THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

Effect of Nitrogen Fertilization on Growth, Yield Attributes, Grain Yield of Hybrid Maize Genotypes

O. Sampath
Ph.D Scholar, Department of Agronomy, College of Agriculture
ANGRAU, Rajendranagar, India
M. Madhavi
Principal Scientist, AICRP on weed control, Rajendranagar, India
P. Chandrashekar Rao
Professor & Head, Department of Soil Science and Agricultural Chemistry
College of Agriculture, ANGRAU, Rajendranagar, India

Abstract:
A field experiment was conducted during rabi 2008-09 with three hybrids viz., BH 40625, Super 900 M and BH 1576 as main treatments and four nitrogen levels (150,200,250 and 300 kg N ha^{-1}) as sub treatments. The results indicated that hybrids BH 40625, Super 900 M and BH 1576 performed almost alike regarding all the growth parameters, yield attributes and grain yield. All the growth parameters except number of green leaves plant^{-1}, yield attributes, grain yield and protein content in grain increased significantly with each higher level of nitrogen up to 200 kg N ha^{-1} Application of 300 kg N ha^{-1} did not prove to advantageous over 200 kg N ha^{-1}. The interaction between hybrids and nitrogen levels was found to be significant only incase of Leaf area index, protein content and nutrient uptake. Maximum grain yield of 7.0 t ha^{-1} was obtained with the application 300 kg ha^{-1} where as hybrid BH 40625 recorded 6.7 t ha^{-1} in comparison to Super 900 M (6.5 t ha^{-1}) and BH 1576 (6.4 t ha^{-1}).

Key words*: Maize, nitrogen, growth, yield*

1. Introduction

The productivity of rabi maize is more compared to kharif maize crop and hence additional plant population with enhanced nitrogen fertilization is required for maximizing the yield potential of presently available genotypes. Maize is a heavy feeder of nutrients. Among the nutrients nitrogen is the primary one in the fertilizer management programme for maize as it is the key to realize the yield potential of maize crop. Nitrogen plays a major role both in structural and functional aspects of crop growth. It not only increases yield by increasing total dry matter production, but also influences the availability of other essential elements. The uptake of nutrients by a maize crop producing 5 t ha-1 of grain yield was estimated around 105 kg N, 50 kg P2O5 and 75 kg K2O kg ha-1. Further, it is assumed that for every 100 kg of grain yield 1.8 kg N in the grain and 1.0 kg in the above ground parts of the plant are required and must be supplied by soil and/or fertilizer. At present the information about the response of present single cross hybrids to higher levels of fertilizers particularly nitrogen is meager therefore the present study is proposed to evaluate different maize genotypes in relation to nitrogen fertilization for maximizing grain yields during rabi season.

2. Material and Methods

A field experiment was conducted during *Rabi*, 2008-09 at the Agricultural College Farm, Rajendranagar, Hyderabad. The soil was sandy loam, neutral in reaction (pH 7.0), with 0.49% of organic matter, 222.75 kg ha^{-1} available nitrogen, 22.60 kg ha^{-1} of available P and 260.70 kg ha^{-1} of available K. Four levels of applied nitrogen viz. - 150 kg N ha^{-1}, 200 kg N ha^{-1}, 250 kg N ha^{-1}and 300 kg N ha^{-1} were used. Three genotypes BH-1576, Super 900M and BH 40625 were tested. Entire quantity of P_2O_5 and K_2O (60:60 kg,P_2O_5:K_2O ha$^{-1)}$ was applied as a basal dose. Nitrogen was applied as per the sub plot treatments in three splits i.e. one third as basal, one third at knee high stage and the remaining one third at tasselling stage. The sources of N, P and K are urea, single super phosphate and muriate of potash respectively. The fertilizers were applied by placement along the lines 5 cm away and 5 cm below the seed rows. Atrazine @ 1.0 kg a.i. ha^{-1} was applied as pre-emergence spray after sowing and irrigation. One interculture and hand weeding were taken at 30 DAE. All the plots were uniformly irrigated as and when required based on soil moisture content and phenological stages of the crop growth. Total 15 irrigations were given to crop. Harvesting was done, when the sheath of the cob dried completely.

3. Results and Discussion

Observations of the data on initial and final plant stand of maize (Table 1) indicated that the maize hybrids, nitrogen levels and their interaction effects were not significant. The initial plant stand ranged between 65400- 66000 plants per hectare and the final plant stand ranged from 64200-65300 plants per hectare since the conditions were favorable to crop growth and pest and disease problem were at minimum level, population stand till maturity was maintained.

Green leaf number increased sharply up to 60 DAS and thereafter declined gradually towards harvest (Table 2). There was no significant difference among the hybrids in the number of green leaves per plant at all stages of the crop growth. However, BH 40625 hybrid was found superior to BH 1576 and Super 900M. Similarly, effect of different nitrogen levels on number of green leaves per plant was found to be non significant at all the crop growth stages. The number of leaves put forth per plant reached to a maximum by 60 DAS and thereafter the leaf number declined with advancement of growth due to senescence of the lower leaves. At different growth periods, application of higher doses of nitrogen favoured the crop to put forth more number of leaves per plant as the nitrogen is the primary absorber of light energy needed for photo synthesis and the integral part of chlorophyll which imparts green colour to plants. At harvest stage the number of green leaves were less, and that might be due to phosphorus which was associated with early maturity of the crop and further senescence of the lower leaves. Similar findings were reported by (1). Perusal of the data LAI (Table 2) indicated that leaf area index tended to increase up to 60 DAS beyond which it declined towards harvest, which was due to senescence of foliage. The maize hybrids differed significantly in terms of LAI. The hybrid BH 40625 recorded significantly more LAI over BH 1576 and Super 900M at all the stages. The increase in LAI due to BH 40625 over BH 1576 and Super 900 M at harvest was 28% and 14 % respectively. This was due to more number of leaves plant^{-1} and large sized leaves. Similarly, LAI was influenced markedly due to N levels. Increasing levels of nitrogen from 150 to 300 kg ha^{-1}significantly increased LAI at all the stages. Maximum LAI of 1.95 was found with 300 kg N ha^{-1} followed by 250 kg N ha^{-1} with 1.70 at harvest. At different growth periods, application of higher doses of nitrogen favoured the crop to put forth more leaf area .Variation in LAI of maize cultivars has been reported by (2). Increase in LAI with increase in nitrogen level was reported by (3). The present findings are in confirmity with those of (4) and (5). Progressive increase in the dry matter accumulation of plants with advance in age of the crop was observed (Table 2). The results revealed that the maize hybrids did not differ significantly in terms of dry matter production at any stage of crop growth. The response of the three hybrids was almost equal. However, the hybrid BH 40625 was found efficient in producing more dry matter over the other two hybrids. A maximum dry matter of 378, 6552 and 15522 kg ha^{-1} was observed with BH 40625 at 30, 60 DAS and at harvest respectively. This might be due to its genetic potential and well developed large sized stalks and higher leaf area index which accumulates higher quantity of photosynthates, contributing to higher dry matter accrual. Similar disparity of dry matter production among cultivars of maize was noticed by (2) and (6). The dry matter yield was significantly influenced by nitrogen levels at all the stages. Increasing level of nitrogen from 150 to 300 kg ha^{-1} brought significant improvement in dry matter at all the stages. Maximum dry matter of 381, 7405 and 16136 kg ha^{-1} was recorded by 300 kg ha^{-1} at 30, 60 DAS and at harvest respectively. The present increase in dry matter yield due to 300 kg N ha^{-1} over 150, 200 and 250 kg N ha^{-1} were in the order of 2258,1030 and 462 kg ha^{-1}. Enhanced dry matter production with adequate supply of nitrogen evidenced in this investigation corroborates the findings of (2), (7) and (5).

Results showed that the number of grain rows per cob and number of grains cob^{-1} recorded by three hybrids namely BH 40625, BH 1576 and Super 900 M did not differ significantly with each other. Maximum number of rows per cob and number of grains cob^{-1} were observed with BH 40625 (Table 3). This might be due to its genetic potential and well developed large sized stalks and higher leaf area index, which accumulates higher quantity of photosynthates, contributing to higher dry matter accrual. Similar disparity of dry matter production among cultivars of maize was noticed by (2) and (6). Perusal of the data on number of grain rows per cob and number of grains cob^{-1} inferred that significant differences existed among different levels of nitrogen. The highest number of grain rows per cob (15.6) and number of grains cob^{-1} (547.20) were obtained at 300 kg N ha^{-1} which was significantly superior to other doses of nitrogen application.The number of grain rows per cob and number of grains cob^{-1} obtained with 150 kg N ha^{-1} were significantly lower compared to 200, 250 and 300 kg N ha^{-1}. These results are in agreement with the findings of (8). Maize hybrids differed significantly in terms of 100 grain weight. The hybrid BH 40625 recorded the highest 100 grain weight (30.9 g) which was significantly superior to Super 900 M (29.8 g) and BH 1576 (29.6 g). The two hybrids namely 1576 and Super 900 M were at par. Maximum 100 grain weight of 31.9 gm was recorded by 300 kg N ha^{-1} level which was on par with that of 250 kg N ha^{-1} (31.2 g) and significantly superior to 150 kg and 200 kg N ha^{-1}. Study of the data in detail revealed that grain yield recorded by three hybrids namely BH 1576, Super 900 M and BH 1576 were found to at par and the differences among themselves did not attain the level of significance. However the hybrid BH 40625 recorded the maximum grain yield of 6700 kg ha^{-1} followed by Super 900 M (6557 kg ha^{-1}) and BH 1576 (6456 kg ha^{-1}) (Table 3). The yield increase recorded with BH 40625 was on par with Super 900 M and BH 1576. But compared to Super 900 M and BH 1576 the hybrid BH 40625 produced more yield. This could be ascribed to higher cob weight, seed weight cob^{-1} and shelling percentage obtained with BH 40625. The superiority of hybrid BH 40625 over Super 900 M and BH 1576 with respect to yield components and yield may be due to its genetic potentiality to utilize and translocate photosynthates from source to sink and their better adoptability to this agroclimatic conditions. Similar trend was also noticed by (9). The yield advantage due to BH 4065 over Super 900M was in the order of 143 and 244 kg ha^{-1} respectively. In respect of stover yield, three hybrids namely BH 40625, BH 1576 and Super 900 M varied significantly. The hybrid BH 40625 recorded the highest stover yield of 8805 kg ha^{-1} followed by Super 900 M (8637 kg ha^{-1}) and BH 1576 (8562 kg ha^{-1}) (table 3). The increase in stover yield due to BH 4065 over Super 900 M and BH 1576 was 168 and 243 kg ha^{-1} respectively. These results corroborate the findings of (7) and (8). Perusal of yield data inferred that significant differences in grain and stover yield were existed among the levels of nitrogen. Significantly highest grain yield of 7003 kg ha^{-1} was obtained at 300 kg N ha^{-1} which was more by 1044 kg ha^{-1} over 150 kg level. The rate of yield increase was maximum with 200 kg N ha^{-1} over 150 kg N ha^{-1}. The highest stover yield of 9103 ha^{-1} was obtained at 300 kg N ha^{-1} level which was more by 1180 kg ha^{-1} over 150 kg level. The rate of stover yield increase was maximum with 200 kg N over 150 kg N. These results are in confirmity with the findings of (2), (7) and (5). The data revealed that the different hybrids differed significantly in respect of shelling percentage. Significantly higher shelling percentage (72 %) was recorded by BH 40625 over other hybrids (Table 3). Regarding the effect of different nitrogen levels, it was found that significant differences were existed among all nitrogen levels of nitrogen. The highest shelling percentage of 73.5 % was obtained at 300 kg N ha^{-1} level followed by 250 kg N ha^{-1} (71.7 %), 200 kg N ha^{-1} (70.6) and 150 kg N ha^{-1} (70.0%).

Treatment	Initial plant population ('000 ha^{-1})	Final plant population ('000 ha^{-1})
Hybrids		
BH 1576	65.4	64.7
Super 900 M	65.3	64.3
BH 40625	66.0	65.2
SEm ±	0.27	0.24
CD (P= 0.05)	NS	NS
Nitrogen levels (kg ha^{-1})		
150	65.1	64.4
200	65.4	64.2
250	65.7	64.6
300	66.1	65.3
SEm ±	0.34	0.23
CD (P= 0.05)	NS	NS
V X N Interaction		
SEm ±	0.59	0.34
(a)CD (P= 0.05)	NS	NS
SEm ±	0.55	0.33
(b)CD (P= 0.05)	NS	NS

Table 1: Initial and final plant population ('000 ha^{-1}) as influenced by maize hybrids in relation to nitrogen levels
(a) Between two sub treatment means at same level of main treatment
(b) Between two main treatment means at same level or different levels of sub treatments

Treatments	Number of green leaves $plant^{-1}$			Leaf area index			Dry matter production (kg ha^{-1})		
	30DAS	60 DAS	At harvest	30DAS	60 DAS	At harvest	30DAS	60 DAS	At harvest
Hybrids									
BH 1576	7.90	12.50	4.50	0.61	3.08	1.39	291	6003	14887
Super 900 M	7.90	12.60	4.60	0.62	3.21	1.57	327	6277	15187
BH 40625	8.00	12.80	5.00	0.79	3.33	1.79	378	6552	15522
SEm ±	0.19	0.35	0.12	0.01	0.05	0.05	18.75	195.5	244.1
CD (P= 0.05)	NS	NS	NS	0.04	0.14	0.15	NS	NS	NS
Nitrogen levels (kg ha^{-1})									
150	7.70	12.60	4.60	0.54	2.76	1.21	289	5275	13878
200	7.90	12.60	4.60	0.63	3.06	1.48	323	5906	15106
250	7.90	12.60	4.70	0.71	3.33	1.70	333	6522	15674
300	8.10	12.80	4.80	0.81	3.68	1.95	381	7405	16136
SEm ±	0.15	0.24	0.15	0.01	0.03	0.03	11.22	238.5	143
CD (P= 0.05)	NS	NS	NS	0.02	0.06	0.07	23.58	501.05	301.3

	30DAS	60 DAS	At harvest	30DAS	60 DAS	At harvest	30DAS	60 DAS	At harvest
V X N Interaction									
SEm ±	0.27	0.42	0.26	0.01	0.05	0.06	19.44	413.06	248.4
(a)CD (P= 0.05)	NS	NS	NS	0.03	0.11	0.13	NS	NS	NS
SEm ±	0.36	0.65	0.25	0.02	0.09	0.10	33.90	396.69	440.7
(b)CD (P= 0.05)	NS	NS	NS	0.06	0.24	0.24	NS	NS	NS

Table 2: Growth characteristic of maize as influenced by hybrids and nitrogen levels
(a) Between two sub treatment means at same level of main treatment
(b) Between two main treatment means at same level or different levels of sub treatments

Treatments	No. of grain rows per cob	No. of grains per cob	100 grain weight (gm)	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Shelling (%)
Hybrids						
BH 1576	14.40	502.30	29.60	6456	8562	70.90
Super 900 M	15.10	506.80	29.80	6557	8637	71.40
BH 40625	15.40	508.70	30.90	6700	8805	72.00
SEm ±	0.30	15.1	0.21	152.2	95.03	0.21
CD (P= 0.05)	NS	NS	0.58	NS	NS	NS
Nitrogen levels (kg ha^{-1})						
150	14.40	454.70	27.90	5959	7922	70.0
200	14.90	503.20	29.40	6543	8544	70.6
250	15.00	532.00	31.20	6778	8835	71.8
300	15.60	547.20	31.90	7003	9103	73.5
SEm ±	0.25	5.23	0.54	76.71	65.7	0.22
CD (P= 0.05)	0.53	10.99	1.14	150.35	138.1	0.46
V X N Interaction						
SEm ±	0.43	9.06	0.94	132.87	113.8	0.38
(a)CD (P= 0.05)	NS	NS	NS	NS	NS	NS
SEm ±	0.56	26.60	0.59	271.95	174.2	0.41
(b)CD (P= 0.05)	NS	NS	NS	NS	NS	NS

Table 3: Yield attributes, grain and stover yields (kg $ha^{-1)}$ of maize as influenced by hybrids and nitrogen levels
(a) Between two sub treatment means at same level of main treatment
(b) Between two main treatment means at same level or different levels of sub treatments

4. References

1. Singh, R. N., Sutaliya R., Ghatak, R. and Sarangi, S. K. (2003). Effect of higher application of nitrogen and potassium over recommended level on growth, yield and yield attributes of late recommended level on growth, yield and yield attributes of late sown winter maize (Zea mays L.). Crop Research 26(1) : 71-74.
2. Shanti K., Praveen Rao V., Ranga Reddy M., Suryanarayana Reddy and Sharma P S. (1997). Response of maize (Zea mays L.) hybrid and composite to different levels of nitrogen. Indian Journal of Agricultural Sciences 67(a): 424-425.
3. Sanjeev Kumar and Bangarwa, A S. (1997). Yield and yield components of winter maize (Zea mays L.) as influenced by plant density and nitrogen levels. Agriculture Science Digest 17 (3): 181-184.
4. Naresh Kumar S and Singh C P. (2001). Growth analysis of maize during long and short duration crop seasons: Influence of nitrogen source and dose. Indian Journal of Agricultural Research 35(1):13-18.
5. Raja V. (2001). Effect of nitrogen and plant population on yield and quality of super sweet corn (Zea mays). Indian Journal of Agronomy 46(2): 246-249.

6. Tiwana U S., Tiwana M., Puri, K P., Thind, I S. (1999). Forage production potential of maize varieties under different date of sowing and nitrogen levels. Journal of research Punjab Agricultural university 36 (1- 2):5-8.
7. Vadivel, N., Subbian, P and Velayutham, A. (1999). Effect of sources and levels of nitrogen on the drymatter production and nutrient uptake in rainfed maize. Madras Agricultural Journal 86(7-9):498-499.
8. Rameshwar Singh and Totawat K. L. (2002). Effect of integrated use of nitrogen on the performance of maize (Zea mays) on Haplu Stalfs of sub humid southern plains of Rajasthan. Indian Journal of Agricultural Research 36(2) : 102-107.
9. Manish Kumar., Tripathi R S and Shrivastava G K. (2001). Quality and yield of winter maize as affected by varying genotypes, nitrogen levels and irrigation schedules. Madras Agricultural Journal 88(10-12): 693-696