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RESPONSE OF *KHARIF* MAIZE (*Zea mays* L.) TO NITROGEN LEVELS AND PLANT DENSITIES

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ABSTRACT
A field experiment was conducted during *kharif* season, 2012 to study the influence of different levels of nitrogen and plant densities on growth parameters, yield parameters and economics of maize. Progressive increase in yield attributes like cob weight (9492.12 kg ha^{-1}), cob girth (14.90 cm), number of rows per cob (14.21), number of grains per row (34.38) and 100-grain weight (30.61 g) was observed due to increased nitrogen levels from 150 to 250 kg ha^{-1} and highest cob length (17.82 cm) and shelling percentage (64.79%) was recorded at 200 kg N ha^{-1}. Application of 250 kg N ha^{-1} produced significantly higher grain and stover yield over 150 and 200 kg N ha^{-1}. With regard to plant densities, yield attributes like longest cobs (18.37 cm), highest cob girth (14.97 cm) and maximum number of grains per row (35.88) were obtained at a spacing of 75 X 20 cm which was on par with 75 X 15 cm and 45 X 30 cm and higher cob yield, grain yield was obtained at a spacing of 75 X 15 cm.

KEY WORDS: Nitrogen, plant densities, *kharif* maize.

INTRODUCTION

Maize is grown under diversified environment unmatched by any another crops as the expansion of maize to new areas and environment still continues. Maize is gaining popularity among the farmers in India due to its versatile characteristics of suitability and adaptability to various agro-climates. Maize is the most efficient coarse cereal crop species in utilizing radiant energy and has the highest capacity to generate carbohydrates per day as compared to other cereals. The crop is less susceptible to environmental hazards and cost of production per kg of grain is less compared to other cereals, which lead to drawing the attention of the farmers of Andhra Pradesh and India. In India it is cultivated in an area of 8.26 million hectares with grain production of 18.96 million tonnes and productivity of 2295 kg ha^{-1}. In Andhra Pradesh it is cultivated in an area of 0.78 million hectares with grain production of 4.13 million tonnes and productivity of 5294 kg ha^{-1} (www.indiastat.com). Since there is a limited scope to increase the area under maize cultivation because of competition from other cereals and commercial crops, the only alternative is through enhancement of productivity by various management factors. Among the factors limiting grain yield of maize in many areas is inadequate nutrition and improper plant population. Nitrogen is universally deficient in majority of Indian soils and experiments conducted at various places in different agro climatic zones of India, indicated that nitrogen has beneficial effect on growth, yield and yield attributing characters of maize. In addition to nutrient management, optimum plant population also play crucial role in enhancement of crop productivity. Optimum plant density should be characterized and maintained with uniform stand which is essential for higher and sustained productivity. In addition to plant population, it is the proper crop geometry which is important from the point of intercepting sunlight for photosynthesis besides efficient use of plant nutrients and soil moisture. Correlating these functions to produce the highest possible yields with greatest efficiency has been the aim of research workers since maize production began. Therefore, matching fertilizer schedule with optimum plant stand is essential to achieve targeted yields.

MATERIALS & METHODS

A field experiment was conducted during *kharif*, 2012 at college farm, agricultural college, Mahanandi, ANGRAU. The soil of the experimental site was sandy loam and it was slightly alkaline in reaction with a pH of 7.98, EC of 0.06 dSm^{-1} and low in organic carbon (0.46%) and available nitrogen (266 kg ha^{-1}), medium in available phosphorous (96.6 kg P_2O_5 ha^{-1}) and high in available potassium (674.3 kg K_2O ha^{-1}). The experiment was laid out in factorial randomized block design and replicated thrice. The treatments consisted of three nitrogen levels *viz.*, N_1 (150 kg N ha^{-1}), N_2 (200 kg N ha^{-1}) and N_3 (250 kg N ha^{-1}) and six plant densities *viz.*, D_1: 75 X 20 cm (66,667 plants ha^{-1}), D_2: 75 X 15 cm (88,889 plants ha^{-1}), D_3: 60 X 20 cm (83,333 plants ha^{-1}), D_4: 60 X 15 cm (1,11,111 plants ha^{-1}), D_5: 45 X 30 cm (74,074 plants ha^{-1}) and D_6: 45 X 20 cm (1,11,111 plants ha^{-1}). Pioneer hybrid 30v92 which matures in 100-105 days was tested in this experiment. Nitrogen, phosphorous and potassium were applied in the form of urea, single super phosphate and muriate of potash. Nitrogen was applied in four equal splits (basal at the time of sowing, 20-25, 40-45 and 60-65 DAS) where as entire phosphorous (60 kg P_2O_5) and potassium (40 kg K_2O) were applied as basal at the time of sowing. Atrazine @ 1.5 kg a.i. ha^{-1} was applied as pre-emergence spray after sowing. One inter cultivation followed by one hand weeding in rows was taken at 30

DAS. All the plots were irrigated uniformly as and when required based on soil moisture content and phenological stages of crop growth. Totally three irrigations were given to crop in addition to the rainfall received during the season. Plant height (cm) was measured from the base of the plant to the tip of the top most leaf at 30 and 60 DAS and to the tip of the tassel at 90 DAS. The girth of cob from selected ten plants was measured in centimeters at center, top and base of cob and the average was expressed as cob girth. Economics was calculated based on present market price of yield and inputs.

RESULTS & DISCUSSION

Effect of nitrogen levels

Yield attributes

Yield attributes like cob weight (9492.12 kg ha^{-1}), cob girth (14.90 cm), number of rows per cob (14.21), number of grains per row (34.38) and 100-grain weight (30.61 g) were increased with increasing nitrogen levels up to 250 kg ha^{-1} which was significantly superior over 200 and 150 kg N ha^{-1} while cob length (17.82 cm) and shelling percentage (64.79%) were higher at 200 kg N ha^{-1}. Application of 250 kg N ha^{-1} recorded significantly highest grain yield (6513.20 kg ha^{-1}) and stover yield (9460.16 kg ha^{-1}) as compared to lower levels of nitrogen. Similar results were obtained by Muniswamy *et al.,* (2007) and Vinod kumar *et al.,* (2012). The grain yield depends on the partioning of the dry matter into its economical portion and its conversion into grain (Donald, 1962).

TABLE 1. Yield attributes as influenced by different nitrogen levels and plant densities

Treatment	Cob length (cm)	Cob girth (cm)	No. of grains per row	No. of rows per cob	Cob yield (kg ha^{-1})	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Shelling percentage	Hundred - grain weight (g)	Harvest index (%)
Nitrogen levels (kg ha^{-1})										
150	17.02	14.51	33.56	13.51	8346.78	5369.7	6647.58	64.38	26.5	35.75
200	17.82	14.63	34.34	13.88	9065.23	5853.04	9437.45	64.79	28.72	32.33
250	17.18	14.9	34.38	14.21	9492.12	6513.2	9460.16	62.04	30.61	31.07
SEm±	0.21	0.07	0.55	0.08	307.64	203.54	160.3	1.37	0.55	0.9
C.D. (P=0.05)	0.63	0.22	NS	0.25	884.48	585.18	460.87	NS	1.61	2.61
Plant densities										
75 X 20 cm	18.37	14.97	35.88	14.02	9046.29	5887.66	10827.42	65.82	28.66	30.22
75 X 15 cm	17.53	14.83	34.86	14.04	9777.74	6241.1	9277.77	63.63	26.11	32.99
60 X 20 cm	17.35	14.66	34.53	14.29	8556.72	5476.15	7458.15	64.03	28.88	34.25
60 X 15 cm	16.07	14.16	30.86	13.26	8096.39	4987.19	8180.58	61.67	27.44	30.44
45 X 30 cm	18.26	14.81	35.75	14.00	8945.45	5557.36	8068.78	62.67	30.22	32.75
45 X 20 cm	16.45	14.65	32.68	13.58	9386.66	6058.14	7277.8	64.6	30.33	37.65
SEm±	0.3	0.1	0.77	0.12	435.08	287.85	226.7	1.93	0.79	1.28
C.D. (P=0.05)	0.89	0.31	2.25	0.35	NS	827.58	651.77	NS	2.28	3.69
N X D										
SEm±	0.53	0.18	1.35	0.21	753.58	498.58	392.66	3.36	1.37	2.22
C.D. (P=0.05)	NS	NS	NS	0.61	NS	NS	1128.9	NS	NS	NS

Effect of plant densities

Yield attributes

Perusal of the data indicated that longest cobs (18.37 cm), highest cob girth (14.97 cm) and maximum number of grains per row (35.88) were obtained at a spacing of 75 X 20 cm which was on par with 75 X 15 cm and 45 X 30 cm. Maximum number of rows per cob (14.29) was found at a spacing of 60 X 20 cm which was at par with 75 X 20 cm, 75 X 15 cm and 45 X 20 cm. The maximum hundred grain weight (30.33 g) was obtained at a spacing of 45 X 20 cm and it was on par with rest of the plant densities. The highest shelling percentage (65.82 %) was recorded at spacing of 75 X 20 cm and significantly highest harvest index (37.65 %) was recorded at 45 X 20 cm. Plant spacing of 75 X 20 cm found to be significantly superior in producing highest stover yield. A wider spacing of 75 X 15 cm recorded significantly higher cob and grain yield over closer spacings. It might be due to beneficial effect of spacing, moisture, nutrients and other growth promoting factors on wide spaced plants having lower plant population of maize. The similar trend of results was also reported by Chennakesava *et al.,* (2000) and Suryavanshi *et al.,* (2008).

From above investigation it can be concluded that sowing of hybrid maize 30v92 at 75 X 15 cm spacing with the application of 250 kg N ha^{-1} was more beneficial for getting higher grain yield.

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