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Annals
Agric. Sci.,
Ain Shams Univ.,
Cairo, 53(1), 139-144, 2008

EFFECT OF PLANTING DATES AND N APPLICATION RATES ON MAIZE YIELD IN RELATION TO CHANGING PLANT DISTRIBUTION

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Keywords: Maize, Sowing dates, Plant distribution, Nitrogen application rates, Yield

ABSTRACT

This study was carried out during the two growing seasons i.e. 2003 and 2006 to study the effect of three planting dates (May, June and July), three nitrogen fertilizer rates (45 & 90 & 120 kg N / feddan) and two plant distribution patterns (25 cm between hills with one plant/ hill & 50 cm between hills with two plants/ hill), on yield of maize crop. Results obtained exerted significant effects on grain yield/ fad., stover yield/fad. and biological yield as planting date delayed from May to July, whilst vice versa trend was shown for harvest index. Grain yield decreased by 9.58% and 23.10% by delaying planting date from May to June and from June to July respectively in the first season and 31.19% and 40.82% respectively in the second season. No significant differences were appeared on grain yield, stover yield, biological yield or harvest index in the first season or stover yield and biological yield in the second season by changing plant distribution. Significant increases were appeared on grain yield/ fad. and harvest index with increasing N fertilizer application while biological yield/fad. tended to decrease. However highest grain yield was obtained at early planting date for plants grown 25 cm between hills and one plant per hill ; by early planting date and fertilized with high nitrogen doses and also by those planted at 25 cm and one plant per hill fertilized by highly nitrogen rate.

(Received January 29, 2008)
(Accepted February 14, 2008)

INTRODUCTION

Maize grain yield suffered considerable reduction with delaying sowing date (**Yousafzai *et al* 2002, Sarma *et al* 2001, Matta *et al* 1996 and Gouda *et al* 1998**). The reduction in grain yield may be owing to decreasing growth duration (**El-Shaer *et al* 1991**).

Nitrogen application plays an important role in determining crop production. Increasing nitrogen application rates from 0 to 120 kg N/fad. caused significant increase in grain yield (**Lamlom 1997, El-Habbak and Shams El-Din 1996 and Abd El-Samie 1994**),

Stover yield of maize plants increased with increasing nitrogen application rates (**Ibrahim 1997, Choudhary *et al* 2002; Tyagi *et al* 1998 and Banerjee and Singh 2003**).

Grain yield of maize was influenced by the increase of plants/m^2 from 3 to 9 plants/m^2 (**Dong and Hu 1993**) and from 6 to 8 plants/m^2 (**Hamidi and Nasab 2001**). Also, spacing distance of 30cm caused significant increments of grain yield (**Mahmood *et al* 2001 and Abo-Shetaia *et al* 2002**).

However, this work was established to study yield response of maize yield (TC325 cv.) to different planting dates, nitrogen fertilization rates and two planting distribution patterns.

MATERIALS AND METHODS

Six field experiments were carried out in the Experimental Station Farm at Shalakan, Kalubia Governorate, Egypt, to investigate the relationship between sowing dates, nitrogen fertilization and plant distribution with growth and yield of maize (*Zea mays*, L). Variety top cross (Tc 325) in 2003 and 2006 growing seasons.

Six treatments which were the combination between three levels of nitrogen fertilizer rates and two levels of plant distribution were applied at early, mid and late planting dates.

The soil of the experiment was clay in texture, pH value, organic matter %, available nitrogen (ppm), EC. (milimohs/cm at 25^0C) and $CaCo_3$ % were 7.35, 2.509, 150.6, 1.30 and 1.5, respectively in the first season, while in the second season, the respective values were 7.65, 2.674, 153.4, 1.41 and 1.35. Normal cultural practices were followed as recommended in the area during the two growing seasons.

Calcium superphosphate (15.5%P_2O_5) at the rate of 23.3 kg P_2O_5/fad. and potassium sulphate (48%K_2O) at the rate of 50kg K_2O /fad. were applied before planting. Nitrogen fertilizer was applied as ammonium nitrate (33.5%N) at two equal doses before the first and second irrigation. Each plot contained seven ridges of 3m in length, 0.6m in width and the plot area was 12.6m^2. The Experimental design used was randomized complete design with eight replications. The studied factors were three planting dates (early at 4^{th} May, mid at 1^{st} June and late at 1^{st} July); three nitrogen fertilizer rates (45 , 90 and 120 kg N / feddan) and two plant distribution patterns (25 cm between hills with one plant/ hill and 50 cm between hills with two plants/ hill).

At harvest, plants of plots were collected for the following measurements

1- Straw yield (kg/plot). 2- Grain yield (kg/plot).
3- Cob weight (kg/plot). 4-Husks weight (kg/plot).
5- Harvest index as (grain yield /biological yield).

Data obtained were subjected to analysis of variance according to **Snedecor and Cochran (1967)**. Least significant differences LSD at 5% level were computered to compare between means.

RESULTS AND DISCUSSION

1. Effect of planting date

Data in **Table (1)** show the effect of planting date on grain yield, stover yield, biological yield and harvest index during the two growing seasons of 2003 and 2006. Results showed that planting date had a significant effect on grain yield, stover and biological yield in both growing seasons. Delaying planting date reduced grain yield, stover yield, biological yield, whereas harvest index decreased from early planting date to mid date and then it increased in late date. With delaying planting date, grain yield decreased by 9.58% and 23.10% by delaying planting date from May to June and from May to July, respectively in the first season of study, while in the second season of study the respective decrements were 31.19% and 40.82% for the aforementioned dates of planting. The reduction in day length duration, light intensity and temperature with delaying date of planting might owe much to this finding. Many research workers come to similar results among whom **El-Shaer *et al* (1991).**

Harvest index suffered considerable reduction by delaying planting date from early date to mid date, then it increased by delaying planting date to the late planting. These results are true in the two studied seasons. This means that grain yield was decreased at a more rapid rate than the biological yield in the early planting date, but at late planting date vegetative parts of maize plants were considerably affected than grains .These results are in agreement with those of **Matta *et al* 1996 and Gouda *et al* 1998.**

2. Effect of nitrogen fertilizer application

Data shown in **Table (2)** indicate the effect of nitrogen fertilizer rates on grain yield, stover yield, biological yield and harvest index during the two growing seasons of 2003 and 2006. Data exhibit significant increases in grain yield and harvest index by increasing N application rates from 45 K/fad up to 120 K/fad., vice versa, stover yield, biological yield decreased by increasing N application rates from 45K/fad up to 120 K/fad. These effects were true in the two growing seasons.

Partitioning of photosynthates among different organs of maize plants was in favor of the developing grains under high nitrogen fertilized rates than low ones. So, both grain yield and harvest index increased on account of photosynthates translocated to stovers or straw organs. These results come in the same line with those of **Matta *et al* (1990), Gouda *et al* (1998),** and **Younis *et al* (1995).**

3- Effect of plant distribution

Data in **Table (3)** show the effect of plant distribution on grain yield, stover yield, biological yield and harvest index. Data indicate that plant distribution showed insignificant effect on grain

Table 1. Effect of planting date on maize yield in the 2003 and 2006 growing seasons

Yield	Planting date							
	2003				2006			
	Early (4th May)	Mid (1st June)	Late (1st July)	L.S.D at 5%	Early (4th May)	Mid (1st June)	Late (1st July)	L.S.D at 5%
Grain yield (ton / fad.)	4.07	3.68	3.13	0.190	4.36	3.00	2.58	0.095
Stover yield (ton / fad.)	10.00	10.15	7.09	0.238	8.71	7.05	6.00	0.119
Biological yield (ton/fad.)	14.07	13.83	10.21	0.309	13.07	10.04	8.58	0.166
Harvest index %	29.0	26.7	30.6	1.307	33.3	29.8	30.1	0.062

Table 2. Effect of Nitrogen application rates on maize yield in 2003 and 2006 growing seasons

Yield	Nitrogen application rates (Kg / fad.)							
	2003				2006			
	45	90	120	L.S.D at 5%	45	90	120	L.S.D at 5%
Grain yield (ton / fad.)	3.03	3.58	4.27	0.190	2.86	3.32	3.75	0.095
Stover yield (ton / fad.)	9.88	9.19	8.17	0.238	7.69	7.29	6.79	0.119
Biological yield (ton/fad.)	12.91	12.77	12.43	0.309	10.55	10.60	10.54	n.s
Harvest index %	23.4	28.2	34.6	1.307	26.8	31.0	35.4	0.062

Table 3. Effect of Plant distribution on maize yield in 2003 and 2006 growing seasons

Yield	Plant distribution					
	2003			2006		
	25 cm 1 plant/ hill	50 cm 2 plants/ hill	Significance	25 cm 1 plant / hill	50 cm 2 plants / hill	Significance
Grain yield (ton / fad.)	3.67	3.58	n.s	3.37	3.25	s
Stover yield (ton / fad.)	9.16	8.99	n.s	7.24	7.27	n.s
Biological yield (ton / fad.)	12.83	12.58	n.s	10.61	10.52	n.s
Harvest index %	28.5	28.7	n.s	31.5	30.6	s

Table 4. Effect of interaction between planting date and plant distribution on maize yield in 2003 and 2006 growing seasons

Planting dates	Plant distribution	Yield characters 2003 Grain yield (ton / fad.)	Stover yield (ton / fad.)	Biological yield (ton / fad.)	Harvest index %
Early (4th May)	25 cm 1 plant / hill	4.34	9.98	14.32	30.5
	50 cm 2 plants / hill	3.80	10.02	13.82	27.6
Mid (1st June)	25 cm 1 plant / hill	3.34	10.47	13.81	24.2
	50 cm 2 plants / hill	4.02	9.82	13.84	29.2
Late (1st July)	25 cm 1 plant / hill	3.33	7.03	10.36	31.8
	50 cm 2 plants / hill	2.92	7.14	10.06	29.3
	L.S.D at 5%	0.280	0.333	n.s	1.850
		2006			
Early (4th May)	25 cm 1 plant / hill	4.45	8.64	13.10	34.0
	50 cm 2 plants / hill	4.27	8.78	13.05	32.6
Mid (1st June)	25 cm 1 plant / hill	2.95	7.22	10.17	29.0
	50 cm 2 plants / hill	3.03	6.87	9.90	30.7
Late (1st July)	25 cm 1 plant / hill	2.71	5.85	8.56	31.6
	50 cm 2 plants / hill	2.46	6.15	8.60	28.6
	L.S.D at 5%	0.143	0.166	n.s	0.855

yield, stover yield, biological yield and harvest index in the two studied seasons with the exception of stover and biological yields in the second season.

Yield of maize plants grown at 25 cm between hills by one plant per hill distribution surpassed those grown at 50 cm by two plants per hill mainly due to the efficiency of plant canopy to intercept solar radiation, also to the well ramification of maize roots within soil volume. The better utilization of 25 cm X 1 plant distribution to the above ground and edaphic environmental resources might owe much to this finding.

4- Interaction Effect

Data in **Table (4)** show the effect of interaction between planting date and plant distribution on grain yield, stover yield, biological yield and harvest index. Data indicated that yield of maize changed significantly by the interaction between planting date and plant distribution. However, the highest values of grain yield, and biological yield were shown by early planting date when sown at 25 cm apart and one plant/hill being 4.34 t/fad., 14.32 t/fad. in the first season and 4.45 t/fad., 13.10 t/fad. in the second season, respectively. However regardless plant distribution treatments, stover yield of early planting was higher than late ones without significant difference between the two planting distribution treatments.

Data obtained show that grain yield of maize was insignificantly affected by the interaction between planting date and N fertilizer application rates in both seasons except for harvest index in second year only. This means that planting date and nitrogen application rates treatments act independently on yield of maize, i.e. grain, stover or biological yield so, data were not included. These results come in the same line with these of **Younis *et al* (1995)**.

Results obtained also showed insignificant effect to the interaction between plant distribution and nitrogen application rates on either of yield criteria studied meaning independent effect of these factors. So, data were excluded.

Moreover, the second order interaction between the three factors studied exerted no significant effect on any of yield criteria, so the data where excluded.

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حوليات العلوم الزراعية
جامعة عين شمس، القاهرة
مجلد(٥٣)، عدد (١)، ١٣٩-١٤٤، ٢٠٠٨

تأثير مواعيد الزراعة ومعدلات التسميد الأزوتى على محصول الذرة الشامية وعلاقته بتغيير توزيع النباتات

[١١]

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أجريت هذه الدراسة خلال عامي (٢٠٠٣ و٢٠٠٦م) لدراسة تأثير ثلاث مواعيد للزراعه (٤مايو و ايونية و ايوليو) وثلاثة مستويات من التسميد النتروجينى (٤٥و٩٠و١٢٠كجم ن /فدان) ونظامين لتوزيع النباتات بالحقل (٢٥سم بين الجور ونبات واحد بالجورة و ٥٠ سم بين الجور ونباتان بالجورة) ، وتتلخص أهم نتائج الدراسة فيما يلى

١. تأثر معنوياً كلاً من محصول الحبوب / فدان ووزن القش للفدان و المحصول البيولوجى /فدان بتأخير ميعادالزراعه من مايو إلى يوليو فقد نقص محصول الحبوب بمعدل ٩,٥٨٪ و ٢٣,١٠ ٪ بالتأخير من مايو الى يونيو ومن يونيو إلى يوليوعلى الترتيب فى الموسم الأول وبمعدل ٣١,١٩٪ و ٤٠,٨٢ ٪ في الموسم الثانى بنفس الترتيب بينما إنخفض دليل الحصاد بتأخير ميعاد الزراعه من الزراعة المبكرة الى المتوسطة ثم يزداد مره أخرى فى الزراعة المتأخرة خلال عامى الدراسه .
٢. لم تظهر فروق معنويه لمعظم شواهد المحصول فى موسمى الزراعة ما عدا وزن القش للفدان ووزن المحصول البيولوجى / فدان فى الموسم الثانى بينما نقص محصول الحبوب / فدان ووزن المحصول البيولوجى/فدان بتوزيع النباتات (٥٠ سم بين الجور ونباتان بالجورة عن ٢٥ سم بين الجور ونبات بالجورة) .
٣. حدثت زيادة معنوية بزيادة معدلات التسميد النتروجينى لمحصول الحبوب/فدان ودليل المحصول بينما نقص معنوياً محصول القش للفدان ووزن المحصول البيولوجى / فدان خلال عامى الدراسة.
٤. لا يوجد تأثير معنوى على محصول الحبوب ومحصول القش والمحصول البيولوجى ودليل الحصاد بالتفاعل بين عوامل الدراسة ماعدا دليل الحصاد فى الموسم الثانى للتفاعل بين مواعيد الزراعة ومعدل التسميد النتروجينى وعلى العكس تماماً يوجد تأثير معنوى للتفاعل بين مواعيد الزراعة و توزيع النباتات فى معظم الصفات المحصولية خلال عامى الدراسة ماعدا المحصول البيولوجى فى كلا الموسمين.

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