented in Table 6 show that the effect of N on P content in grain was only significant in the second season where a marked increase in P% was induced due the increase in N fertilizer level. In 1992 season, applying N at 80, 105 and 130 kg/fed significantly increased P% in grain over the control treatment by 0.08, 0.18 and 0.17, respectively.

In the first season, slight increase in P % in grain were observed, but all the differences were too slight to reach the level of significance.

It could be concluded, that a good supply of N may increase P content in maize grain as indicated in the second season.

Result reported by **Krantz (1949)** and **Krantz and Chandler (1951)** showed that N application increased N content in maize leaves and grain as well as P and K especially on soils well supplied with these elements. Also, **Jordan et al (1950)** concluded that the total uptake of P by maize plant increased with the increase in N application.

6- Potassium content in grain :

The increase in N application level significantly increased K percentage in grains in both seasons of experimentation (Table 6). Applying N at 80, 105 and 130 kg/fed increased K percentage in grain by 0.09, 0.12 and 0.14 compared with the check treatment, respectively in the first season. The same N levels induced increases in K % of 0.04, 0.08 and 0.15 in the second season, respectively. All differences in K % among the different N levels were significant indicating an important role of N on potassium content in grains.

The present results may be due to the increase in the other major elements, brought about by the good supply of N as well as to the positive effect of N on maize growth which encouraged a greater uptake of the available nutrient elements.

Similar results were also obtained by **Awad (1976)** who found that increasing either N or K rates enhanced markedly K content of different parts of maize plants.

7- Protein content in grain :

The increase in N level significantly increased protein content in maize grain in both seasons of experimentation as shown in Table 6.

In 1991 season, applying N at 80, 105 and 130 kg/fed significantly increased protein % by 1.37, 1.76 and 1.84, respectively compared with check treatment. The corresponding increases in 1992 season for the same N levels were 1.16, 2.12 and 3.56, respectively.

The present results show clearly the influence of N in increasing the nutritive value of cereals. This result is mainly due to the effect of N application on N content in leaves as well as in grains.

Similar results were also reported by **Faisal (1983), Abdel-Aziz (1986), Mahgoub (1987) and Gouda (1989)** who found that the increase in N level significantly increased protein content in grain.

B. EFFECT OF VARIETIES :

I. Growth Characters :

1.- Plant height :

Results presented in Table 7 show the performance of the four evaluated maize varieties with regard to some of their growth characters.

and S.C. 10. After 50 days from planting no any marked difference was observed between the tested varieties in both growing seasons.

Results reported by **Mahmoud (1967), Bisher (1973), Yakout (1977), Bedeer (1979), Kamel et al. (1979a) Eraky et al. (1982), El-Hattab et al. (1985), Mourad et al. (1986) and Gouda et al. (1992)** indicated marked differences in number of leaves/plant of the different maize varieties. The bulk of their results showed that single crosses, followed by three way crosses and double crosses were superior to open-pollinated varieties in this trait.

4- Leaf area :

Results presented in Table 7 show that the four tested varieties differed significantly in the area of the topmost ear leaf only in 1991 season.

In the first season, the four varieties could be arranged according to leaf area in a descending order as follows: D.C. 215, S.C. 10, T.W.C. 310 and Giza-2. Significant differences were recorded between Giza-2 and each of D.C. 215 and S.C. 10 as well as between T.W.C. 310 and D.C. 215.

In 1992 season, Giza-2 was inferior in this character compared with the three other varieties, showing a superiority of maize hybrids in leaf area over the open-pollinated varieties. However, all differences in that season were below the level of significance.

It could be concluded that hybrids, in general, possessed greater leaf area than the composite variety Giza-2.

Results reported by Amer (1982), Mourad et al. (1986)Gouda (1989) and Gouda et al. (1992) coincided with the present results as they found that hybrids were superior to composite and or open-pollinated varieties in leaf area.

II. Agronomic characters :

1- Days to 50 % Tasseling :

Results in Table 8 show that varieties differed significantly in their tasseling date in both seasons of experimentation.

In 1991 season, S.C 10 was the earliest variety in tasseling followed by D.C. 215, Giza-2 and T.W.C. 310. Significant differences were only found between S.C. 10 and each of T.W.C. 310 and Giza-2.

In 1992 season, the earliest tasseling was achieved by S.C. 10 followed by D.C. 215, Giza-2 and T.W.C. 310. Significant differences were only found between S.C. 10 and the three other varieties, whereas the three latter varieties, i.e. Giza-2, D.C. 215 and T.W.C. 310 did not show any significant difference in their tasseling date. The present results are mainly due to the differences in the genetical constitution of the four tested varieties.

Table 8. Effect of variety on flowering date and some agronomic characters in 1991 and 1992 seasons.

Characters	Varieties				Mean	L.S.D.
	Giza-2	D.C.215	T.W.C. 310	S.C. 10		
	1991					
Days to 50 % tasseling	55.56	55.19	56.19	54.81	55.44	0.67
Days to 50 % silking	58.75	59.00	58.38	58.50	58.66	NS
Barren plants (%)	6.44	4.00	5.94	3.00	4.84	1.00
No of ears per plant	0.89	0.98	1.00	1.04	0.98	0.04
	1992					
Days to 50 % tasseling	57.50	57.25	57.57	56.25	57.19	0.66
Days to 50 % silking	58.81	58.75	59.06	58.06	58.67	0.59
Barren plants (%)	6.19	4.50	4.50	3.50	4.67	0.64
No of ears per plant	0.94	0.99	1.04	1.12	1.02	0.05

Several investigators reported marked differences in tasseling date of maize varieties (**Bedeer, 1979; Kamel et al. , 1979; Amer, 1980; Eraky et al., 1982; El-Hattab et al., 1985; Gouda, 1989 and Gouda et al., 1992**).

2- Silking date :

Data in Table 8 show that significant differences among the four tested maize varieties were observed in the second season. In 1991 season, T.W.C. 310 was the earliest variety followed by S.C. 10, Giza-2 and D.C. 215. However, all differences in silking date in the first season were below the level of significance. In 1992 season, different trend was observed where S.C. 10 was the earliest variety followed by D.C. 215, Giza-2 and T.W.C. 310. Significant differences were only found between S.C. 10 and the three other varieties whereas no any difference was observed among these varieties, i.e. Giza-2, D.C. 215 and T.W.C. 310 in silking date.

The present results are mainly due to the differences in the genetical make up of the evaluated varieties and agree with those reported by **Bedeer (1979), Kamel et al. (1979 b), Amer (1980), Gouda (1989) and Gouda et al (1992)** who reported marked differe-nces in silking date of the tested maize varieties.

3- Percentage of barren plants :

Results presented in Table 8 show clearly that the prolificacy of the tested varieties markedly varied in both seasons of experimentation.

In 1991 season, S.C. 10 was significantly superior compared with the three other varieties showing the lowest barrenness percentage followed by D.C. 215 and T.W.C. 310, whereas the composite variety Giza-2 was the worst with the highest barrenness percentage. Significant differences were recorded between S.C. 10 and all other varieties, between D.C. 215 and each of T.W.C. 310 and Giza-2 and between T.W.C. 310 and Giza-2.

In 1992 season, also S.C. 10 was at the top of the tested varieties and significantly surpassed the three other varieties in prolificacy followed by each of D.C. 215 and T.W.C. 310 having the same score of barrenness, while Giza-2 was the worst variety with the highest value of barrenness. In that season, Giza-2 was significantly inferior compared with the other three varieties.

It could be concluded that S.C. 10 was superior to the double as well as the three way crosses, and the crosses were superior to the open-pollinated variety Giza-2 as far as barrenness percentage is concerned.

The present results indicate the importance of growing hybrid maize in general and single crosses in particular as a tool for improving maize productivity.

Similar results were also reported by **Kamel et al (1979 a and b), Amer (1984) and Moustafa (1990)** who found that hybrid varieties were superior compared with open-pollinated varieties showing a lower percentage of barren plants.

4- Number of ears per plant :

Results presented in Table 8 show clearly that the tested varieties showed significant differences in number of ears/plant in both seasons.

Similarly to barrenness percentage trait, S.C. 10 was significantly superior compared with the three other varieties having the highest number of ears/plant in both seasons. T.W.C. 310 followed S.C. 10 in this trait with a significant difference compared with D.C. 215 in the second season. Giza-2 was the worst in this character having the lowest number of ears/plant in both seasons and was significantly inferior compared with the three other varieties.

It could be concluded that S.C. 10 was the most productive variety concerning ears number/plant and Giza-2 was the worst variety, while T.W.C. 310 and D.C. 215 were in-between.

The superiority of hybrid maize in number of ears/plant over the open-pollinated varieties was also reported by **Yakout (1977), kamel et al. (1979a), Eraky et al. (1980), Hussein et al. (1981), El-Hattab et al. (1985) and El-Agamy et al. (1986).**

III. Ear Characters :

1- Ear length :

Results presented in Table 9 show that significant differences were recorded in ear length among the four tested maize varieties in both seasons. In 1991 seasons, S.C. 10 has the longest ears followed by T.W.C. 310, D.C. 215 and Giza-2 in descending order. Significant differences were only found between S.C. 10 and each of D.C. 215 and Giza-2 as well as between T.W.C. 310 and both of D.C. 215 and Giza-2.

Table 9. Effect of variety on ear characters in 1991 and 1992 seasons.

Characters	Varieties				Mean	L.S.D.
	Giza-2	D.C.215	T.W.C. 310	S.C. 10		
			1991			
Ear length (cm)	18.00	18.20	18.83	19.44	18.62	0.63
Ear diameter (cm)	4.36	4.33	4.43	4.38	4.37	NS
Ear weight (g)	199.38	229.19	244.13	229.19	224.30	11.57
No of rows per ear	12.88	13.25	13.38	13.75	13.31	NS
			1992			
Ear length (cm)	18.83	19.83	20.16	20.80	19.90	0.33
Ear diameter (cm)	4.55	4.68	4.96	4.65	4.71	NS
Ear weight (g)	224.94	263.25	272.88	274.69	258.94	13.46
No of rows per ear	12.88	13.13	13.25	14.00	13.31	NS

In 1992 season, similarly ear length of S.C. 10 surpassed that of the three other varieties with significant differences. On the other hand, Giza-2 has the shortest ears which were significantly shorter compared with the three tested varieties. Ears of T.W.C. 310

were significantly longer than those of D.C. 215. It could be concluded that S.C. 10 was a superior maize variety, followed by T.W.C. 310 and D.C. 215, whereas Giza-2 has shorter ears that the three hybrid varieties.

The present results indicated the superiority of growing hybrid varieties in general and single crosses in particular.

Similar results were also reported by **Bedeer (1979), Eraky et al. (1980), Hussein et al. (1981), Khalifa et al. (1983), Gouda (1982), El-Agamy et al. (1986), Gouda (1989), Nigem (1989), Mohamed et al. (1991) and Gouda et al. (1992)** who found that hybrid varieties were superior compared with open-pollinated varieties as far as ear length is concerned.

2- Ear diameter :

Results presented in Table 9 show that the four evaluated varieties did not significantly differ in their ear diameter. The four tested varieties showed no apparent differences in this trait and were more or less of a similar diameter.

The present results show clearly that the increase in ear size of the hybrid varieties in general and S.C. 10 in particular is mainly due to the increase in ear length rather than ear diameter.

The present results disagree with those of **El-Agamy et al. (1986), Moustafa (1990) and Gouda et al. (1992)** who found significant differences among different varieties in ear diameter. On the other hand, **Bedeer (1979)** showed that differences in ear diameter were highly significant in 1974 season but insignificant in 1975.

3- Ear weight :

The tested varieties differed significantly in ear weight in both seasons as shown in Table 9. The results indicated clearly the superiority of hybrid varieties in this trait overthe composite variety Giza-2. In 1991 season, the four varieties could be arranged in a descending order according to their ear weight as follows: T.W.C. 310, S.C. 10, D.C. 215 and Giza-2. Significant differences in ear weight were found between T.W.C. 310 and the other varieties as well as between Giza-2 and all other varieties. The difference between the leading variety T.W.C. 310 and the worst variety Giza-2 is 44.75 gm or 22.44 %.

In 1992 season, S.C. 10 was the top, followed by T.W.C. 310, D.C. 215 and Giza-2 in a descending order. Significant differences were only recorded between Giza-2 and the other three hybrids, whereas no significant differences were observed among the three hybrids. It could be concluded that hybrid varieties surpassed significantly the composite variety Giza-2 in ear weight.

The present results are mainly due to superiority of hybrids in growth characters and ear size. Similar results were reported by **El-Hattab et al. (1979) and Kamel et al. (1979a and b)** who found that hybrid varieties surpassed the open-pollinated varieties in ear weight.

4- Number of rows per ear :

Results in Table 9 show that no significant differences were found among the four evaluated varieties in number of rows/ear in both seasons of experimentation. In both seasons, it was observed that S..C. 10 has higher number of rows/ear compared with the three other varieties, whereas Giza-2 has the lowest number and T.W.C. 310 and D.C. 215 were in between. However, all differences were too slight to reach the level of significance. These results are mainly due to the genetical constitution of the tested varieties because it is well known that number of rows/ear is mainly a genetical trait. Results reported by **Gouda (1982), El-Agamy et al. (1986), El-Bialy et al (1991) and Gouda et al. (1992)** indicated marked differences of number of rows per ear of the tested varieties.

IV. Grain Yield And Its Components :

1- Weight of 100 kernels :

Results presented in Table 10 show that 100-kernel weight of the tested maize varieties differed significantly in both seasons.

In 1991 season, S.C. 10 was significantly superior to the three other varieties in grain index., followed by T.W.C. 310 which was insignificantly higher than D.C. 215, whereas Giza-2 has the lowest index which was significantly inferior compared with all other varieties.

In 1992 season, S.C. 10 was also superior in 100-kernel weight and was significantly higher than D.C. 215 and Giza-2. On the other hand, Giza-2 has the lowest grain index

Table 10. Effect of variety on grain yield and some of its components in 1991 and 1992 seasons.

Characters	Varieties				Mean	L.S.D.
	Giza-2	D.C.215	T.W.C. 310	S.C. 10		
			1991			
Weight of 100 kernels (g)	28.58	30.27	30.48	32.73	30.52	0.79
Shelling percentage	83.73	86.96	83.75	84.74	84.79	0.88
Grain yield (Kg/fad)	2600.20	2772.70	2999.50	3835.50	3051.90	288.4
			1992			
Weight of 100 kernels (g)	36.07	37.74	38.77	38.92	37.88	0.92
Shelling percentage	85.93	87.31	86.63	87.11	86.75	1.00
Grain yield (Kg/fad)	3507.00	3659.60	3967.60	4141.20	3818.50	331.80

which was significantly lower than that of T.W.C. 310 and S.C. 10. Also, T.W.C. 310 was significantly superior compared with D.C. 215.

maize over the open-pollinated variety in shelling percentage is clearly demonstrated.

Similar results were also obtained by **Gouda (1982), El-Agamy et al. (1986) and Mohamed et al (1991).**

3- Grain yield :

Results in Table 10 show clearly that the tested varieties markedly differed in their productivity in both seasons of experimentation.

In 1991 season, D.C. 10 was the best variety with an excellent potentiality, followed by T.W.C. 310, D.C. 215 and Giza-2 in a descending order. S.C. 10 outyielded T.W.C. 310, D.C. 215 and Giza-2 by 28.87, 28.33 and 47.51 %, respectively. Significant differences were found in grain yield between S.C. 10 and all other varieties as well as between Giza-2 and T.W.C. 310, whereas no significant differences were detected between Giza-2 and D.C. 215 as well as between D.C. 215 and T.W.C. 310.

In 1992 season, a similar trend was also observed where S.C. 10 outyielded T.W.C. 310, D.C. 215 and Giza-2 by 4.38, 13.16 and 18.08 %, respectively. Significant differences in grain yield were found between S.C. 10 and each of D.C. 215 and Giza-2 as well as between T.W.C. 310 and Giza-2, whereas no significant differences were detected between S.C. 10 and T.W.C. 310, Giza-2 and D.C. 215 and between D.C. 215 and T.W.C. 310.

It could be concluded that on the average of both seasons S.C. 10 was the best variety and Giza-2 was the worst, whereas T.W.C. 310 and D.C. 215 were in-between.

The present results show clearly the importance of growing high yielding single crosses as an effective tool for increasing maize grain yield.

The superiority of the hybrid varieties in general and the single cross in particular is mainly due to the better growth, ear and agronomic characters. The previous results ndicated the superiority of the S.C. 10 in plant height, number of leaves/plant, leaf area, number of ears/plant, prolificacy, ear length, ear diameter, ear weight, grain index and shelling percentage compared with the other three varieties. The superiority of growing hybrid maize varieties was also indicated by several investigators (**Bedeer, 1979; Kamel et al., 1979; Early et al., 1980; Gouda, 1992; Khalifa et al., 1983; Nigem, 1989; Mostafa, 1990; Mohamed, 1991 and Gouda et al., 1992**).

V. Chemical Content of Leaves and Grain of Maize Varieties :

1- Nitrogen, Phosphorus and Potassium Contents in Leaves :

Results in Table 11 cleared that in both seasons, the four tested varieties did not show any significant differences in their leaf content of the three major elements, N, P and K. The leaf content of N ranged between 1.31 - 1.44 % in the first season, being 1.78 - 1.93 % in the second one, without any specific trend, indicating that the four tested varieties were similar in this concern. Also, P content in leaves ranged between 0.563 and 0.575 in 1991 season and from 0.469 to 0.513 % in 1992 season without any specific trend. Potassium content in leaves ranged between 0.600 and 0.625 % in 1991 season, being from 0.494 to 0.550 in 1992 season without any significant difference. The present results indicate a great similarity of the four tested varieties in their leaf content of the three major nutritive elements.

Results reported by **Mahgoub (1987)** showed that some inbred lines and their hybrids were superior in their N content in leaves compared with other genotypes.

2- Nitrogen, Phosphorus and Potassium content in grain :

Results presented in Table 11 indicate that N content in grain of the four tested varieties showed no apparent differences in both seasons of experimentation. However, T.W.C. 310 showed higher grain content of N % in both seasons, whereas Giza-2 contained the lowest N percentage in both season.

Table 11. Effect of variety on chemical content of leaves and grains of maize in 1991 and 1992 seasons.

Characters	Giza-2	D.C.215	T.W.C 310	S.C. 10	Mean	L.S.D.
			1991			
N % in leaves	1.33	1.31	1.44	1.37	1.36	NS
P % in leaves	0.569	0.563	0.569	0.575	0.569	NS
K % in leaves	0.625	0.600	0.606	0.608	0.609	NS
N % in grains	1.28	1.28	1.32	1.29	1.29	NS
P % in grains	0.550	0.49	0.530	0.54	0.53	NS
K % in grains	0.380	0.430	0.500	0.490	0.450	0.024
Protein % in grain	7.97	8.01	8.09	8.24	8.08	NS
			1992			
N % in leaves	1.78	1.93	1.93	1.93	1.89	NS
P % in leaves	0.506	0.469	0.513	0.469	0.489	NS
K % in leaves	0.500	0.494	0.550	0.531	0.519	NS
N % in grains	1.52	1.61	1.62	1.61	1.59	NS
P % in grains	0.52	0.48	0.62	0.41	0.51	0.11
K % in grains	0.43	0.380	0.460	0.440	0.430	0.039
Protein % in grain	10.09	10.03	9.50	10.15	9.94	NS

Table 11. Effect of variety on chemical content of leaves and grains of maize in 1991 and 1992 seasons.

Characters	Varieties				Mean	L.S.D.
	Giza-2	D.C.215	T.W.C 310	S.C. 10		
	1991					
N % in leaves	1.33	1.31	1.44	1.37	1.36	NS
P % in leaves	0.569	0.563	0.569	0.575	0.569	NS
K % in leaves	0.625	0.600	0.606	0.608	0.609	NS
N % in grains	1.28	1.28	1.32	1.29	1.29	NS
P % in grains	0.550	0.49	0.530	0.54	0.53	NS
K % in grains	0.380	0.430	0.500	0.490	0.450	0.024
Protein % in grain	7.97	8.01	8.09	8.24	8.08	NS
	1992					
N % in leaves	1.78	1.93	1.93	1.93	1.89	NS
P % in leaves	0.506	0.469	0.513	0.469	0.489	NS
K % in leaves	0.500	0.494	0.550	0.531	0.519	NS
N % in grains	1.52	1.61	1.62	1.61	1.59	NS
P % in grains	0.52	0.48	0.62	0.41	0.51	0.11
K % in grains	0.43	0.380	0.460	0.440	0.430	0.039
Protein % in grain	10.09	10.03	9.50	10.15	9.94	NS

Although, all differences were too slight to reach the level of significance. With regard to P content in grain, a significant difference was only detected in the second season. In that season, S.C. 10 showed the highest P content in grain, being 0.615 % followed by Giza-2 (0.52 %), T.W.C. 310 0.453 %) and D.C. 215 (0.405 %). The superiority of S.C. 10 in P % in grain was not clear in the first season.

In 1991 season, T.W.C. 310 showed the highest K % in grain being 0.50 % followed by S.C. 10 (0.49 %), D.C. 215 (0.43 %) and Giza-2 (0.38 %) in a descending order.

In 1992 season, also T.W.C. 310 was at the top in K % in grain recording 0.46 %, followed by S.C. 10 (0.44 %), Giza-2 (0.43 %) and D.C. 215 (0.38 %).

It could be concluded that T.W.C. 310 was superior in assimilating potassium compared with the other three varieties, which may be due to the differences in the genetical constitution.

3- Protein content in grain :

Results presented in Table 11 show clearly that no significant differences were detected among the four evaluated varieties in their protein content in grain in both seasons.

However, slight differences were observed and S.C. 10 was at the top in both seasons recording 8.24 and 10.15 % in the first and second season, respectively. The other three varieties showed no specific trend in their grain protein content.

This result is expected since N % in grain was also not significantly affected due to the different genotypes.

Results reported by **Tasi et al. (1983)** indicated that there were wide variations in kernel N sink. Also, **Yakout (1977)** found that maize open-pollinated varieties surpassed maize hybrids in crude protein percentage. On the other hand, **El-Kalla et al. (1985)** observed that D.C. 19 contained higher percentage of protein than V.C. 80. Also,

Mahgoub (1987), Attia (1989) and Gouda (1989) reported that maize genotypes differed significantly in protein content in grain.

C. NITROGEN UPTAKE, NITROGEN USE EFFICIENCY AND NITROGEN RECOVERY IN GRAIN :

I. Nitrogen Uptake in Grain :

1- Effect of N level :

Results in Table 12 show N uptake in grain (kg/fed) as affected by nitrogen level and variety in both seasons of experimentation. Results indicated clearly that N uptake markedly increased with the increase in N level in both seasons.

Table 12. Nitrogen uptake in grains (kg/fed) as affected by N fertilizer level and variety in 1991 and 1992 seasons.

	Giza-2	D.C.215	T.W.C.310	S.C. 10	Mean
kg N/fed	N uptake in kg/fed (1991 season)				
Zero	23.06	22.64	29.48	36.70	27.97
80	31.52	34.57	40.15	51.76	39.50
105	35.71	42.69	41.37	51.95	42.93
130	45.17	45.54	48.24	59.68	49.66
Mean	33.87	36.36	39.81	50.02	40.02
	N uptake in kg/fed (1992 season)				
Zero	36.44	42.23	40.48	41.10	40.06
80	49.06	50.62	54.99	66.47	55.29
105	60.52	65.66	69.25	71.66	66.77
130	70.05	81.45	99.76	92.21	85.87
Mean	54.02	59.99	66.12	67.86	61.99

In 1991 season, applying N at 80, 105 and 130 kg/fed increased N uptake in grain by 41.22, 53.49 and 77.55 % compared with the uptake under the check treatment, respectively.

In 1992 season, the increase in N uptake due to N application was more evident compared with the first season. Applying N at 80, 105 and 130 kg/fed markedly increased N uptake over the check treatment by 38.02, 66.67 and 113.61 %, respectively.

It is evident from Table 12 that the highest N level, i.e. 130 kg/fed caused a marked increase in N uptake compared with the lower levels. In other words, the last increment in N level (35 kg N/fed) caused an increase of 15.68 and 28. 61 % in the first and second season, respectively. This result show that the highest N level was economic to be applied. Even, further increase in N level over 130 kg/fed may be used as optimum N level.

Similar results were also reported by **Mahgoub (1987), Sisson et al (1991)** and **Reeves et al (1993).**

2 - Effect of variety :

Results presented in Table 12 show clearly that marked differences were recorded among the four evaluated varieties in N uptake in grain in both seasons.

Results showed that in 1991 season the four tested varieties could be arranged in a descending order with regard to N uptake in grain as follows: S.C. 10, T.W.C. 310, D.C. 215 and Giza-2. The N uptake in grain averaged over the four N levels for S.C. 10 was higher than that of T.W.C. 310, D.C. 215 and Giza-2 by 26.65, 37.57 and 47.68 %, respectively.

In 1992 season, a similar trend was also observed with regard to N uptake in grain where S.C. 10 was the leading variety followed by T.W.C. 310, D.C. 215 and Giza-2 in a descending order. S.C. 10 was superior in N Uptake and surpassed the three other varieties by 2.63, 13.12 and 25.62, respectively.

Marked differences in N uptake were recorded between S.C. 10 and the three other varieties as well as between T.W.C. 310 and Giza-2 in the first season. On the other hand, in the second season, S.C. 10 and T.W.C. 310 were nearly similar in N uptake and were superior compared with Giza-2 and D.C. 215.

It could be concluded that S.C. 10 was superior in N uptake with a high yield potentiality, whereas Giza-2 was the worst variety with the lowest N uptake, while T.W.C. 310 and D.C. 215 were in-between.

The leading position of S.C. 10 in N uptake is a good indicator for its high yielding capacity. The superiority of hybrid varieties in general and S.C. 10 in particular, in N uptake is a good illustration for the importance of growing hybrid maize in Egypt. Similar results were also reported by **Alofe (1974), Chevalier and Scrader (1977), Fox et al. (1978), Kamprath et al. (1982), Pan et al. (1985) and Mahgoub (1987)** who found marked differences among maize genotypes in N uptake.

II. Nitrogen Use Efficiency :

1 - Effect of N level :

Results presented in Table 13 show that N use efficiency was markedly increased with the increase in N level in both seasons of experimentation. In 1991 season, applying N at 80, 105 and 130 kg/fed produced N use efficiency of 5.84, 6.31 and 7.17, respectively.

The corresponding values for the same levels of N in 1992 season were 7.80, 9.31 and 11.46, respectively.

The presented results indicate clearly that on the average of the four evaluated varieties, N use efficiency has been gradually increased with the increase in N level, particularly in the second season. The result showed that N use efficiency reached a maximum of 7.17 and 11.46 in 1991 and 1992 seasons, respectively, when N was

Table 13. Nitrogen use efficiency in grains as affected by N fertilizer level and variety in 1991 and 1992 seasons.

kg N/fed	Giza-2	D.C.215	T.W.C.310	S.C. 10	Mean
	N use efficiency (1991 season)				
Zero	----	----	----	----	----
80	2.33	5.46	6.41	9.17	5.84
105	4.25	7.48	6.36	7.13	6.31
130	6.26	6.26	9.47	6.68	7.17
Mean	4.28	6.40	7.41	7.66	6.44
	N use efficiency (1992 season)				
Zero	----	----	----	----	----
80	6.69	2.77	9.00	12.74	7.80
105	10.49	5.27	10.72	10.76	9.31
130	9.07	8.20	14.94	13.61	11.46
Mean	8.75	5.41	11.55	12.37	9.52

applied at 130 kg/fed. In other words a N level of 130 kg/fed could be recommended under the conditions of the experiment as an optimum level of N. Every kg of N produced an increase of 7.17 kg grain in 1991 season and 11.46 kg grain in 1992 season.

Moreover, further investigations are needed to study the efficient use of higher N levels than had been used in the present investigation.

It is worth mentioning here that from an economic point of view, the use of 130 kg/fed is recommended, since the price of 1 kg N is L.E. 1.22* and maize is L.E. 0.53* according to the official prices announced on July, 1st, 1993.

It could be concluded that with the introduction of high yielding hybrids an increase in N level to 130 kg N/fed (or even more) could be recommended.

* Official prices declared by the Egyptian Agricultural Credit and Development Bank on the first of July, 1993

Results reported by **Mahgoub (1987)** showed different trend as he found that N use efficiency at the ;location "Hancocke and Arlington" tended to decrease as the N fertilizer increased, but differences between N rates were not significant. Also **Sisson et al (1991)** reported that N use efficiency decreased as N rates were increased.

2 - Effect of Variety :

Results in Table 13 show the N use efficiency of the four varieties under study in both season of experimentation.

Results indicated marked differences among varieties in use efficiency. In 1991 season, S.C. 10 was the best variety with the highest value followed by T.W.C. 310, D.C. 215 and Giza-2 in a descending order.

In 1992 season, S.C. 10 was also the leading variety with the highest efficiency followed by T.W.C. 310, Giza-2 and D.C. 215 in a descending order. In both seasons, S.C. 10 and T.W.C. 310 were nearly similar in their efficiency in assimilating N with an efficient use of 7.66 and 7.41, respectively in 1991 season. In 1992 season, S.C. 10 recorded an efficient use of 12.37 whereas T.W.C. 310 followed with a value of 11.55. It is worth noting that the N use efficiency in the second season was higher than that in the first one, perhaps due to better environmental conditions.

It could be concluded that the superiority of S.C. 10 is clearly demonstrated. Also T.W.C. 310 is a variety with a high efficiency in assimilating N compared with Giza-2 and D.C. 215.

Results reported by **Mahgoub (1987)** showed that hybrids had higher N use efficiency than inbred parents, but there was no difference between the two hybrids for N use efficiency.

III. Nitrogen Recovery :

1 - Effect of N Level :

Results in Table 14 show that N recovery was markedly affected by N level, particularly in the second season.

Table 14. Nitrogen recovery in grains as affected by N fertilizer level and variety in 1991 and 1992 seasons.

kg N/fed	Giza-2	D.C.215	T.W.C.310	S.C. 10	Mean
	N recovery (1991 season)				
Zero	----	----	----	----	----
80	10.58	14.91	13.34	18.83	14.42
105	12.05	19.10	11.32	14.52	14.25
130	17.01	17.62	14.43	17.68	16.69
Mean	13.21	17.21	13.03	17.01	15.12
	N recovery (1992 season)				
Zero	----	----	----	----	----
80	15.78	10.49	18.14	31.71	19.03
105	22.93	22.31	27.40	29.10	25.44
130	25.85	30.17	45.60	39.32	35.24
Mean	21.52	20.99	30.30	33.38	26.56

In 1991 season, N recovery was estimated as 14.42, 14.25 and 16.69 % for the N levels 80, 105 and 130 kg/fed. In 1992 season, a gradual increase was observed with the increase in N level. Applying N at 80, 105 and 130 kg/fed resulted in N recovery values of 19.03, 25.44 and 35.24 %, respectively.

These results indicate clearly the efficient use of the highest N level and a further increase in N level seems to be effective and economic. It is also observed that N recovery was higher in 1992 season compared with 1991 season.

Results reported by **Mahgoub (1987)** showed that N recovery tended to decrease as fertilizer N was increased but the differences between rates were not significant, showing an opposite trend from the present results.

2 - Effect of variety :

Results in Table 14 show that varieties differed greatly in N recovery in both seasons. In 1991 season, S.C. 10 as well as D.C. 215 were superior in N recovery with a N recovery of about 17 %, whereas Giza-2 and T.W.C. 310 recorded lower values of N recovery, being about 13 %. In 1992 season, varieties showed a different trend, but S.C. 10 was still at the top with a N recovery of 33.38 followed by T.W.C. 310 with a value of 30.3. Giza-2 and D.C. 215 were nearly similar in their N recovery with a value of 21.52 and 20.99, respectively.

The present results are mainly due to the differences in the genetical constitution of the tested varieties.

It could be concluded that the superiority of S.C. 10 is quite evident with its higher N recovery value. Results reported by **Mahgoub (1987)** showed that hybrids were higher in N recovery than inbred parents.

D : INTERACTION EFFECTS :

The analysis of variance of the present results showed that N levels x varieties had no significant effect on growth, agronomic, ear characters as well as grain yield and its components except on leaf area of the topmost ear in 1991 season. Consequently, the interaction data were excluded.

Table 15 shows the leaf area of the topmost ear as influenced by N levels and varieties in 1991 season.

Table 15. Effect of interaction between N level and varieties on leaf area (in dm^2) In 1991 and 1992 seasons.

kg N/fed	Giza-2	D.C. 215	T.W.C.310	S.C. 10	Mean
Zero	53.5	57.6	54.4	54.7	55.1
80	56.2	68.7	63.5	74.8	65.8
105	64.5	75.3	63.9	69.7	68.3
130	68.5	71.3	71.3	65.5	69.1
Mean	60.7	68.2	63.3	66.2	64.6
L.S.D. for	V = 3.1	N = 3.1	V x N = 9.4		

Results cleared that the highest leaf area of Giza-2, D.C. 215, T.W.C. 310 and S.C. 10 was recorded at the N levels of 130, 105 and 80 kg/fed, respectively. That indicates clearly that varieties responded differently to N levels as far as leaf area is concerned. The highest leaf area was 75.3 dm^2 which was recorded with D.C. 215 supplied with 105 kg N/fed and the lowest area 53.5 dm^2 which was recorded with Giza-2 under the check treatment.

The following Tables (16 and 17) show a summary of the highest values obtained in 1991 and 1992 seasons for all characters studied.

From the results summarized in Table 16, it is clear that in 1991 season, the highest N level combined with S.C. 10 produced the highest values in most of the studied traits, namely plant height at 35 days from planting, plant height at harvest, ear height, number of rows/ear, grain index, grain yield/fed, K % in leaves and grains and N uptake.

This combination was followed by the same N level, i.e. 130 kg/fed combined with T.W.C. 310. This combination produced the highest values for ear weight, N % in leaves,

Table 16. Summary of the effect of N levels and varieties on the studied characters showing the highest values obtained and the best trearments in 1991 season.

Characters	Treatment	Value	Significance
01. Plant height at 35 days (cm)	130 kg N + S.C. 10	137.18	NS
02. Plant height at 50 days (cm)	105 kg N + D.C. 215	228.00	NS
03. plant height at harvest (cm)	130 kg N + S.C. 10	352.82	NS
04. Ear height (cm)	130 kg N + S.C. 10	223.09	NS
05. No of leaves at 35 days	105 kg N + S.C. 10	9.13	NS
06. No of leaves at 50 days	105 kg N + D.C. 215	14.08	NS
07. Leaf area (dm^2)	105 kg N + D.C. 215	75.30	Significant
08. Days to 50 % tasseling*	130 kg N + T.W.C. 310	53.25	NS
09. Days to 50% silking*	130 kg N + T.W C 310	56.25	NS
10. Percentage of barren plants*	130 kg N + D.C. 215	1.25	NS
11. No of ears per plant	105 kg N + S.C. 10	1.15	NS
12. Ear length (cm)	80 kg N + S.C. 10	20.43	NS
13. Ear diameter	105 kg N + S.C. 10	4.70	NS
14. Ear weight (g)	130 Kg N + T.W.C. 310	274.00	NS
15. No of rows per ear	130 kg N + S.C. 10	14.50	NS
16. Weight of 100 kernels (g)	130 kg N + S.C. 10	34.47	NS
17. Shelling percentage (%)	130 kg N + D.C. 215	87.27	NS
18. Grain yield (kg/fed)	130 kg N + S.C. 10	4116.00	NS
19. N % in leaves	130 kg N + T.W.C. 310	1.78	NS
20. P % in leaves	130 kg N + T.W.C 310	0.60	NS
21. K % in leaves	130 kg N + S.C. 10	0.60	NS
22. N % in grains	130 kg N + Giza-2	1.48	NS
23. P % in grains	130 kg N + T.W.C. 310	0.63	NS
24. K % in grains	130 kg N + T.W.C. 310	0.57	NS
25. Protein % in grain	105 kg N + D.C. 215	9.22	----
26. N uptake in grain (kg/fed)	130 kg N + S.C. 10	59.68	----
27 Nuse efficiency Kg grain (kg/n	130 kg N + T.W.C. 310	9.47	----
28. N recovery	105 kg N + D.C. 215	19.10	----

* Lowest value

Table 16. Summary of the effect of N levels and varieties on the studied characters showing the highest values obtained and the best trearments in 1991 season.

Characters	Treatment	Value	Significance
01. Plant height at 35 days (cm)	130 kg N + S.C. 10	137.18	NS
02. Plant height at 50 days (cm)	105 kg N + D.C. 215	228.00	NS
03. plant height at harvest (cm)	130 kg N + S.C. 10	352.82	NS
04. Ear height (cm)	130 kg N + S.C. 10	223.09	NS
05. No of leaves at 35 days	105 kg N + S.C. 10	9.13	NS
06. No of leaves at 50 days	105 kg N + D.C. 215	14.08	NS
07. Leaf area (dm^2)	105 kg N + D.C. 215	75.30	Significant
08. Days to 50 % tasseling*	130 kg N + T.W.C. 310	53.25	NS
09. Days to 50% silking*	130 kg N + T.W C 310	56.25	NS
10. Percentage of barren plants*	130 kg N + D.C. 215	1.25	NS
11. No of ears per plant	105 kg N + S.C. 10	1.15	NS
12. Ear length (cm)	80 kg N + S.C. 10	20.45	NS
13. Ear diameter	105 kg N + S.C. 10	4.70	NS
14. Ear weight (g)	130 Kg N + T.W.C. 310	274.00	NS
15. No of rows per ear	130 kg N + S.C. 10	14.50	NS
16. Weight of 100 kernels (g)	130 kg N + S.C. 10	34.47	NS
17. Shelling percentage (%)	130 kg N + D.C. 215	87.27	NS
18. Grain yield (kg/fed)	130 kg N + S.C. 10	4116.00	NS
19. N % in leaves	130 kg N + T.W.C. 310	1.78	NS
20. P % in leaves	130 kg N + T.W.C 310	0.60	NS
21. K % in leaves	130 kg N + S.C. 10	0.60	NS
22. N % in grains	130 kg N + Giza-2	1.48	NS
23. P % in grains	130 kg N + T.W.C. 310	0.63	NS
24. K % in grains	130 kg N + T.W.C. 310	0.57	NS
25. Protein % in grain	105 kg N + D.C. 215	9.22	----
26. N uptake in grain (kg/fed)	130 kg N + S.C. 10	59.68	----
27 Nuse efficiency Kg grain (kg/n	130 kg N + T.W.C. 310	9.47	----
28. N recovery	105 kg N + D.C. 215	19.10	----

* Lowest value

ble 17. Summary of the effect of N levels and varieties on the studied characters showing the highest values obtained and the best trearments in 1992 season.

Characters	Treatment	Value	Significance
01. Plant height at 35 days (cm)	130 kg N + S.C. 10	117.95	NS
02. Plant height at 50 days (cm)	105 kg N + D.C. 215	205.58	NS
03. plant height at harvest (cm)	130 kg N + D.C. 215	307.58	NS
04. Ear height (cm)	130 kg N + S.C. 10	176.48	NS
05. No of leaves at 35 days	130 kg N + S.C. 10	8.58	NS
06. No of leaves at 50 days	130 kg N + S.C. 10	14.08	NS
07. Leaf area (dm^2)	130 kg N + T.W.C. 310	91.50	NS
08. Days to 50 % tasseling*	130 kg N + D.C. 215	53.25	NS
09. Days to 50% silking*	130 kg N + S. C 10	56.50	NS
10. Percentage of barren plants*	130 kg N + S.C. 10	1.25	NS
11. No of ears per plant	80kg N + S.C. 10	1.23	NS
12. Ear length (cm)	130 kg N + S.C. 10	21.65	NS
13. Ear diameter	130 kg N + T.W.C. 310	5.10	NS
14. Ear weight (g)	130 Kg N+ S.C. 10	323.75	NS
15. No of rows per ear	130 kg N + S.C. 10	14.50	NS
16. Weight of 100 kernels (g)	130 kg N + S.C. 10	41.06	NS
17. Shelling percentage (%)	130 kg N + D.C. 215	88.74	NS
18. Grain yield (kg/fed)	130 kg N + T.W.C. 310	4963.0	NS
19. N % in leaves	130 kg N + T.W.C. 310	2.10	NS
20. P % in leaves	105 kg N + T.W.C 310	0.55	NS
21. K % in leaves	80 kg N + T.W.C. 310	0.675	NS
22. N % in grains	130 kg N + T.W.C. 310	2.01	NS
23. P % in grains	105 kg N + T.W.C. 310	0.78	NS
24. K % in grains	130 kg N + T.W.C. 310	0.55	NS
25. Protein % in grain	130 kg N + S.C. 10	12.56	----
26. N uptake in grain (kg/fed)	130 kg N + T.W.C. 310	99.76	----
27 Nuse efficiency Kg grain (kg/n	130 kg N + T.W.C. 310	14.94	----
28. N recovery	130 kg N + T.W.C. 310	45.60	----

* Lowest value

P % in grain and N use efficiency as well as earliest tasseling and silking dates.

In 1992 season, results in Table 17 show that supplying S.C. 10 with 130 kg N//fed produced the highest values of plant height at 35 days from planting, ear height, number of leaves/plant at 35 and 50 days from planting, ear length, ear weight, number of rows/ear, grain index and protein % in grain and also the earliest silking date and lowest barren plant %.

This combination was followed by T.W.C. 310 and 130 kg N/fed which was the best treatment for leaf area, ear diameter, grain yield/fed, N % in leaves, N % in grain, K % in grain, N uptake, N use efficiency and N recovery.

It could be concluded that both S.C. 10 and T.W.C. 310 were the best varieties and a N level of 130 kg/fed is recommended.