EFFECT OF THE PROPER TIME OF NITROGEN APPLICATION ON GROWTH, YIELD AND ITS COMPONENTS OF MAIZE PLANTS

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ABSTRACT

Two field experiments were carried out during two successive summer seasons 2001 and 2002 at the experimental Farm, Faculty of Agriculture, Kafr EL Sheikh, Tanta University to find out the proper time to application the recommended dose of nitrogen fertilization [120 kg N/fed] and its effects on growth, yield and its components of maize plants of cultivar [Twe321]

1- Application of nitrogen fertilizer in two equal doses [½ at sowing date plus ½ at the first irrigation] gave the best results on dry weight of tassel at age of 80 day in the second season and at age 95 day in the first season, plant height, dry weight of leaves and leaf area/plant at age of 65 day and number of leaves at age of 95 day in the second season and stem diameter at age of 95 day in the first season.
2- Splitting the nitrogen into two equal doses [½ at the first and the second irrigations] significantly increased each of dry weight of stem, number of leaves, stem diameter, total weight of the plant at age of 65 day and dry weight of leaves, leaf area/plant at age of 95 day in the second season
3- Splitting the nitrogen into three portions, $^1/_3$ at sowing date, $^1/_3$ at first irrigation and $^1/_3$ at second irrigation caused a significant increase in dry weight of tassel at age of 65 day, total dry weight of plant at age of 80 day, dry weight of ears at age of 95 days in the first season and on number of leaves/plant at age 65 day, dry weight of ears at age of 80 day and plant height, total chlorophyll in leaves, stem diameter, grain yield/fed in ardab and number of leaves/plant at age of 95 day in the second season.
4- Dividing the nitrogen into three portions, ¼ at sowing date, ½ at first irrigation and ¼ at second irrigation resulted in a significant increase on dry weight of tassel at age of 65 day, dry weight of stem and ears, number of leaves at age of 95 day in the first season. Also, on dry weight of ears and leaf area/plant at age of 65 day, number of leaves, dry weight of stem, leaves, tassel and total plant at age of 80 day and on dry weight of leaves, plant height,

number of leaves at age of 95 day in the second season and on straw yield/fed and ear length in both seasons.

5- Applied nitrogen onto three portions, ½ at sowing date, ¼ at the first irrigation and ¼ at the second irrigation gave the best results in dry weight of tassel at age of 65 and 95 days,dry weight of stem, total plant at age of 80 day and on leaf area/plant at age of 95 day in the first season and on stem diameter, plant height, number of leaves and leaf area at age of 65 day and on dry weight of stem, plant total at age of 80 day and on leaf area/plant, plant height at age of 95 day and on grain yield/fed in ardab in the second season.

6- Nitogen applied in three portions ¼ at sowing date and first irrigation and ½ at second irrigation gave the best results in dry weight of tassel at age of 65 day and on dry weight of ears, whole plant at age of 80 day and grain yield/fed in tons and in gm per plant in the first season and on plant height, leaf area/plant, stem diameter at age of 65 day and on total plant at age of 80 day and on dry weight of ears, plant height, number of leaves at age of 95 day in the second season and on ear length, straw yield/fed in tons and grain yield/fed in ardab in both seasons.

INTRODUCTION

Maize [Zea mays l.] is considered one of the most important cereal crops in terms of total production and cultivated area. The local production of the crop is not sufficient to meet the continuous increase in population. Therefore, any attempt to raise maize production is considered at matter of utmost importance. Such attempts could be achieved through horizontal and vertical expansion. With respect to time of nitrogen application, Praphakaran and Singh 1974, reported that splitting the nitrogen to one third and two third combination at planting, respectively gave the highest yield Khalil 1978 and Haque 1979 found that applying nitrogen as double dress [in two equal doses before first and second irrigation] gave maximum leaf area/plant, plant height and grain yield. Gomaa 1985 indicated that splitting nitrogen fertilizer into three equal splits at the first, second and third irrigations gave the highest grain yield, while the maximum stover yield produced was due to splitting nitrogen fertilizer into two equal doses at the first and second irrigation. This investigation aimed to find out the proper time of nitrogen application on growth, grain yield and its components of maize

MATERIAL AND METHODS

Two experiments were carried out at farm of the Faculty of Agriculture at Kafr EL Sheikh during 2001 and 2002 seasons. The soil is clay in texture contained 1.66 and 1.50 organic matter, 0.49 and 0.54 ppm available N, 14.5 and 13.8 available P_2O_5 and 420 and 452 ppm available K and had pH of 8.1 and 8.2 in the two seasons, respectively. The preceding crop was wheat in the two seasons. Every experiment included six treatments which were; 1- ½ of the recommended dose of N at sowing date and ½ at the first irrigation. 2- ½ at first and the other half at the second irrigation. 3- $^1/_3$ at sowing date, 1/3 and the later $^1/_3$ at the first or second irrigation. 4- ¼ at sowing date, ½ at first irrigation and ¼ at second irrigation. 5- ½ at sowing date and ¼ at first and ¼ at second irrigation. 6- ¼ at sowing date and1/4 at first irrigation and ½ at second irrigation in four replicates. The randomized complete blocks design was used, each treatment consisted of six ridges [5m long times 70 cm apart and the area of each treatment 21 meter square. Grains of cultivar three ways cross 321 were planted in June 6 and 11th in the two seasons, respectively. Under traditional cultural practices. Phosphorus in form of calcium super phosphate [15.5 P_2O_5] was added through preparation of the soil. Growth analyses were determined on five guarded plants from each treatment. Three samples were taken at 65, 80 and 95 days from planting in both seasons. Total plant dry weight (DM) gm and its organs [stem, leaves, ears and tassel], leaf area LA (dm) square, plant height (cm), leaf number per plant, total chlorophyll in leaves was determined according to the method recommended

by , stem diameter in cm, number of days to 50 percent silking. Plants were harvested and three inner ridges with ten guarded plants were taken random and grain yield was determined on the basis of 15.5 percent moisture. Also, ear height (cm), ear length (cm), ear diameter (cm), number of rows/ear, number of kernels/row, number of kernels/ear, 100 kernels weight (gm), shelling percentage, grain yield/plant (gm), grain yield/fed (ardab), grain yield/fed (ton), straw yield/fed (ton) were obtained. Protein percentage was determined according to the improved Kheldahl methods of association official Agriculture chemicts [A. O.A.C, 1970]. Crude protein percentage was calculated by multiplying the total nitrogen for each sample by 6.25.

All the data were subjected to the stander analysis of variance procedure according to Snedecor and Cochran, 1967 and Duncans, 1955. Also, percentage data were transformed to Arcsine before

statistical analysis and the means were presented before transformed in scale.

RESULTS AND DISCUSSION

A- Agronomic characteristics:

Data in Table (1), indicated clearly that splitting nitrogen fertilization into three portions by different methods as mentioned in M & M caused a tallest plants as compared with other treatments at age of 65 days, adding the nitrogen doses into two equal portions, ½ at sowing date and at first irrigation resulted in a highly significant effect and gave the tallest plants as compared with other treatments at age of 65 days in the first season, while in the second seasons at age of 65 days, adding the nitrogen doses into two equal portions, ½ at sowing date and at first irrigation resulted in a highly significant effect and gave the tallest plants, also at age of 95 days in the second season, when nitrogen was added in three portions, 1/3 at sowing date and first and second irrigations or ¼ at sowing date, ½ at the first irrigation and ¼ at second irrigation gave the tallest plants. The superiority of plant height by adding the nitrogen into two equal doses as ½ at sowing date plus ½ before the first irrigation may be due to the early application of nitrogen fertilizer which stimulate plant growth and elongation of the internodes and consequently increasing the plant height. This may be due to that adding parts of whole amount of nitrogen can be absorbed by the youngest roots and these percentages of nitrogen that added at sowing date may be adsorption in the absorbing the applied nitrogen. These results agree with those obtained by Abou-Khadah *et al.* 1984, Ahmed 1990, Basha 1994, Mahgoub *et al.* 1994 and Kakar *et al.* 1999.

Data presented in Table [1-3] showed that adding the nitrogen fertilizer in two equal portions, half amount at sowing date and the other at first irrigation caused significant effect on DM of stem at age of 65 days in the second season and on stem diameter at age of 95 days in the first season and highly significant effect on plant height at age of 65 days in the second season and number of leaves at age of 95 days in the second season. These results are in accordance with those obtained by Basha 1994 on plant height. This may be due to that increasing the basic dose of nitrogen was more beneficial on plant height. This reflects the need of adequate supply of nitrogen from soil at earlier growth stages of plant growth. In contrast Mahgoub *et al.* 1994 found no significant differences in plant height among time of N application treatments.

Table (1): Plant height and total dry weight/plant at age 65, 80 and 95 days as influenced by application time of nitrogen in 2001 and 2002 seasons.

Treat.	Plant height Season 2001			Plant height Season 2002			Total dry weight/plant Season 2001			Total dry weight/plant Season 2002		
	65	80	95	65	80	95	65	80	95	65	80	95
T_1	226.83 c	234.83	270.16 a	259.63 a	258.08	267.49	170.50	221.29 b	309.62	235.32 ab	430.58 c	513.30
T_2	236.74 bc	249.58	247.22	241.24 ab	253.00	257.74	179.52	225.74 b	290.51	253.39 a	470.56 bc	600.16
T_3	230.41 c	231.06	b263.83 a	232.0 ab	261.66	282.55	163.61	273.46 a	245.54	204.60 b	518.40 ab	623.63
T_4	250.58 ab	251.83	268.10 a	221.25 b	260.16	280.07	187.87	237.93 b	469.25	209.20 bc	566.69 a	638.22
T_5	257.41 a	263.66	267.55 a	242.09 ab	260.05	270.16	194.13	283.03 a	332.09	182.10 c	433.33 c	592.50
T_6	253.33 a	250.91	270.22 a	220.54 b	249.41	260.00	187.61	306.34 a	332.72	184.14 c	544.62 a	543.92
F-test	*	Ns	*	**	NS	NS	NS	**	NS	**	**	NS

Notes: Values followed by the same letters horizontally are not significantly different according to DMRT at 0.05

Table (2): Ear leaf area and number of green leaves/plant at age 65, 80 and 95 days as influenced by application time of nitrogen in the two seasons 2001 and 2002 seasons.

Treat.	Ear leaf area Season 2001			Ear leaf area Season 2002			Number of green leaves/plant Season 2001			Number of green leaves/plant Season 2002		
	65	80	95	65	80	95	65	80	95	65	80	95
T_1	370.03 b	692.27	788.58 ab	511.13	608.89	621.76 c	15.82	1416	6.77 c	15.00 ab	12.49 bc	11.66 a
T_2	473.49 ab	589.04	719.04 bc	483.82	588.28	835.97 a	15.49	13.3	7.58 bc	15.83 a	12.32 bc	9.99 b
T_3	250.05 c	570.26	586.74 de	402.35	634.015	729.07 b	16.49	14.83	7.99 b	15.49 a	13.55 ab	11.77 a
T_4	450.65 ab	636.6	665.45 cd	512.80	559.90	755.47 ab	15.99	14.32	9.25 a	14.24 bc	14.33 a	11.88 a
T_5	534.45 a	721.31	880.795 a	446.04	669.27	827.46 a	16.08	14.41	7.58 bc	15.33 a	11.22 c	9.66 b
T_6	407.51 b	572.9	513.73 e	503.84	625.07	733.28 b	16.16	14.419	7.99 b	13.36 c	13.24 ab	12.32 a
F-test	**	NS	**	NS	NS	**	NS	NS	**	**	**	**

Notes: Values followed by the same letters horizontally are not significantly different according to DMRT at 0.05

When nitrogen was applied in two splitting portions as a half at first and second irrigation resulted in a significant effect on stem diameter at age of 65 days in the second season and high significant effect on number of leaves/plant, total DM of the plant at age of 95 days and leaf area/plant at age of 95 days in the second season. Abo-Khadra *et al.* 1984 and Ahmed 1990 found that adding N fertilizer into two equal applications, half at the first and second irrigations gave a significant effect on stem diameter and leaf area per plant and total weight of plant in the two seasons.

When nitrogen fertilizer was splitting into three portions, 1/3 at sowing, 1/3 at the first and second irrigation caused a significant effect on plant height, total chlorophyll in leaves and stem diameter at age of 95 days in season 2002 and highly significant effect on total DM of the plant at age of 80 days in season 2001 and on number of leaves/plant at age of 65 days, number of leaves at age of 95 days in the second season. Basha, 1994 found that applied N as 1/3 at sowing date and 1/3 at first and second irrigation it produced the highest values for the area of leaves of the plant

When N fertilization was applied in three portions a ¼ at sowing date, a ½ at the first irrigation and ¼ at the second irrigation gave the significant effect on number of leaves/plant at age of 95 days in the second season and highly significant effect on number of leaves/plant at age of 95 days in the first season and on DM of the plant. When N fertilizer was applied in three portions, ½ at sowing date and ¼ at first and second irrigation and resulted in a significant and highly effect on leaf area per plant and DM of plant in the first season and on ear leaf area at age of 95 days and number of green leaves/plant in the second season. The high values of stem diameter at age of 65 days in the second season and DM of plant at age of 80 days in both season and number of leaves/plant at age of 95 days in the second season when N fertilizer was applied in three portions, a ¼ at sowing date and first irrigation and ½ at the second irrigation.

B. Yield and its components

The highest values of straw and grain yields/fed in both seasons were obtained when N fertilizer was splitting into three portions,1/3 at sowing date at first and second irrigation. While applied in three portions, ¼ at sowing date and ½ at first irrigation and ¼ at second irrigation gave the significant effect on straw yield/fed and ear length in both seasons. Also, the highest values of grain yield/fed was obtained when N fertilizer was applied in three portions,

Table (3): Stem diameter and total chlorophyll at age 65, 80 and 95 days as influenced by application time of nitrogen in the two season 2001 and 2002.

Treat.	Stem diameter season 2001			Stem diameter season 2002			Total chlorophyll season 2001			Total chlorophyll season 2002		
	65	80	95	65	80	95	65	80	95	65	80	95
T_1	2.23	2.35	2.76 a	2.80 b	3.10	3.49 b	50.80	49.17	44.5	53.75	49.17	44.32 bc
T_2	2.23	2.39	2.71 ab	3.17 a	3.44	3.61 b	50.50	48.47	49.97	51.25	48.40	49.77 ab
T_3	2.14	21.35	2.44 c	3.07 ab	3.42	4.23 a	49.42	48.77	50.92	51.80	48.77	52.28 a
T_4	2.23	2.33	2.65 abc	3.08 ab	3.52	3.67 a	51.10	48.75	51.30	452.45	50.25	50.70 ab
T_5	2.21	2.39	2.56 abc	2.29 b	3.54	3.77 b	46.43	47.95	45.87	48.85	48.95	46.26abc
T_6	2.21	2.27	2.53 bc	3.37 a	3.52	3.67 b	48.53	49.47	45.35	50.87	49.47	42.90 c
F-test	NS	NS	*	*	NS	*	NS	NS	NS	NS	NS	*

Notes: Values followed by the same letters horizontally are not significantly different according to DMRT at 0.05

Table (4): Yield and yield component in the two seasons 2001 ad 2002 as influenced by application time of nitrogen.

Treat.	Ear length		Ear diameter		Number of kernels/row		Number of rows/ear		Number of kernels/ear		Ear height	
	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002
T_1	11.96 c	13.76 c	4.050	5.27	32.9	48.4	14.10	12.27	468.5	594.04	132.40	122.82
T_2	13.42 b	15.22 bc	4.087	4.62	34.9	47.07	13.20	12.62	435.1	588.7	134.65	127.32
T_3	14.20 ab	16.22 ab	4.050	5.70	36.6	47.1	13.65	12.90	447.8	608.5	126.77	129.00
T_4	15.13 a	16.91 a	4.075	5.82	37.00	47.6	14.00	13.00	517.9	619.5	138.00	132.15
T_5	14.17 ab	16.22 ab	4.175	4.72	37.45	45.6	13.80	12.75	514.2	580.6	128.60	127.12
T_6	14.95 a	17.02 a	4.088	5.12	34.2	47.2	14.20	12.17	484.9	574.3	136.37	124.25
F-test	**	**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Notes: Values followed by the same letters horizontally are not significantly different according to DMRT at 0.05

Table (5): Yield and yield component in the two seasons 2001 ad 2002 as influenced by application time of nitrogen.

Treat.	Shelling percentage %		Weight of 100 kernels		Straw yield/feddan (ton)		Grain yield per feddan/ardab		Protein percentage	
	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002
T_1	85.21	83.52	31.26	32.29	5.77 ab	6.72ab	14.71 c	28.13 b	8.65	9.2
T_2	84.81	86.02	33.93	30.55	4.90 b	5.93b	16.04 bc	31.07 ab	8.58	9.18
T_3	85.05	83.42	30.13	30.98	6.24 a	7.25 a	15.29 bc	33.60 a	8.40	9.0
T_4	84.99	85.42	32.23	31.44	6.35 a	7.45 a	18.33 ab	31.47 ab	8.87	9.22
T_5	84.75	84.70	33.87	34.52	5.15 b	6.10 b	15.86 bc	33.19 a	8.61	9.21
T_6	85.23	85.60	32.17	31.00	6.31 a	7.77 a	20.40 a	35.14 a	8.82	9.42
F-test	NS	NS	NS	NS	**	**	*	*	NS	NS

Notes: Values followed by the same letters horizontally are not significantly different according to DMRT at 0.05

½ at sowing date and ¼ at first and second irrigation. But when N fertilizer was applied in three portions, ¼ at sowing date and first irrigation and ½ at second irrigation gave the highest values of ear length, straw yield/fed in ton and grain yield/fed in the two seasons. Basha 1994 found that ear length was significantly affected when N fertilizer was applied into three portions, 1/3 at sowing date, first and second irrigation. On the contrast, Abou Khadrah *et al.* 1994 reported that ear length was affected significantly when N fertilizer was applied in two portions ½ at first and second irrigation in the first season.

Faisal 1983 and Ahmed 1989 found that straw yield and biological yield increased significantly by splitting the N fertilizer into two portions, ½ at the first and second irrigation. Srivastava *et al.* 1971, Faisal 1983 and Basha 1994 reported that when N fertilizer was applied into three portions,1/3 at sowing date and first and second irrigations out yielded the other treatments, while Fayomi 1966 and Ahmed 1989 observed that the highest grain yield/fed. was obtained when the N fertilizer was splitted in two portions and supplied at the first and second irrigation.

On the contrary, Papanicolanon *et al.* 1985 and Mahgob *et al.* 1994 recorded that the grain yield was not significantly affected by splitting the nitrogen fertilizer.

From the practical stand point this study recommended splitting N fertilizer into three portions, one of them must be added at sowing date and the rest must be added at first and second irrigation or a quarter of amount at sowing date and at first irrigation and the half at the second irrigation or a quarter at sowing date, ½ at the first irrigation and ¼ at second irrigation were more affective in increasing the growth of maize plants and obtained the highest yield under field experiment condition in Kafr EL Sheikh region

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الملخص العربي

تأثير مواعيد اضافة مستويات السماد النيتروجينى على النمو والمحصول ومكوناته لنباتات الذرة الشامية

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أجريت تجربتان حقليتان أثناء الموسمين ٢٠٠١و٢٠٠٢ في المزرعة الحقلية لكلية الزراعة بكفر الشيخ جامعة طنطا بغرض معرفة الوقت المناسب لإضافة الجرعة الموصي بها من السماد النتروجيني وهو ١٢٠ كيلو نتروجين للفدان وأثرها علي النمو والمحصول ومكوناته لنبات الذرة الشامية للصنف الهجين الثلاثي ٣٢١ وكانت النتائج كما يلي:

١- إضافة النتروجين في جرعتين النصف عند وقت الزراعة ونصف عند الرية الأولى أعطى أحسن النتائج لصفات طول النبات وقطر الساق عند عمر٩٥ يوم في الموسم الأول وعلي طول النبات عند عمر٦٥ يوم وعلي عدد الأوراق الغض للنبات عند عمر٩٥ يوم في الموسم الثاني.

٢- عند وضع النتروجين بالأرض علي دفعتين نصف الكمية قبل الرية الأولى والنصف الأخر قبل الرية الثانية كان له تأثير معنوي علي زيادة كل من الوزن الجاف للنبات الكامل وقطر الساق وعدد الأوراق الخضراء للنبات عند عمر ٦٥ يوم وعلي مساحة الأوراق عند عمر ٩٥ يوم في الموسم الثاني

٣- عند وضع النتروجين علي ثلاث دفعات الأولى عند ميعاد الزراعة والثانية والثالثة عند الرية الثانية والثالثة كان له اثر معنوي علي طول النبات عند عمر ٩٥ يوم وعلي الوزن الجاف للنبات الكامل عند عمر٨٠ يوم في الموسم الأول وعلي عدد الأوراق الخضراء للنبات عند عمر٦٥ يوم وعلي عدد الأوراق الخضراء للنبات وقطر الساق وعلي نسبة الكلوروفيل الكلية عند عمر٩٥ يوم في الموسم الثاني وعلي محصول القش للفدان بالطن في كلا الموسمين وعلي محصول الحبوب للفدان بالإردب في الموسم الثاني

٤- عند وضع النتروجين علي ثلاث دفعات الربع عند الزراعة والنصف عند الرية الأولى والربع عند الرية الثانية أعطى زيادة معنوية علي طول النبات وعدد الأوراق للنبات عند عمر٩٥ يوم في الموسم الأول وعلي الوزن الجاف للنبات الكامل وعدد الأوراق للنبات عند عمر ٨٠ يوم وعلي عدد الأوراق للنبات وعلي قطر الساق عند عمر٩٥ يوم في الموسم الثاني وعلي طول الكوز ومحصول القش للفدان بالطن في كلا الموسمين

٥- إضافة النتروجين علي ثلاث دفعات النصف عند الزراعة والربع عند الرية الأولى والربع الغير عند الثانية أعطى نتائج معنوية علي طول النبات وعلي المساحة الورقية عند عمر٦٥ يوم وعلي الوزن الجاف للنبات الكامل عند عمر ٨٠ يوم وعلي طول النبات والمساحة الورقية لورقة الكوز عند عمر ٩٥ يوم في الموسم الأول وعلي المساحة الورقية لورقة الكوز عند عمر٩٥ يوم وعلي عدد الاوراق للنبات عند عمر٦٥ يوم وعلي محصول الحبوب للفدان بالإردب في الموسم الثاني

٦- إضافة السماد النتروجيني علي ثلاث دفعات الاولي عند الزراعة وهي ربع الكمية وعند الرية الأولى والنصف الأخر عند الرية الثانية أعطى أحسن النتائج علي طول النبات عند عمر ٦٥ و٩٥ يوم في الموسم الأول وعلي الوزن الجاف للنبات الكامل عند عمر٨٠ يوم في كلا الموسمين وعلي عدد الأوراق للنبات عند عمر٩٥ يوم وعلي قطر الساق عند عمر٦٥ يوم في الموسم الثاني

٧- وعلي طول الكوز وعلي محصول القش للفدان بالطن وعلي محصول الحبوب بالإردب للفدان في كلا الموسمين

ومن النتائج التي يمكن التوصية بها أن السماد النتروجيني يمكن إضافته علي ثلاث دفعات حتى يكون لها التأثير الفعال في زيادة النمو والمحصول تحت ظروف التجربة الحقلية في منطقة كفر الشيخ