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IMPACT OF CROP GEOMETRY AND NITROGEN LEVELS ON THE PERFORMANCE OF FODDER MAIZE

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ABSTRACT

An investigation on the performance of fodder maize to varied crop geometry and nitrogen levels was conducted during *kharif*, 2013 at S.V.Agricultural College, Tirupati on sandy loam soil. There were eighteen treatment combinations consisted of six crop geometries *viz.,* 30 × 10 cm, 30 × 15 cm , 30 × 20 cm, 45 × 10 cm , 45 × 15 cm and 45 × 20 cm assigned to the main plots and three nitrogen levels *viz.,* 140 kg ha^{-1}, 180 kg ha^{-1} and 220 kg ha^{-1} applied to sub plots in split plot design with three replications. The crop geometry of 30 × 10 cm (3,33,333 plants ha^{-1}) recorded the highest values of growth parameters and green fodder yield of fodder maize while they were found to be the lowest with 45 × 20 cm (1,11,111 plants ha^{-1}). Growth characters like number of leaves $plant^{-1}$ and dry matter accumulation as well as green fodder yield were increased due to increased levels of nitrogen application from 140 to 220 kg ha^{-1}. The treatment combination of a crop geometry of 30 × 10 cm with application of 220 kg N ha^{-1} resulted in the maximum green fodder yield (412 q ha^{-1}) and benefit-cost ratio (4.0) followed by 30 × 15 cm with 220 kg N ha^{-1}.

KEY WORDS: Crop geometry, Fodder maize, Green fodder and Nitrogen levels

INTRODUCTION

Against the projected need of 1025 million tonnes of green fodder in the country, the present availability is to the tune of 390 million tonnes only. Andhra Pradesh supports 59.8 million heads of livestock with a vast deficit of about 50 per cent of green fodder. The area under fodder crops is negligible with 4.6 per cent of the cultivated area. Maize (*Zea mays* L.) is a miracle crop grown for food as well as fodder having an edge over other fodder crops due to its higher production potential of green herbage, which is highly succulent, sweet, palatable, nutritious with lactogenic effect and highly relished by the milch cattle at any stage of the crop growth. The plant population that can be maintained with crop geometry influences the canopy architecture, alters growth and developmental pattern and paves the way for efficient utilization of available resources. Therefore, among the agronomic practices, the optimum plant population with suitable crop geometry is an extremely simple and monetary practice for enhancing the productivity of fodder maize. On the other hand, maize is a nitro positive crop and needs ample quantity of nitrogen for the expression of its full yield potential. Keeping all the above points in view, to evolve best agronomic practices for higher yield and quality of fodder maize, the present investigation was carried out to identify the best combination of crop geometry and nitrogen levels for higher productivity and quality of fodder maize.

MATERIAL AND METHODS

A field experiment was carried out during *kharif*, 2013 on sandy loam soils of dryland farm, S.V. Agricultural College, Tirupati, Acharya N.G. Ranga Agricultural University. The soil was sandy loam in texture, low in organic carbon and available nitrogen (188 kg ha^{-1}) and medium in available phosphorus (14 kg ha^{-1}) and potassium (164 kg ha^{-1}) .The experiment was laid out in a split plot design and replicated thrice. The treatments consisted of six crop geometries *viz.,* 30 × 10 cm, 30 × 15 cm, 30 × 20 cm , 45 × 10 cm, 45 × 15 cm and 45 × 20 cm assigned to the main plots and three nitrogen levels *viz.,* 140 , 180 and 220 kg ha^{-1} applied to sub plots. The test variety of fodder maize was 'African Tall'. was sown on 26-07-2013 and harvested on 02-10-2013. Uniform dose of 75 kg ha^{-1} P_2O_5 through single super phosphate and 30 kg ha^{-1} K_2O through muriate of potash was applied basally, at the time of sowing in furrows

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5 cm away from the seed rows. Nitrogen was applied through urea as per the treatments in two equal splits at the time of sowing as basal and at 30 DAS as top dressing. The growth parameters *viz.*, number of leaves plant^{-1}, drymatter production along with green fodder yield were recorded and statistically analyzed by the method of analysis of variance as outlined by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Crop Geometry

The highest number of leaves plant^{-1} and dry matter production of fodder maize at harvest were produced with the crop geometry of 30 × 10 cm, while the reduced growth stature was observed with 45 × 20 cm. Higher plant density unit area^{-1} (3,33,333 plants ha^{-1}) might have produced more number of green leaves per unit area though the number of leaves plant^{-1} was found to be the lowest. Optimum plant density at this geometry might have promoted better light interception by the leaves and enhanced photosynthesis leading to higher dry matter production, which was noticed in the present study corroborates with earlier findings of Sheraz Mahdi *et al.* (2010).

Higher plant density of 3,33,333 plants ha^{-1} might have resulted in better light absorbance by more number of flag leaves which have higher photosynthesis efficiency and enhanced green fodder yield. (Tetio-Kagho and Gardnar, 1988). Decreased row spacing with 30 × 10 cm also promotes more equidistant plant spacing which decreases plant competition, while improves better resource capture and utilization in maize. (Duncan, 1958). The crop geometry of 30 × 10 cm recorded 102.6% of higher green fodder yield than 45 × 20 cm. Though the leaf number plant^{-1} was found to be the highest with the crop geometry of 45 × 20 cm, it resulted in the lowest leaf area index and dry matter production due to sparse plant density unit area^{-1} and thus recorded the lowest green fodder yield. Enhanced fodder yield with the closer crop geometry of fodder maize, as in the present study corroborates with earlier findings of Muhammad Aslam *et al.* (2011). The highest net returns and benefit-cost ratio were realized with fodder maize under the crop geometry of 30 × 10 cm, which was superior to all other crop geometries tried.

Nitrogen Levels

Increasing the nitrogen levels from 140 to 220 kg ha^{-1} resulted in progressively improved growth stature of maize *viz.,* higher number of leaves plant^{-1} and dry matter production. The increase in growth parameters with increased levels of nitrogen might be due to enhanced synthesis of chlorophyll, induced cell division and cell expansion leading to stimulated cell elongation along the main axis, which resulted in increased number and length of internodes and conspicuous increase in number of leaves plant^{-1}. Therefore, the increased photosynthetic efficiency with higher nitrogen supply might have resulted in higher dry matter accrual. The findings evidenced in this investigation corroborates with the reports of Safdar Ali *et al.* (2012).

Nitrogen in plants has many functions for enhancement of morphological and physiological traits *viz.*, shoot development, leaf emergence, plant stuffiness and dry matter accumulation. The highest level of nitrogen tried at 220 kg ha^{-1} resulted in 43.5% of higher green fodder yield compared to the lowest level at 140 kg ha^{-1}. There was linear and significant increase in benefit-cost ratio with increase in nitrogen level. Higher nitrogen level of 220 kg ha^{-1} proved to be economically advantageous with higher green fodder yield of maize.

Interaction effect of crop geometry and nitrogen levels

With regard to interaction effect, the highest number of leaves plant^{-1} was observed with 45 × 20 cm of crop geometry and 220 kg N ha^{-1} due to the advantage of increased availability of nitrogen and other growth resources under higher level of nitrogen supply with lower plant population. Whereas, the lowest level of nitrogen @ 140 kg N ha^{-1} might not be sufficient to meet the requirement of higher plant population of 3,33,333 under 30 × 10 cm, which was reflected through production of the lowest number of leaves plant$^{-1.}$. Biomass production is the function of leaf area development and consequential photosynthetic activity. Therefore, the highest green fodder yield of fodder maize was registered with narrow crop geometry of 30 × 10 cm along with the application of highest nitrogen level at 220 kg ha^{-1}. The positive effect of higher plant density under higher level of nitrogen nutrition was resulted through the production of maximum biological yield. The next best combination in producing higher dry matter production was the application of 220 kg N ha^{-1} and 45 × 10 cm. The lowest green fodder yield recorded with the crop geometry of 45 × 20 cm along with 140 kg N ha^{-1} was due to the fact that reduced plants unit area^{-1} with the crop geometry of 45 × 20 cm might have prevented the exploitation of available resources

Table 1. Number of leaves plant^{-1} and dry matter production (kg ha^{-1}) of fodder maize as influenced by crop geometry and nitrogen levels

Treatments	Number of leaves plant^{-1}				Dry matter production (kg ha^{-1})			
	Nitrogen levels (kg ha^{-1})				Nitrogen levels (kg ha^{-1})			
Crop geometry	**140**	**180**	**220**	**Mean**	**140**	**180**	**220**	**Mean**
30 × 10 cm	11.2	12.3	13.3	12.2	7150	7912	10314	8459
30 × 15 cm	11.9	12.9	13.7	12.8	4926	5991	8135	6351
30 × 20 cm	12.7	13.1	14.1	13.3	4138	5308	6141	5196
45 × 10 cm	11.9	14.1	13.7	13.2	4892	6118	7492	6167
45 × 15 cm	12.7	13.3	14.3	13.4	4044	5156	6094	5098
45 × 20 cm	13.1	13.9	14.8	13.9	3319	4335	4910	4188
Mean	12.3	13.3	14.0		4745	5803	7181	
	CD(P=0.05)				**CD(P=0.05)**			
Crop geometry	0.08				339			
Nitrogen levels	0.29				501			
P at N	0.14				587			
N at P	0.32				726			

Table 2. Green fodder yield (q ha^{-1}) and benefit-cost ratio of fodder maize as influenced by crop geometry and nitrogen levels

Treatments	Green fodder yield (q ha^{-1})				Benefit – cost ratio			
	Nitrogen levels (kg ha^{-1})				Nitrogen levels (kg ha^{-1})			
Crop geometry	**140**	**180**	**220**	**Mean**	**140**	**180**	**220**	**Mean**
30 × 10 cm	286	315	411	337	2.8	3.1	4.0	3.3
30 × 15 cm	198	239	239	226	2.1	2.5	3.4	2.7
30 × 20 cm	165	212	246	208	1.8	2.3	2.6	2.2
45 × 10 cm	196	245	299	246	2.1	2.6	3.1	2.6
45 × 15 cm	161	211	242	205	1.8	2.3	2.6	2.2
45 × 20 cm	133	170	196	166	1.5	1.9	2.2	1.8
Mean	189	232	272		2.1	2.5	2.9	
	CD(P=0.05)				**CD(P=0.05)**			
Crop geometry	13.0				0.14			
Nitrogen levels	18.9				0.19			
P at N	22.5				0.26			
N at P	27.6				0.29			

under sub optimal supply of nitrogen at 140 kg ha^{-1} which eventually resulted in the lowest fodder yield under their combination. Sowing the crop with geometry of 30 × 10 cm and application of nitrogen at 220 kg ha^{-1} registered 209 per cent of higher green fodder yield and benefit-cost ratio than with wider crop geometry of 45 × 20 cm and 140 kg N ha^{-1}. These results are in conformity with the findings of ShafiNazir *et al.* (1997).

The present study has revealed that sowing of at 30 × 10 cm (3,33,333 plants ha^{-1}) and application of nitrogen at 220 kg ha^{-1} proved suitable agro technique for achieving higher productivity and remunerative returns of fodder maize.

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