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Response of Maize hybrids of contrasting duration to graded levels of Nitrogen

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ABSTRACT

In order to study the effects of nitrogen graded levels on yield and yield components of maize hybrids, a field experiment was conducted at College of Agriculture, Navile, Shimoga during *kharif* 2012under rainfed conditions on sandy loam soil.The experiment was laid out in Factorial Randomized Complete Block Design with three replications. There were twelve treatment combinations comprised of two maize hybrids and six nitrogen levels. Results indicated that nitrogen levels had significant effects on yield and yield components of maize hybrids. Higher number of grains per cob, number of grains per row, cob length, plant height, total dry matter and LAI was recorded at the application of 250 kg N ha^{-1} and it was on par with application of 200 kg N ha^{-1}. Among the differenthybrids, LDH recorded maximum plant height, number of grains rows per cob, cob length, number of grains per cob, test weight and grain yield compared to SDH. The interaction effect of maize hybrids and nitrogen levels found to be non-significant with respect to yield and yield parameters.

Keywords: Maize, Nitrogen, Hybrids, yield, yield components.

1. INTRODUCTION

Maize is one of the most important cereal crop grown in India. Maize grain is used for both human consumption and poultry feed. It has a great utility in agro-industry. This crop has much higher grain protein content than our staple food rice. The yield of maize in India is very low as compared to other maize producing countries. One of the most important effective factors is non-application of optimal amounts of nitrogen fertilizer per hectare and maize hybrids differ in their response to different levels of nitrogen fertilizer.

GLOBAL JOURNAL OF ADVANCED RESEARCH
(Scholarly Peer Review Publishing System)

Nitrogen is the key element in increasing productivity. It is an integral component of many compounds essential for plant growth processes including chlorophyll and many enzymes. Nitrogen also mediates the utilization of potassium, phosphorus and other elements in plants. The optimum amounts of these elements in the soil cannot be utilized effectively if nitrogen is deficient in plants. Therefore, nitrogen deficiency or excess can result in reduced maize yields. However, nitrogen requirement and utilization in maize also depend on environmental factors like irrigation, hybrids and expected yield. Application of nitrogen fertilizer has also been reported to have significant effect on grain yield and quality of maize.

Maize is mainly grown as rainfed crop in Southern Transition Zone of Karnataka. Most of the formers are growing full maturity hybrids. But these hybrids fail to exhibit their full genetic potential under changed climate as well as changes in the rainfall pattern. Hence there is a need to evaluate the performance of maize hybrids of contrasting duration to suit the changing rainfall patterns.

2. MATERIALS AND METHODS

The present field trial was conducted on a sandy loam soil having available N of213.25 kg ha^{-1}availablephosphorus of 109.3 kg ha^{-1} and 171.36 kg ha^{-1} of available potassium at the Agronomic Research Area, college of agriculture, Navile, Shimoga during *kharif* 2012. The experiment was laid out in Factorial Randomized Complete Block Design with three replications. There were twelve treatment combinations comprised of two maize hybrids (SDH and LDH) and six nitrogen levels (0, 50, 100, 150, 200 and 150 kg N ha^{-1}). Net plot size was 3.6 m x 2.4 m. Seedbed was prepared by cultivating the soil 2-3 times with tractor mounted cultivator each followed by planking. Maize hybrids were sown @ 15 kg seeds per hectare in 45 cm between the rows and 30 cm between the plants on 30th July 2012 by dibbling. The amount of P and K (each 75 and 50 kg ha^{-1}, respectively) was remained constant in all the treatments. The sources of NPK in all the treatments were Urea, SSP (single super phosphate) and MOP (murate of potash), respectively. All P, K and 1/2N according to respective treatment was applied at the time of sowing, 1/2 N was applied at 40DAS.Seven irrigation were given at different growth stages especially at seedling, knee high, tasselling, silking, and grain filling stage through surface irrigation. Thinning was done at 3-4 leaf stage to maintain a single plant at each hill. Crop was kept free of weeds by hoeing twice to avoidweed crop competition. All other agronomic practiceswere kept constant and uniform for all treatments. The crop was harvested on 3rd November 2012 for LDH (CP 818) and 25th October 2012 for SDH (Rajkumar), and standard procedures were followed to collect the data on growth andyield parameters.Mature plant heights of 5 randomPlants/plot were measured in cm as the distances from ground level to the lowest branch of the panicle. The number of kernels in 5 ears was counted after they had been shelled and divided by the number of ears. The grain of the same 5 ears mentionedabove was weighed and divided by the number of ears. For total nitrogen in grain and stover was determined Kjeldhals method (Jackson, 1962). The data collected from the experiment was statistically analyzed by using Fisher's analysis of variance technique and the difference among the treatments means were compared using least significant difference (LSD) test at 5% probability level (Steel *etal.*, 1997).

3. RESULTS AND DISSCUSSION

Nitrogen levels had significant effects on grainyield, plant height, number of grains per cob, number of grain rowper cob, number of cobs per plant and cob length. Maize hybrids had different response to these characteristics.
The comparison of treatment meansindicated that the LDH of maize recordedsignificantly maximum height as compared SDH used in the present study due its high genetic potential of LDH. While, the effect of nitrogen levels on plant height was also found significant. Maximum plant height was recorded by 250 kg N ha^{-1} application and it was on par with the treatment which receives 200 kg N ha^{-1}minimum plant height was obtained in 0 kg N ha^{-1}. The interaction between cultivars and nitrogen levels was found to be non-significant. These results were similar with the findings of Akhtar*et al*. (1996) and Hassan (2005).

GLOBAL JOURNAL OF ADVANCED RESEARCH
(Scholarly Peer Review Publishing System)

The leaf area index of maize hybrids differed significantly at different growth stages. Long duration hybrid (LDH) registered maximum leaf area index compared to short duration hybrid (SDH) similar views were expressed by Tollenaar, (1989). Nitrogen levels differed significantly in influencing the LAI at different growth stages. Application of nitrogen at 250 kg ha^{-1} recorded significantly maximum LAI and it was on par with the treatment which receives 200 kg N ha^{-1}.

Table 1: Growth parameters of maize hybrids as influenced by graded levels of nitrogen.

Hybrids / Nitrogen Levels	Plant height (cm)			LAI			Total dry matter (g/plant)		
	SDH	LDH	Mean	SDH	LDH	Mean	SDH	LDH	Mean
0 kg N ha^{-1}	104.1	111.1	107.6	1.31	1.39	1.35	142.7	192.9	167.8
50 kg N ha^{-1}	121.1	145.5	133.3	1.58	1.87	1.72	179.8	246.3	213.1
100 kg N ha^{-1}	149.8	156.8	153.3	1.66	2.10	1.88	182.9	222.4	202.6
150 kg N ha^{-1}	168.8	189.5	179.1	2.31	2.62	2.46	251.5	292.5	272.0
200 kg N ha^{-1}	190.0	200.0	195.0	2.75	2.90	2.82	302.7	319.4	311.1
250 kg N ha^{-1}	190.1	204.3	197.2	2.85	3.07	2.96	314.4	324.0	319.2
Mean	154.0	167.8	107.6	2.08	2.32		229.0	266.2	
For Comparing	**SEm ±**	**CD at 5%**	**CV (%)**	**SEm ±**	**CD at 5%**	**CV (%)**	**SEm ±**	**CD at 5%**	**CV (%)**
Hybrid (H)	3.33	9.79		0.07	0.21		5.30	15.56	
Nitrogen level (N)	5.78	16.96	8.80	0.12	0.36	13.83	9.19	26.95	9.08
H× N	8.17	NS		0.17	NS		12.99	NS	

With The total dry weight of maize hybrids differed significantly at different growth stages. Long duration hybrid (LDH) registered maximum total dry weight compared to short duration hybrid (SDH) at all the growth stages. These might be due to difference in the translocation of source-sink ratio further resulting in better uptake of nutrients, increased vegetative growth, PAR and RUE throughout the growth period leads to increased accumulation of dry matter in the different parts of the plant. These results are in conformity with the findings of Manishkumar(1998).Application of nitrogen at 250 kg ha^{-1} recorded significantly maximum total dry weight and it was on par with the treatment which receives 200 kg N ha^{-1}. Nitrogen as greater effect on photosynthesis at the later stages of growth in maize. The above ground biomass is a function of the amount of PAR intercepted by the canopy and its ability to convert radiant energy in to chemical energy. These helped in accumulation of higher dry matter in different plant parts. These results are in conformity with the findings of Kaul*et al*. (1994); Khatun*et al.* (2012).

GLOBAL JOURNAL OF ADVANCED RESEARCH
(Scholarly Peer Review Publishing System)

Table 2: Yield parameters of maize hybrids as influenced by graded levels of nitrogen.

Hybrids / Nitrogen Levels	No. of grains per cob			Test weight (g)			Cob length (cm)			Grain weight per cob (g)		
	SDH	**LDH**	**Mean**	**SDH**	**LDH**	**Mean**	**SDH**	**LDH**	**Mean**	**SDH**	**LDH**	**Mean**
0 kg N ha^{-1}	161.0	184.2	172.6	21.86	23.53	22.70	13.03	14.80	13.91	34.8	43.3	39.1
50 kg N ha^{-1}	308.1	332.2	320.2	23.73	25.40	24.56	13.86	16.00	14.93	73.0	84.3	78.7
100 kg N ha^{-1}	399.1	409.5	404.3	24.46	26.66	25.56	17.96	19.30	18.63	97.5	109.5	103.5
150 kg N ha^{-1}	465.0	496.0	480.5	25.63	27.70	26.66	19.26	19.96	19.61	119.9	137.2	128.5
200 kg N ha^{-1}	576.1	595.0	585.6	27.40	28.20	27.80	20.60	21.60	21.10	157.7	167.7	162.7
250 kg N ha^{-1}	579.7	613.1	596.4	27.73	28.73	28.23	20.92	21.76	21.34	160.2	176.3	168.2
Mean	414.8	438.3		25.13	26.70		17.60	18.90		107.2	119.7	
For Comparing	**SEm ±**	**CD at 5%**	**CV (%)**	**SEm ±**	**CD at 5%**	**CV (%)**	**SEm ±**	**CD at 5%**	**CV (%)**	**SEm ±**	**CD at 5%**	**CV (%)**
Hybrid (H)	7.10	20.85		0.51	1.52		0.37	1.10		2.68	7.86	
Nitrogen level (N)	12.31	36.11	7.07	0.89	2.63	8.49	0.65	1.91	8.78	4.64	13.62	10.02
H× N	17.41	NS		1.27	NS		0.92	NS		6.56	NS	

LDH has recorded higher yield parameters like number of grains per cob, number of grain rows, test weight, cob length and number of cobs per plant higher in LDH compared to SDH. These could be due to high genetic potentiality , high growth parameters like, plant height, LAI, and dry matter accumulation in different plant parts and better interception of PAR resulting in higher yield attributes further leads to increase in grain and stover yield of LDH over SDH.Increase in the yield attributes like number of grains per cob (596.4)test weight (28.23 g),cob length (21.34 cm) and grain weight per cob (168.2 g) was noticed in the higher level of nitrogen treatments i.e. treatment which received 250 kg N ha^{-1} and it was on par with the treatment which receives 200 kg N ha^{-1} this could be due to nitrogen is instrumental in photosynthesis even at critical stages and facilitates the translocation of metabolitesand also associated with higher biomass production and N uptake during grain filling , and longer duration of effective grain filling resulted in higher grain yield. Increase in the grain yield by increasing nitrogen level was also stated by Muchow (1988); Duraisami and Mani (2000).

GLOBAL JOURNAL OF ADVANCED RESEARCH
(Scholarly Peer Review Publishing System)

Table 3: Grain yield, stover yield and harvest index of maize hybrids as influenced by graded levels of nitrogen.

Hybrids / Nitrogen Levels	Grain yield (kg ha^{-1})			Stover yield (kg ha^{-1})			Harvest Index		
	SDH	LDH	Mean	SDH	LDH	Mean	SDH	LDH	Mean
0 kg N ha^{-1}	1244	1467	1355	2080	2343	2211	0.37	0.38	0.38
50 kg N ha^{-1}	2504	2784	2644	3982	4361	4171	0.39	0.39	0.39
100 kg N ha^{-1}	3468	3693	3581	5511	5735	5623	0.39	0.39	0.39
150 kg N ha^{-1}	4461	4856	4659	6944	7769	7356	0.39	0.38	0.39
200 kg N ha^{-1}	5752	6320	6036	8598	9291	8945	0.40	0.41	0.40
250 kg N ha^{-1}	6080	6574	6327	8840	9653	9247	0.41	0.41	0.41
Mean	3918	4282		5993	6525		0.39	0.39	
For Comparing	**SEm ±**	**CD at 5%**	**CV (%)**	**SEm ±**	**CD at 5%**	**CV (%)**	**SEm ±**	**CD at 5%**	**CV (%)**
Hybrid (H)	68.3	200.4		118.6	348.0		0.005	NS	
Nitrogen level (N)	118.3	347.1	10.07	205.5	602.7	8.04	0.009	NS	5.92
H× N	167.3	NS		290.6	NS		0.013	NS	

The grain yield is a function of combined effect of all the individual yield components. Our results showed that the LDH yielded maximum as compared to SDH. The response of different nitrogen levels to grain yield was also found highly significant. These results are in agreement with the findings of Setty (1981); Sharifi and Taghizadeh (2009).In the case of N levels 250 kg N ha^{-1}produced significantly higher grain yield and it was on par with treatment which receives 200 kg N ha^{-1} and minimum grain yield was produced in fertilization of 0 kg N ha^{-1}. It is clear that grain yield increases with an increase innitrogen levels. The interaction effect of hybrids andnitrogen levels was found to be non- significant. These results are confirmatory to the findings of Mkhabela*et al*. (2001) and Younas*et al.* (2002). They reported that higher levels of nitrogen enhanced the grain yield on account of increased number of grains per cob and grain weight per cob, etc.

4. CONCLUSIONS

Considering all the results presented above, it canbe concluded that, LDH performs better then SDH which out yielded with respect to higher grain, stover yields and also growth parameters.Grain yield showed an increasing trend up to the maximum levels of the N applied (250 kg N ha^{-1}). The N applied at levels greater than 200 kg ha^{-1} resulted in no additional response in terms of grain yield, but increased in the grain nitrogen content and nutrient uptake.

GLOBAL JOURNAL OF ADVANCED RESEARCH
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