Minufiya J. Agric. Res. Vol.35 No. 6: 2109-2133 (2010)"http://www.mujar.net"

PRODUCTIVITY AND NITROGEN ACCUMULATION AND TRANSLOCATION OF SOME MAIZE GENOTYPES AS AFFECTED BY DIFFERENT NITROGEN FERTILIZATION LEVELS

M. E. Ibrahim, Sh. A. El-Shamarka, N. A. Gaafar and M. S. M. Abdel-Aal

Crop Science Department, Faculty of Agriculture, Minufiya University , Egypt

(Received: Sep. 25, 2010)

ABSTRACT: *Field experiment was carried out at the Experimental Farm, Faculty of Agriculture , Minufiya University in 2008 season and repeated in 2009 season to investigate the effect of nitrogen fertilization levels (0 , 30 , 60 , 90 and 120 Kg N / fed) on the productivity and nitrogen accumulation of five maize varieties differed in their prolificacy (number of ears), i.e Single cross 122 (S.C. 122), Single cross 30 K 8 (S.C. 30 K 8), Three way cross Nefertiti (T.W.C. Nefertiti), Synthetic variety Composit 1 and Open pollinated variety Giza 2 .*

The results could be summarized as follows :

1- *Application of Nitrogen fertilization generally significantly increased ear diameter, shelling % and N harvest index in the first season and 100-grain weight, N assimilation/ plant at 50% silking and N retranslocation in the second season (up to 30 Kg N/ fed); ear length, 100-grain weight, cob welght/ ear, no. of ears/ plant, sub apical ears % , grain, cob and ear yields / fed, N assimilation in grains, straw and total plant at maturity in the first season and grain and total weights/ ear and grain yield from apical ear in the second season (up to 60 Kg N/fed); N % in total plant at 50 % silking, no .of grains/ ear, grain and total weights/ ear, grain yield from apical and sub apical ears, N assimilation/ plant at 50% silking and N retranslocation in the first season and ear diameter, shelling %, grain, cob, ear, biological and straw yields/fed, N assimilation in grains and in total plant at maturity in the second season as well as total grain yield/ plant in both seasons (up to 90 Kg N / fed). However, the differences between the application of 90 and 120 Kg N / fed were not significant for all characters studied.*

2- *S.C 30 k 8 and T.W.C Nefertiti varieties generally surpassed the other tested varieties in grain weight/ ear, total ear weight , no. of ears/ plant, grain yield from apical and sub apical ear, total grain yield/ plant and sub apical ears %, grain, cobs , ears , straw and biological yields/ fed and N assimilation in each of grains, straw , total plant at maturity as well as N translocation indeces (N harvest index, N retranlocation and N retranslocation efficiency).*

3- *Growing single cross 30 K 8 and / or three way cross Nefertiti varieties and fertilizing them with 90 and/or 120 Kg N/ fed are the best treatments*

for improving the productivity of maize under Minufiya Governorate conditions through increasing dry matter accumulation and nitrogen translocation as well as number of ears/ plant and grain yield / fed.

Keywords: *Maize, N levels, genotypes, productivity, N assimilation and translocation*

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal crops which is used for human consumption and animal feed. It has always been the most efficient crop for converting the sun energy into food .

In Egypt , many attempts were devoted for increasing its productivity to face urgent demands of Egyptian people through the last period . This was achieved by growing high yielding varieties which carried more than one ear and improving cultural practices like nitrogen fertilization which it was considered the most factor affecting the growth and productivity of maize plant .

Although many studies had been done on the productivity and quality of maize as affected by nitrogen fertilization , less information is available for the response of new hybrid maize varieties to N fertilization under Minufiya Governorate conditions . In this respect , many investigators had been reported that increasing the levels of nitrogen fertilizer increased yield and its components of maize such as ear length, ear diameter and 100-grain weight (Ibrahim *et al* , 1995), no .of grains/ ear (Abo El-Zahab and Rady , 1990), shelling % (El-Moursy *et al* , 1998), ear yield/ fed (Salwau and Shams El-Din, 1992), straw yield / fed (Ashoub *et al* , 1996), grain yield/ fed (Mohamed, 2004) and crude protein % (Darwish, 2003). Moreover, Ibrahim (1997) found that N accumulated in plants at 50 % silking, grain, straw and total yields/plant and their N contents at maturity, grain yield of apical and sub apical ears and total yield/fed as well as N retranslocation and retranslocation efficiency were increased with increasing nitrogen fertilization

With respect to varietal differences , many investigators found variation among maize varieties in favor of the hybrid varieties which had the better performance and highest values of ear length and 100-grain weight , shelling % and grain yield/ fed (Mansour and Abdel-Maksoud, 2009), ear diameter (Mowafy, 2003), no. of grains/ear and biological yield / fed (Abdel-Maksoud and Sarhan, 2008), no. of ears/ plant, total ear weight and grain yield/ plant (Abdel-Aal *et al* , 1997), straw yield /fed (Ahmed, 1989 b), crude protein % (Said and Gabr, 1999) and N contents in grains and total plant at maturity and N retranslocation and its efficiency (Ibrahim, 1997).

The present investigation has been conducted to study the effect of N fertilization on yield and its components as well as nitrogen accumulation and translocation of some maize genotypes

MATERIALS AND METHODS

Field experiment was carried out at the Experimental Farm , Faculty of Agriculture , Minufiya university in 2008 season and repeated in 2009 one to investigate the effect of various nitrogen fertilization levels on the productivity as well as nitrogen accumulation and translocation of some maize varieties differed in their prolificacy (no. of ears / plant) . Every experiment included 25 treatments which were the combination of five nitrogen and five maize varieties .

The tested treatments are as follows :

A- Nitrogen levels :

1- 0 Kg N / fed (Control)
2- 30 Kg N / fed
3- 60 Kg N / fed
4- 90 Kg N / fed
5- 120 Kg N / fed

B- Varieties :

1- S.C.122 (Single cross hybrid)
2- S.C. 30 K 8 (Single cross hybrid)
3- T.W.C. Nefertiti (Three way cross hybrid)
4- Composit 1 (Synthetic variety)
5- Giza 2 (Open pollinated variety)

The tested treatments were arranged in a split plot design with three replicates where the nitrogen levels was allocated in the main plots and the varieties occupied the sub-plots. Each plot size was 12.6 m2 included 6 rows , 3 m length and 0.7 m width for each. The grains were sown on May 12 and 14 for 2008 and 2009 seasons, respectively. The preceding crop was Egyptian clover (*Trifolium alexandrinum,* L) and Wheat (*Triticum aeastivum,* L) in the first and second season , respectively . The physical and chemical properties of the experimental soil are shown in Table (1).

Table (1): Physical and chemical properties of the experimental soil during 2008 and 2009 seasons

Properties	Physical properties					chemical properties					
	Fine sand %	Coarse sand %	Silt %	Clay %	Texture class	PH	E.C	O.M %	Available (ppm)		
Seasons									N	P	K
2008	17.5	7	38	37.5	Clay loam	7.5	0.60	2	33.5	8.5	340
2009	16.5	7.5	40.5	35.5	Clay loam	7.9	0.80	1.8	26	7.5	300

Phosphorus fertilizer was applied pre sowing for each plot at a rate of 100 Kg / fed as calcium super phosphate (15.5 % P2O5). The plots were irrigated six times, where the first irrigation was applied 21 days after sowing and the following irrigations were applied every 14 days. Plants were thinned to one plant/ hill before the first irrigation. Nitrogen fertilizer was applied according

to the tested nitrogen fertilization levels in the form of urea (46.5 % N) in the two equal doses , the first dose was applied perior the first irrigation and the second one was added perior the second irrigation in both seasons . The plants were harvested on 9 and 14 September in the first and second seasons , respectively

Characters studied :

I- Yield and yield components :

At harvest, from the inner rows in each plot, five apical ears and five guarded plants were taken at random to determine the following ear characters and yield/ plant and its components, while the characters of yield / fed were determined from the rest plants in each plot :

A- Ear characters:

1- Ear length " cm "
2- Ear diameter " cm "
3- No . of grains / ear
4- 100 – grain weight " g "
5- Grain weight / ear " g "
6- Cob weight / ear " g "
7- Total weight / ear " g "
8- Shelling % = $\frac{\text{Grain weight / ear}}{\text{Total weight / ear}} \times 100$

B- Yield / plant and its component :

9 - No . of ears / plant
10- Grain yield of apical ear / plant " g "
11- Grain yield of sub apical ear / plant " g "
12- Total grain yield / plant (apical + sub apical ears) " g "
13- Sub apical ear / plant % =
$\frac{\text{Grain yield of sub apical ear / plant}}{\text{Total grain yield / plant}} \times 100$

C- Yield / fed and its component :

14- Grain yield / fed " Ton " (adjusted to 15.5 % moisture)
15- Cob yield / fed " Ton "
16- Ear yield / fed (grain + cob) " Ton "
17- Straw yield / fed " Ton " (stem + leaves + tassel)
18- Biological yield / fed (ear yield + straw yield) " Ton "

II – Chemical composition :

The following chemical analysis for different plant organs were studied

1- N % in total plant at 50 % silking
2- N % in grains at maturity
3- N % in straw at maturity
4- N % in total plant at maturity

Nitrogen % in the different plant organs were determined using micro kjeldahl methods as described by Pellett and Young (1980). The crude protein % in grains was calculated by multiplying the nitrogen % in grains by 5.75 according to the method described by A.A.C.C. (1983).

III – Nitrogen accumulation (assimilation) and translocation :

A – Nitrogen assimilation characters

1- N assimilation / plant at 50 % silking (g N / plant)
= N % in total plant at 50 % silking x total dry weight / plant at 50 % silking

2- N assimilation in grains / plant at maturity (g N / plant)
= N % in grains x grain yield / plant

3- N assimilation in straw at maturity (g N / plant)
= N % in straw x straw yield / plant

4- N assimilation in total plant at maturity (g N / plant)
= N assimilation in grains/ plant+ N assimilation in straw/ plant at maturity

B – N retranslocation characters :

The following aspects of N translocation characters within the maize plants were calculated according to the method described by Bulman and Smith (1993)

5- N assimilation in total plant at Post flowering (g N / plant)
= N assim. in total plant at maturity – N assim. in total plant at 50% silking

$$6\text{- N harvest index \%} = \frac{\text{N assim. in grains / plant}}{\text{N assim. in total plant at maturity}} \times 100$$

7- N retranslocation (g N / plant) =
N assim. in total plant at 50 % silking – N assim. in straw /plant at maturity

$$8\text{- N retranslocation efficiency \%} = \frac{\text{N retranslocation}}{\text{N assim. in total plant at 50 \% silking}} \times 100$$

Statistical analysis :

The data were statistically analyzed according to the methods described by Snedecor and Cochran (1967). Duncan's multiple range test Duncan (1955) was used to compare the treatment means . The mean values within each column followed by the same letters (s) are not significant at 5 % level

RESULTS AND DISCUSSION

A- Effect of nitrogen fertilization :

1- Yield and its components :

Data presented in Table (2) show the effect of N fertilization levels on the ear characters (ear length and diameter, no. of grains/ ear, grain, cob and total weights/ ear, 100-grain weight and shelling %), grain yield / plant characters (no. of ears/ plant, grain yield of apical and sub apical ear and their total grain yields/ plant as well as the percentage of grain yield of sub apical ear) , yields / fed characters (grain, cob, total ear, straw and biological yields/ fed) during 2008 and 2009 seasons

The data show that there are a consistent and gradual increase in all ear characters studied with increasing nitrogen fertilization from zero up to 120 Kg N / fed in both seasons. This increase was significant when the plants were fertilized up to 30 Kg N/ fed for (ear diameter and shelling % in the first season and for 100-grain weight in the second season), and up to 60 Kg N / fed for (ear length, 100-grain weight and cob weight/ ear in the first season and for grain and total weights / ear in the second season) as well as up to 90 Kg N / fed for (no .of grains / ear and grain and total weights / ear in the first season and for ear diameter and shelling % in the second season). However, the differences between the application of 90 and 120 Kg N/ fed were not significant for the abovementioned ear characters . From these results , it can be concluded that the superiority of grain weight/ ear with increasing nitrogen fertilization may be mainly due to the increase in number of grains/ ear (owing to the increase in ear length and diameter) as well as grain weight. In this concern , many investigators found that increasing N levels up to 90 Kg N / fed caused an increment in ear characters of maize plants , i.e ear length and diameter as well as 100-grain weight (Ibrahim *et al* , 1995 and El-Moursy *et al* , 1998), no. of grains/ ear (Abo El-Zahab and Rady , 1990) and shelling % (El-Moursy *et al* , 1998).

With regard to grain yield/ plant and its attributes, the data show that no. of ears/ plant and the total grain yield / plant and its two components (grain yield of apical and sub apical ears / plant) as well as the grain yield of sub apical ear % were gradually increased as N levels increased from zero up to 120 Kg N/ fed in the two seasons. This increase was significant up to 60 Kg N / fed for (no .of ears / plant and grain yield of sub apical ear % in the first season and grain yield of apical ear in the second season), as well as up to 90 Kg N / fed for (total grain yield / plant in both seasons and its two components, i.e yields of apical and sub apical ears in the first season). However, further increase in nitrogen fertilization levels up to 120 Kg N / fed insignificantly increased the above mentioned characters in both seasons. From these results , it can be suggested that the increase in the grain yield / plant may be due to the increase in the number and weight of grains per ear and / or the number of ears / plant which were encouraged with increasing

Table (2): Effect of nitrogen fertilization on yield and its components of maize during 2008 and 2009 seasons (overall tested varieties)

characters / N Levels Kg N/fed	Ear length (cm)	Ear diameter (cm)	No. of grains / ear	100-grain weight (g)	Weight / ear (g)			Shelling %
					Grain	Cob	Total	
2008 season								
0	14.58 c	4.25 b	419.33 c	24.56 c	100.71 d	27.26 b	127.98 d	78.8 b
30	15.96 b	4.59 a	477.33 b	25.74 bc	120.08 c	29.62 b	149.71 c	80.05 ab
60	16.58 ab	4.64 a	508.66 b	28.28 ab	140.96 b	33.74 a	174.70 b	80.59 ab
90	17.25 ab	4.66 a	571.33 a	28.89 a	152.34 ab	35.02 a	187.36ab	81.22 a
120	17.73 a	4.82 a	610.66 a	27.87 ab	157.07 a	35.14 a	192.21 a	81.70 a
2009 season								
0	14.23 a	4.38 c	297.77 a	25.06 b	73.51 c	26.42 a	99.93 c	73.30 d
30	14.70 a	4.47 bc	307.77 a	27.46 a	82.11 bc	27.75 a	109.86bc	74.5 c
60	15.94 a	4.53 bc	324.22 a	28.32 a	89.68 abc	29.17 a	118.86abc	75.18 b
90	15.27 a	4.75 ab	357.09 a	28.74 a	101.02 ab	30.57 a	131.59 ab	76.5 a
120	16.62 a	5.01 a	370.98 a	29.19 a	107.02 a	32.57 a	139. 60 a	76.5 a

Table (2): cont

characters / N Levels Kg N/fed	No. of ears/ plant	Grain yield / plant (g)				Yield / fed (ton)				
		Apical ear	Sub-apical ear	Total	Sub-apical Ear %	Grain	Cob	Ear	Straw	Biological
2008 season										
0	1.008 c	105.84 d	1.16 b	107.00 d	0.082 b	2.066 c	0.551 c	2.618 c	4.176 d	6.794 d
30	1.034 bc	126.47 c	3.71 b	130.18 c	1.846 b	2.494 b	0.618 bc	3.113 b	4.464 cd	7.577 c
60	1.076 abc	147.96 b	11.84 b	159.80 b	6.409 ab	2.897 a	0.688 ab	3.585 a	4.613 bc	8.198 bc
90	1.100 ab	157.51 ab	14.48 ab	171.99ab	7.416 ab	3.005 a	0.688 ab	3.693 a	4.869 ab	8.562 ab
120	1.140 a	162.79 a	25.95 a	188.74 a	12.740 a	3.180 a	0.704 a	3.885 a	4.980 a	8.865 a
2009 season										
0	1.017 a	75.96 c	1.16 a	77.12 c	1.504 a	1.695 d	0.515 c	2.210 d	3.675 c	5.885 d
30	1.020 a	81.93 bc	2.04 a	83.97 c	2.419 a	1.923 cd	0.602 bc	2.525 cd	4.030 c	6.555 c
60	1.028 a	90.43 abc	2.99 a	93.42 bc	3.198 a	2.171 bc	0.720 b	2.891 bc	4.305 bc	7.196 b
90	1.039 a	100.14 ab	4.26 a	104.40ab	4.080 a	2.350 ab	0.795 ab	3.145 ab	4.600 ab	7.745 a
120	1.060 a	108.70 a	6.47 a	115.17a	5.620 a	2.598 a	0.878 a	3.476 a	4.949 a	8.425 a

nitrogen fertilization levels . Similar results were obtained by Ibrahim (1997) who found that grain yield of apical and sub apical ears and their total / fed as well as the percentage of grain yield from sub apical ears were gradually increased with increasing the amount of N fertilization from 60 to 120 Kg N / fed which produced the highest values.

It is evident from the same table that increasing N fertilization levels caused a significant increase in grains , cobs and ear yields / fed up to 60 Kg N / fed in the first season and up to 90 Kg N / fed in the second season as well as straw and biological yields/ fed up to 90 Kg N/ fed in both seasons. However, further increase in the N fertilizer more than such levels gave insignificant increases in the abovementioned traits in the two seasons. From these results, it can be suggested that the increase in grain yield / fed obtained herein by the application of N fertilization may be attributed to the increase in total weight/ ear and number of ears/ plant and consequently grain yield/ plant as discussed. Similar favorable effects due to nitrogen fertilization were previously reported by many researchers who found that increasing N levels up to 120 Kg N/ fed caused an increase in grain yield/ fed (Ash-Shormillesy, 2005 and Hamada *et al*, 2008), ear yield / fed (Salwau and Shams El-Din, 1992) and straw yield/ fed (Ahmed, 1989 a, and Ashoub *et al*, 1996).

2- Chemical composition

The result in Table (3) show that there was a gradual increase in the N % in each of total plant at 50 % silking and at maturity as well as in straw at maturity with increasing N levels from zero up to the highest level (120 Kg N/ fed). This increase was significant for N % in total plant at 50 % silking in the first season only. However, the differences among the tested N levels did not reach the level of significance for N % and crude protein % in grains as well as N % in straw and total plant at maturity in both seasons. In this concern , El-Moursy *et al* (1998), Said and Gabr (1999), El-Metwally *et al.* (2001) , Darwish (2003) and El-Rewainy and Galal (2004) found that the crude protein % in maize grains was increased with increasing nitrogen fertilization.

3- Nitrogen accumulation and translocation :

Regarding results in Table (4), the data indicated that the application of nitrogen fertilization had significant increase in the amount of N assimilation in total plants at 50 % silking and at maturity as well as in the grains/ plant at maturity in both seasons and in the straw/ plant in the first season only. However, N assimilation in total plant at post flowering (after tasseling emergence) was not significantly affected by any tested N levels in both seasons. These results indicate that N fertilization increased the plant capacity in nutrients absorbtion. Similar results were obtained by Anderson

Table (3): Effect of nitrogen fertilization on chemical composition of maize plant during 2008 and 2009 seasons (overall tested varieties)

Characters / N Levels (Kg N/fed)	N% in total plant at 50% silking	N % at maturity			Crude Protein % in grains
		Grains	straw	total plant	
2008 season					
0	1.343 c	1.475 a	0.761 a	2.236 a	8.48 a
30	1.439 bc	1.497 a	0.784 a	2.281 a	8.60 a
60	1.506 b	1.554 a	0.834 a	2.388 a	8.93 a
90	1.599 ab	1.573 a	0.858 a	2.431 a	9.04 a
120	1.746 a	1.598 a	0.869 a	2.467 a	9.18 a
2009 season					
0	1.444 a	1.390 a	0.725 a	2.115 a	7.99 a
30	1.470 a	1.514 a	0.752 a	2.266 a	8.70 a
60	1.484 a	1.540 a	0.785 a	2.325 a	8.85 a
90	1.544 a	1.580 a	0.846 a	2.430 a	9.08 a
120	1.666 a	1.584 a	0.894 a	2.474 a	9.10 a

Table (4): Effect of nitrogen fertilization on nitrogen accumulation (assimilation) and translocation indeces during 2008 and 2009 seasons (overall tested varieties)

Characters / N Levels (Kg N/fed)	N assimilation (g N / plant)					N translocation indeces		
	in total plant at 50% silking	in grains/ plant at maturity	in straw/ plant at maturity	in total plant at maturity	in total plant at Post flowering	N Harvest index	N retranslocation (g N / plant)	N retranslocation efficiency %
2008 season								
0	2.465 d	1.584 c	1.360 c	2.945 c	0.478 a	0.538 b	1.105 c	44.82 a
30	2.897 cd	1.976 bc	1.572 bc	3.549 bc	0.652 a	0.557ab	1.324 bc	45.70 a
60	3.380 bc	2.496 ab	1.767 ab	4.263 ab	0.883 a	0.586ab	1.616 bc	47.81 a
90	3.756 ab	2.760 a	1.916 ab	4.677 a	0.920 a	0.591ab	1.839 ab	48.96 a
120	4.208 a	3.027 a	1.970 a	4.999 a	0.789 a	0.606 a	2.237 a	53.16 a
2009 season								
0	1.583 b	1.043 d	1.177 a	2.220 d	0.636 a	0.469 a	0.406 b	25.64 a
30	1.845 ab	1.243 cd	1.330 a	2.573 cd	0.728 a	0.483 a	0.515 ab	27.91 a
60	2.035 ab	1.466 bc	1.455 a	2.921 bc	0.886 a	0.501 a	0.580 a	28.50 a
90	2.158 ab	1.673 ab	1.720 a	3.394 ab	1.236 a	0.492 a	0.438 ab	20.29 a
120	2.351 a	1.805 a	1.868 a	3.673 a	1.322 a	0.491 a	0.483 ab	20.54 a

et al (1984) who found that increasing N rates caused a significant increase in N content in grain and stalk of some semiprolific maize genotypes. Moreover, Ibrahim (1997) found that increasing N rate up to 120 Kg N /fed exerted a significant increase in the N accumulated at 50% silking and at maturity as well as N uptake in grains / maize plant , while post flowering N uptake were not affected by raising nitrogen fertilization

The data in the same table indicate also that the application of N fertilizer generally increased the three tested translocation indeces (harvest index, crop index and migration coefficient). This increase was significant for N retranslocation up to 90 Kg N / fed and 60 Kg N / fed in the first and second season , respectively and up to 30 Kg N / fed for harvest index in the first season . However , the differences among the five tested nitrogen fertilizer levels did not reach the level of significance for N retranslocation efficiency % in both seasons and for N harvest index in the second season only. This means that the N retranslocation rate from different vegetative parts of plant to the grain were generally increased with increasing nitrogen application and consequently the N retranslocation efficiency percentage was improved . Similar results were obtained by Ibrahim (1997).

B- Varietal differences :

1- Yield and its components :

The data in Table (5) showed that there are significant differences among the five tested maize varieties (S.C 122, S.C 30 K 8, T.W.C Nefertiti, Composit 1 and Giza 2) in ear characters studied in both seasons The highest values of ear characters were obtained by Nefertiti (for ear length), S.C 30 K 8 variety (for grain weight/ ear and shelling %) and Composit 1 (for ear diameter and 100 grain weight) in both seasons. However , it can be noticed that some maize varieties were superior in the no . of grains/ ear (S.C 122 and 30 K 8) , cob weight (composit 1 and 30 K 8) and total weight/ ear (Nefertiti and 30 k 8) compared to the other tested varieties in the first and second season, respectively . From these results , it can be concluded that the superiority of S.C 30 K 8 and T.W.C Nefertiti in their grain weight and total weight/ ear during the first and/ or second seasons may be generally due to their tendency to produce more number of grains/ ear, shelling % and ear length . In this concern , many researchers reported that maize single cross hybrids surpassed the other varieties in ear length and seed index (El-Aref *et al* , 2004 and Mansour and Abdel-Maksoud , 2009), total ear weight (Abdel-Aal *et al* , 1997) and no. of grains/ ear (Mowafy, 2003 and Oraby *et al*, 2005). However , other investigators reported the superiority of three way cross hybrids in each of ear length and 100-grain weight (El-Zeir *et al*, 1998 and El-Danasoury, 2009), ear diameter (Mowafy, 2003 and Mohamed, 2004), shelling % (Mansour and Abdel-Maksoud, 2009) and no. of grains/ ear (Abdel-Maksoud and Sarhan, 2008).

Table (5): Mean performance of yield and its components of the tested maize varieties during 2008 and 2009 seasons (overall nitrogen levels)

characters / Varieties	Ear length (cm)	Ear diameter (cm)	No. of grains / ear	100-grain weight (g)	Weight / ear (g)			Shelling %
					Grain	Cob	Total	
2008 season								
S.C. 122	16.06 bc	4.15 b	612.66 a	23.16 c	134.57 ab	29.50 c	164.09 a	81.92 b
S.C. 30 K 8	16.37 b	4.68 a	564.00 a	26.38 b	144.73 a	29.89 bc	174.63 a	82.72 a
T.W.C Nefertiti	18.12 a	4.60 a	561.33 a	26.45 b	145.26 a	34.56 b	179.82 a	81.21 c
Composit 1	16.49 b	4.79 a	442.00 b	30.51 a	130.65 b	36.98 a	167.64 a	77.86 e
Giza 2	15.06 c	4.73 a	407.33 b	28.85 ab	115.94 c	31.18 bc	147.12 b	77.66 d
2009 season								
S.C. 122	14.98 ab	4.22 b	363.42 a	24.68 d	88.98 bc	25.82 b	114.8 bc	77.43 b
S.C. 30 K 8	15.85ab	4.73 a	418.67 a	27.88 bc	115.67 a	33.45 a	149.13 a	77.38 a
T.W.C Nefertiti	16.68 a	4.66 a	354.79 a	27.14 c	95.32 b	30.07 ab	125.4 ab	75.88 c
Composit 1	14.68 b	4.78 a	280.45 b	29.85 a	81.68 bc	29.91 ab	111.6 bc	72.92 e
Giza 2	14.58 b	4.75 a	240.51 b	29.22 ab	71.70 c	27.21 b	98.91 c	72.36 d

Table (5) : cont

characters / Varieties	No. of ears / plant	Grain yield / plant(g)				Yield / fed(Ton)				
		Apical ear	Sub-apical ear	Total	Sub-apical ear %	Grain	Cob	Ear	Straw	Biological
2008 season										
S.C. 122	1.054 bc	134.07 bc	10.25 bc	144.32 bc	6.104 bc	2.707 ab	0.590 b	3.297 ab	4.310 cd	7.607 c
S.C. 30 K 8	1.118 ab	151.100 ab	15.97 ab	167.07 ab	8.558 ab	2.811 a	0.675 a	3.486 ab	4.932 b	8.418 b
T.W.C Nefertiti	1.153 a	158.96 a	28.26 a	187.22 a	14.094 a	2.970 a	0.673 a	3.643 a	5.529 a	9.172 a
Composit 1	1.035 c	131.67 c	1.56 c	133.23 c	0.170 c	2.691 ab	0.655 a	3.346 ab	4.551 bc	7.897 bc
Giza 2	1.003 c	124.78 c	1.09 c	125.87 c	0.862 c	2.463 b	0.656 a	3.119 b	3.779 d	6.898 d
2009 season										
S.C. 122	1.016 b	86.71 b	1.33 b	88.04 b	1.506 b	2.016 b	0.591 c	2.607 b	4.389 a	6.996 b
S.C. 30 K 8	1.056 a	115.37 a	6.74 a	122.11 a	5.520 a	2.702 a	0.818 a	3.520 a	4.737 a	8.257 a
T.W.C Nefertiti	1.071 a	91.42 ab	7.21 a	98.63 ab	7.312 a	2.431 a	0.782 ab	3.213 a	4.609 a	7.822 a
Composit 1	1.013 b	81.82 b	1.31 b	83.13 b	1.575 b	1.856 b	0.658 bc	2.514 b	3.902 a	6.416 bc
Giza 2	1.006 b	81.80 b	0.33 b	82.13 b	0.401 b	1.732 b	0.591 c	2.323 b	3.924 a	6.247 c

Concerning grain yield/ plant and its components , the data show that T.W.C Nefertiti and S.C. 30 K 8 recorded the highest significant values for number of ears/ plant as well as total grain yield/ plant and its components (apical and sub apical ears) and the percentage of grain yield of sub apical ear. In this respect, many investigators found high variation among some maize varieties in favor of single cross varieties in their no .of ears and grain yield/ plant as reported by Abdel-Aal *et al*, (1997), Khalil *et al* (1999) and Soliman *et al*, (1999). However, Abdel-Maksoud and Sarhan *et al*, (2008) found that three way hybrid (T.W.C 310) variety was superior to the single cross hybrids (S.C 10 and 122) varieties in the grain yield / plant and its main components (no .of grains / ear and 100-grain weight).

It is clear from the obtained data in Table (5) that the five tested maize varieties differed significantly in their grain, cob, ear, biological yields/ fed in both seasons and straw yield/ fed in the first season. Moreover, it could be noticed that the two maize varieties (S.C 30 k 8 and T.W.C Nefertiti) varieties scored the highest values of the all mentioned traits as compared with the other three maize varieties, i.e S.C 122, composit 1 and Giza 2 generally in a descending order . The superiority of S.C 30 k 8 and T.W.C Nefertiti in grain yield/ fed is to be expected because they had the highest values of ear characters and grain yield/ plant and its components compared to the other three tested maize varieties in both seasons. In this respect , some researchers found high variation among some maize varieties in favor of single cross hybrid varieties for grain yield/ fed (El-Danasoury, 2009 and Mansour and Abdel-Maksoud et al , 2009) as well as straw and biological yields/ fed (Ahmed , 1989 b). However , Abdel-Maksoud and Sarhan, (2008) found that T.W.C 310 surpassed S.C 10 and S.C 122 in grain and biological yields / fed.

2- Chemical composition:

The data in Table (6) show that the five tested maize varieties varied significantly, as far as, in their chemical composition , i.e N % in the total plant at 50 % silking (in both seasons) and N % in straw and total plant at maturity (in the first season). However, no significant differences could be detected among the tested maize varieties in each of N % and crude protein % in the grains in both seasons. Moreover, it can be noticed that the single cross varieties (S.C. 122 and S.C 30 k 8) surpassed the other tested varieties in N % in total plant at 50 % silking and straw at maturity in both seasons. However, three way cross variety (T.W.C Nefertiti) had the values of nitrogen and crude protein percentages in grains higher than that of the other tested varieties in both seasons. Moreover, it is clear that the two tested single cross varieties (S.C. 122 and S.C 30 k 8) as well as three way cross (T.W.C Nefertiti) contained more nitrogen percentage in their total plants than that in the other tested varieties , i.e synthetic variety (composit 1) and open pollinated variety (Giza 2) which came in the least rank in this

Table (6) : Mean performance of chemical composition of the tested maize varieties during 2008 and 2009 seasons (overall nitrogen levels)

Characters / Varieties	N% in total plant at 50% silking	N % at maturity			Crude Protein % in grains
		grains	straw	total plant	
2008 season					
S.C. 122	1.599 a	1.623 a	0.889 a	2.512 a	9.33 a
S.C. 30 K 8	1.606 a	1.484 a	0.867 a	2.351 ab	8.53 a
T.W.C Nefertiti	1.462 b	1.644 a	0.757 b	2.401 ab	9.45 a
Composit 1	1.480 b	1.479 a	0.791 b	2.270 b	8.50 a
Giza 2	1.488 b	1.468 a	0.801 b	2.269 b	8.44 a
2009 season					
S.C. 122	1.490 b	1.510 a	0.830 a	2.340 a	8.68 a
S.C. 30 K 8	1.703 a	1.503 a	0.848 a	2.351 a	8.64 a
T.W.C Nefertiti	1.455 b	1.650 a	0.768 a	2.418 a	9.48 a
Composit 1	1.473 b	1.491 a	0.770 a	2.261 a	8.57 a
Giza 2	1.486 b	1.456 a	0.784 a	2.240 a	8.37 a

respect. From these results, it can be concluded that the tested hybrid varieties in this study had high ability to transport enough absorbed nitrogen to grains and total plant more than that of the open pollinated varieties. In this concern, Said and Gabr (1999) reported that single cross hybrid 129 markedly surpassed open pollinated variety (Giza 2) in grain protein percentage . However , Mowafy (2003) reported that there was no significant differences between single cross hybrids (S.C 10 , 123 , 124 and 129) and three way cross hybrid (T.W.C 310) in crude protein % in their grains .

3- Nitrogen accumulation and translocation :

The data in Table (7) show significant differences among the five tested maize varieties for N assimilation in each of total plant at 50 % silking and at maturity as well as grains and straw / plant at maturity in both seasons . However , the five maize varieties did not vary significantly in their N assimilation in total plant at post flowering in the two seasons. Moreover, it can be noticed that the highest significant values of N assimilation in total plant at 50 % silking and at maturity as well as N assimilation in grains and straw/ plant at maturity were obtained by growing T.W.C Nefertiti variety in the first season and S.C 30 k 8 variety in the second season compared to the other varieties in the two seasons . This means generally that the crosses varieties either single or three way had higher capacity of N accumulated and assimilated in their plants than that either synthetic or open pollinated varieties. Similar results were obtained by Ibrahim (1997) who found that prolific single cross varieties surpassed the open pollinated varieties (Giza 2 and Cairo 1) for N uptake in each of grains / plant and total plant at 50 % silking and at maturity .

The data in the same Table show significant variation among the five tested maize varieties in N translocation indeces, i.e N harvest index in the first season and N retranslocation / plant and its efficiency percentage in the two seasons. Moreover, the data show that T.W.C Nefertiti in the first season and S.C 30 k 8 in the second one had the highest values of the three above mentioned N translocation indeces. The values of translocation efficiency indicated that about 40.28 % and 40.68 % of N assimilated in the plants were translocated to the grains for T.W.C Nefertiti and S.C 30 K 8 varieties, respectively as an average of the two seasons . The superiority of T.W.C Nefertiti and S.C 30 k 8 in their N retranslocation efficiency may be due to the increase in their ear sink size as shown previously in Table (5) and N assimilation in their plant organs as shown in Table (7). Similar results were obtained by Ibrahim (1997).

Table (7) : Mean performance of nitrogen accumulation (assimilation) and translocation indeces of the tested maize varieties during 2008 and 2009 seasons (overall nitrogen levels)

Characters / Varieties	N assimilation (g N / plant)					N retranslocation indeces		
	in total plant at 50% silking	in grains / plant at maturity	in straw / plant at maturity	in total plant at maturity	in total plant at Post flowering	N harvest index	N retranslocation (g N / plant)	N retranslocation efficiency %
2008 season								
S.C. 122	3.116 b	2.355 bc	1.728 a	4.083 b	0.967 a	0.575 ab	1.388 bc	44.34 b
S.C. 30 K 8	3.767 a	2.482 b	1.858 a	4.341 b	0.572 a	0.570 ab	1.909 ab	50.44 a
T.W.C Nefertiti	3.943 a	3.120 a	1.873 a	4.994 a	1.049 a	0.623 a	2.070 a	52.26 a
Composit 1	3.008 b	1.996 bc	1.744 a	3.741 bc	0.732 a	0.532 b	1.266 c	41.89 b
Giza 2	2.873 b	1.890 c	1.384 b	3.274 c	0.401 a	0.576 ab	1.488 bc	51.56 a
2009 season								
S.C. 122	1.739 b	1.320 bc	1.583 a	2.904 bc	1.165 a	0.455 a	0.202 b	11.40 b
S.C. 30 K 8	2.464 a	1.880 a	1.736 a	3.616 a	1.151 a	0.520 a	0.728 a	30.93 a
T.W.C Nefertiti	2.208 a	1.625 ab	1.611 a	3.237 ab	1.028 a	0.503 a	0.597 a	28.30 a
Composit 1	1.774 b	1.234 c	1.313 b	2.547 cd	0.772 a	0.485 a	0.461 ab	27.20 a
Giza 2	1.785 b	1.170 c	1.307 b	2.477 d	0.712 a	0.473 a	0.432 ab	25.04 a

C – Interaction :

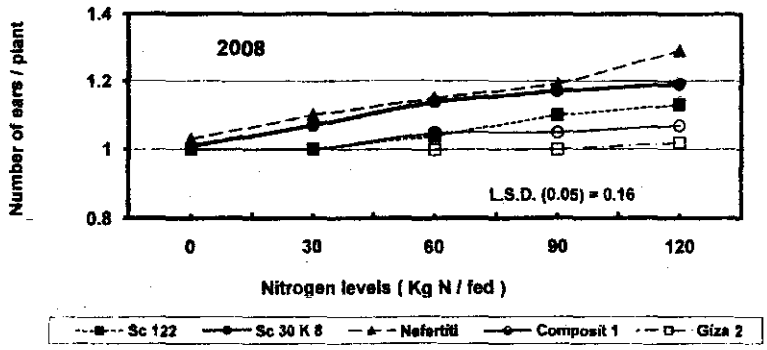
The interaction between nitrogen levels and tested maize genotypes was found to be significant for no. of ears/plant (Fig 1,a), grain yield/ fed (Fig 1,b) and N retranslocation (Fig 1,c) in the first season. This means that the tested maize varieties differed in their responses to nitrogen fertilization levels for those traits. However, the most rest characters were not significantly affected by the interaction between the two tested factors in the first and / or second season , therefore their data were excluded.

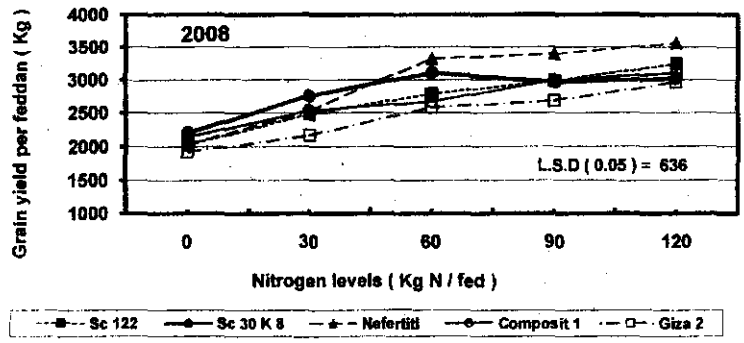
The interaction effect between maize varieties and nitrogen fertilization levels on the number of ears/ plant in the first season illustrated in Fig (1,a) show that the maximum of the number of ears/ plant (1.29) was obtained by growing Nefertiti variety and fertilized with 120 Kg N / fed .

Grain yield / fed as affected by the interaction between nitrogen fertilization and maize varieties in the first season are shown in Fig (1,b). The data show that the tested varieties responded differently in their ranking from nitrogen level to another. The maximum grain yield/ fed (3561 Kg grains/ fed) was obtained by the application of 120 Kg N / fed to Nefertiti variety, while the lowest values (1925 Kg grains/ fed) was obtained by growing Giza 2 variety under Zero N level. In this respect, many investigators found that grain yield of maize genotypes responded differently and significantly to nitrogen fertilizer levels as reported by El-Aref *et al* , (2004), Mohamed, (2004) and Mansour and Abdel-Maksoud, (2009).

The data illustrated in Fig (1,c) show that N retranslocation/ plant was significantly increased by increasing N fertilization levels up to 90 Kg N/fed for each of S.C 122, Nefertiti , Composit 1 and Giza 2 varieties and up to 120 Kg N/fed for S.C 30 k 8 variety. This means that the tested maize varieties were responded differently to various tested N levels experienced herein. The highest value of N retranslocation (3.813 g N/plant) was obtained by growing S.C 30 K 8 variety and was fertilized with 120 Kg N / fed as compared with the other tested treatments.

From the abovementioned results, it could be suggested generally that the single and three way cross hybrids had higher potentiality than open pollinated and / or synthetic varieties in their productivity and N retranslocation from different plant parts to grains especially at high nitrogen fertilization levels.





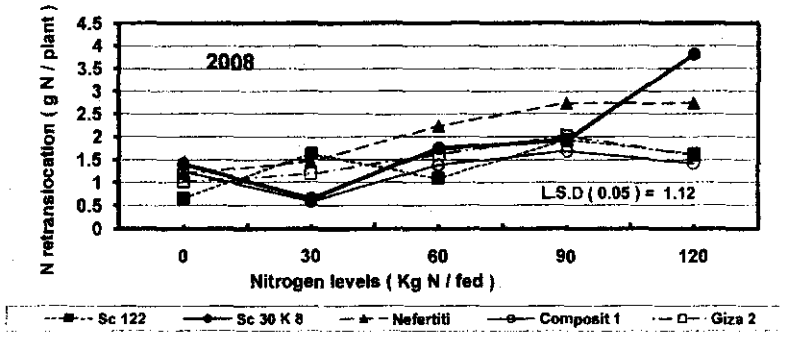


Fig (1 a,b,c) : Effect of the interaction between nitrogen fertilization levels and maize varieties on (a) no. of ears/ plant, (b) grain yield / fed and (c) N retranslocation / plant during 2008 season.

REFERENCES

A.A.C.C. (1983). American association of cereal chemists . Cereal laboratory methods . St. Paul ., Minnesota , U.S.A

Abdel-Aal , S.M, M.E. Ibrahim, A.A. Ali and Kh. SH. Sarhan (1997). Studies on some maize varieties sown at different plant distribution systems. II . Flowering , grain filling and yield and its components . Minufiya . J. Agric. Res . 22 (3): 755-780

Abdel – Maksoud , M.F. and A.A. Sarhan (2008). Response of some maize hybrids to bio and chemical nitrogen fertilization . Zagazig J. Agric . Res 35 (3): 497-515

Abo El– Zahab, A. and M.A. Rady (1990). Relationship of development , growing degree days and yield in maize . Assiut Journal of Agricultural Sciences . 21 (5) : 251-273

Ahmed, M.A. (1989 a). Effect of nitrogen fertilizer levels and time of nitrogen application on yield and its components of some white and yellow maize cultivars grown in Egypt . Egypt . J. Agron. 14 (1-2):187-200

Ahmed, M.A (1989 b). Effect of nitrogen applied at sowing on yield and its components of some white and yellow maize cultivars grown in Egypt . Egypt . J. Agron. 14 (1-2):201-213

Anderson, E.L., E.J. Kamprath, R.H. Moll and W.A. Jackson (1984). Effect of N fertilization on silk synchrony , ear number and growth of semi prolific maize genotypes . Crop Sci . 24 : 643-666

Ashoub, M.A., M.S. Hassaneln, I.M.A. Abdel – Aziz, M.M. Shahin and M.N. Gohar (1996). Influence of irrigation , nitrogen , zinc and manganese fertilization on yield and yield components of maize . Annals agric . Sci ., Ain Shams Univ., Cairo 41 (2) : 697-711

Ash-shormillesy, Salwa, M.A.I. (2005). Effect of splitting different nitrogen fertilizer levels on productivity of maize . Zagazig J. Agric . Res 32 (1):1-21

Bulman, P. and D.L. Smith (1993). Accumulation and redistribution of dry matter and nitrogen by spring barley . Agron . J . 85 : 1114 – 1121

Darwish, A.A. (2003). The yield and yield components of maize as influenced by nitrogen, zinc and boron fertilization. J. Agric . Sci . Mansoura Univ ., 28 (2) : 799-810

Duncan , D.B. (1955). Multiple range and multiply F. test . Biometrics , 11:1-42

El-Aref, Kh.A.O., A.S. Abo El-Hamed and A.M. Abo El-Wafa (2004). Response of some maize hybrids to nitrogen and potassium fertilization levels . J. Agric . Sci . Mansoura Univ ., 29 (11) : 6063-6070

El-Danasoury, M.A.M. (2009). Studies on some factors affecting the productivity of maize in new soil , Ph.D . Thesis , Fac. of Agric . Al-Azhar Univ , Egypt .

El-Metwally, I.M., S.A. Ahmed and Samia A. Saad El-Din (2001). Nitrogen fertilizer levels and some weed control treatments effects on maize and its associated weeds. J. Agric . Sci . Mansoura Univ ., 26 (2) : 585-601

El-Moursy, S.A., A.A. Kandil, A.N. Attia and M.M. Abd El-Naby (1998). Evaluation of some foliar and soil fertilizers on growth and yield of corn. J. Agric. Sci. Mansoura Univ ., 23 (2) : 711-721

El-Rewainy, Hamdia . M. and Anaam H. Galal (2004). Effect of inoculation with Azospirillium brasilense or Bacillus megatherium on maize yield and its attributes under nitrogen or phosphorus fertilization levels . Assiut Journal of Agricultural Sciences . 35 (1) : 145-163

El-Zeir, F.A., A.A. El-Shenawy, E.A. Amer and A.A. Galal (1998). Influence of narrow row spacing (high plant density) and nitrogen fertilization on two maize hybrids . J. Agric . Sci . Mansoura Univ ., 23 (5) : 1855-1864

Hamada, Maha M., A.M. Abo-Shetaia and K.A. El- Shouny (2008). Effect of planting dates and N application rates on maize yield in relation to changing plant distribution. Annals Agric. Sci., Ain Shams Univ., Cairo 53 (1): 139-144.

Ibrahim , M.E. (1997). Effect of nitrogen fertilization on dry matter , nitrogen accumulation and yield of corn genotypes differed in prolificacy . Annals of Agric . Sc . Moshtohor 35 (1) : 25-47

Ibrahim, M.E., S.E. Ismail and A.A. Nawar (1995). Varietal response to nitrogen level and planting date and determination of the dependence structure in yellow maize yield by using factor analysis . Zagazig J. Agric . Res 22 (2): 329-347

Khalil, A.N.M., Sh. A. El-Shamarka, M.E. Ibrahim and E.A. El-Absawy (1999). Effect of plant densities on grain yield of sixteen maize genotypes differed in their leaves angle . Minufiya . J. Agric. Res 24 (1): 85-106

Mansour, A.A. and M.F. Abd El-Maksoud (2009). Response of some maize hybrids to nitrogen fertilizer levels under cultivated sandy soils . J. Agric . Sci . Mansoura Univ ., 34 (4) : 3335-3347

Mohamed, N.A. (2004). Principal component and response curve analysis of some maize hybrids to different nitrogen fertilization levels and plant density. Bull. Fac. Agric, Cairo univ 55 : 531 – 556

Mowafy, S.A.E. (2003). Response of some maize hybrids to nitrogen fertilizer splitting under drip irrigation system in sandy soils . Zagazig J. Agric . Res 30 (1): 17-34

Oraby, F.T., A.E.A. Omar, M.F. Abd El-Maksoud and A.A. Sarhan (2005). Proper agronomic practices required to maximize productivity of some maize varieties in old and reclaimed soils : VII- Effect of soil moisture stress on the productivity of some maize hybrids under newly reclaimed sandy soil conditions . J. Agric . Sci . Mansoura Univ ., 30 (4) : 1839-1850

Pellett, L.P. and V.R. Young (1980). Nutritional evaluation of protein foods . The united nations university, Japan , P.8 .

Said , El. M. and E.M.A. Gabr (1999). Response of some maize varieties to nitrogen fertilization and planting density . J. Agric . Sci . Mansoura Univ ., 24 (4) : 1665-1675

Salwau, M.I.M. and G.M. Shams El-Din (1992). Effect of nitrogen fertilization and defoliation on the yield and yield components of maize , Proc. 5th Conf. Agron .Zagazig Univ 13-15 Sept . Vol . 1 : 241-252

Snedecor. G.W. and W.G. Cochran (1967). Statistical methods 5 th Ed . Iowa state univ ., Press , Iowa , U.S.A

Soliman, F.H., G.A. Morshed, M.M.A. Ragheb and M.Kh. Osman (1999). Correlations and path coefficient analysis in four yellow maize hybrids grown under different levels of plant population densities and nitrogen fertilization, Bull . Fac. Agric, Cairo Univ ., 50 : 639 – 658.

تأثير معدلات التسميد الازوتي علي إنتاجية وتكوين وانتقال النتروجين المتراكم لبعض أصناف الذرة الشامية

محمود الدسوقي ابراهيم – شعبان أحمد الشمارقة – ناجد عبد العظيم جعفر
محمد سيد محمود عبد العال
قسم المحاصيل – كلية الزراعة – جامعة المنوفية

الملخص العربي

أجريت تجربتان حقليتان بمزرعة كلية الزراعة جامعة المنوفية بشبين الكوم خلال موسمي الزراعة ٢٠٠٨ , ٢٠٠٩ بهدف دراسة تأثير التسميد الازوتي (صفر و ٣٠ و ٦٠ و ٩٠ و ١٢٠ كجم ن / فدان) علي صفات كل من المحصول ومكوناته والتحليل الكيميائي والنتروجين المتراكم والمنتقل من أجزاء النبات للحبوب وذلك لبعض التراكيب الوراثية من الذرة الشامية ذات الحبوب البيضاء المتباينة في عدد الكيزان (هجين فردى ١٢٢ وهجين فردى ٣٠ ك ٨ و هجين ثلاثي نفرتيتي و صنف تركيبي ١ و صنف مفتوح التلقيح جيزة ٢) , وقد اشتملت التجربة في كل موسم علي ٢٥ معاملة هي عبارة عن التوافيق بين معاملات التسميد الازوتي والاصناف واستخدم تصميم القطع المنشقة في تنفيذ التجربة

ويمكن ايجاز أهم النتائج المتحصل عليها علي النحو التالي :

١- أدى زيادة التسميد الازوتي بصفة عامة الي زيادة معنوية في كل من قطر الكوز و نسبة التفريط ودليل حصاد النتروجين في الموسم الاول ووزن ١٠٠ حبة ومحتوى النبات من النتروجين عند ٥٠ % تزهير ومعدل النتروجين المنتقل من اجزاء النبات الخضرية الي الحبوب في الموسم الثاني (حتي ٣٠ كجم ن/فدان) وكذلك صفات طول الكوز و وزن ١٠٠ حبة ووزن القولحة / كوز و عدد الكيزان / نبات والنسبة المئوية لمحصول الكيزان السفلية و محصول الفدان لكل من الحبوب والقولحة والكوز و محتوى النبات من النتروجين في الحبوب والقش والنبات الكلي عند النضج في الموسم الاول ووزن الحبوب/ كوز ووزن الكوز الكلي ومحصول الحبوب من الكيزان العلوية / نبات في الموسم الثاني

(حتي ٦٠ كجم ن / فدان) . هذا بالاضافة الي صفات نسبة النتروجين في النبات الكلي عند ٥٠ % تزهير و عدد الحبوب / كوز ووزن الحبوب/كوز ووزن الكوز الكلي ومحصول الحبوب من الكيزان العلوية والسفلية ومحتوى النبات من النتروجين عند ٥٠% تزهير ومعدل النتروجين المنتقل من اجزاء النبات الخضرية الي الحبوب في الموسم الاول وقطر الكوز ونسبة التفريط ومحصول الفدان لكل من الحبوب والقولحة والكوز والقش والبيولوجي ومحتوى النبات من النتروجين في الحبوب والنبات الكلي عند النضج في الموسم الثاني وكذلك محصول النبات الكلي من الحبوب في كلا الموسمين (حتي ٩٠ كجم ن/فدان). هذا في حين لم تكن هناك اختلافات معنوية بين مستويي التسميد الازوتي ٩٠ و ١٢٠ كجم ن/فدان علي كل الصفات المدروسة

٢- تشير النتائج الي تفوق الهجين الفردى ٣٠ ك ٨ والهجين الثلاثي نفرتيتي علي باقي الاصناف المختبرة الاخرى بصفة عامة في صفات وزن الحبوب / كوز ووزن الكوز الكلي و عدد الكيزان / نبات ومحصول الحبوب من الكيزان العلوية والسفلية ومحصول النبات الكلي من الحبوب والنسبة المئوية لمحصول الكيزان السفلية ومحصول الفدان لكل من الحبوب والقولحة والكوز والقش والبيولوجي , ومحتوى النبات من النتروجين في الحبوب والقش والنبات الكلي عند النضج ودليل حصاد النتروجين ومعدل وكفاءة النتروجين المنتقل من اجزاء النبات الخضرية الي الحبوب

٣- يمكن التوصية بزراعة الهجين الفردي ٣٠ ك ٨ أو الهجين الثلاثي نفرتيتي وتسميدهما بمعدل ٩٠ أو ١٢٠ كجم للحصول علي أعلي إنتاجية من محصول الذرة الشامية تحت ظروف محافظة المنوفية وذلك من خلال زيادة الكمية المتراكمة من المادة الجافة والنتروجين المنتقل داخل النبات وعدد الكيزان علي النبات ومحصول الحبوب للفدان