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RESEARCH PAPER

Evaluation of medium-maturity maize genotypes under varying planting densities and fertility levels

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Abstract A field experiment was conducted at the Agricultural Research Station, Peddapuram, Kakinada District during *kharif,* 2019 on sandy loam soils to evaluate the performance of pre-release medium-maturity maize genotypes under varying planting densities and fertility levels. The experiment was laid out in a split-split plot design with three replications. The main plots comprised two planting densities *viz*., 60 × 20 cm and 50 × 20 cm. The sub-plots included two fertility levels *viz*., 100 per cent recommended dose of fertilizer (RDF)- 200:60:50 kg NPK/ha and 150% RDF (300:90:75 kg NPK/ha) and in the sub-sub plot, two genotypes *viz*., H_1- INDAM 1122, H_2 - BIO - 9544© were tried. The results revealed that the maize genotype INDAM 1122, when planted at 50 × 20 cm spacing with 150% RDF, recorded the highest net returns (Rs. 83,891/ha) and benefit-cost (B:C) ratio (2.38). Moreover, maize genotype INDAM 1122 produced a 7.04% higher grain yield (8,247.6 kg/ha) compared to the check hybrid BIO 9544, which yielded 7,666.5 kg/ha. Thus, maize hybrid INDAM 1122 at 50 × 20 cm spacing with 150% RDF is recommended for realizing higher yield and profitability under Andhra Pradesh condition

Keywords: Economics • Fertility levels • Maize • Spacing

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Introduction

Maize (*Zea mays* L.) is the third most important cereal crop in India after rice and wheat and holds considerable global significance. Known as the “Queen of Cereals” and the “Miracle C_4 crop,” maize has the highest yield potential among cereal crops, making it a vital component of global agriculture. It serves as a primary source of food (61%), animal feed (17%) and industrial raw materials (22%), including starch, syrup, ethanol and cosmetics. Its ability to thrive across diverse agro-climatic zones and its wide range of applications have contributed to increased demand and expanded cultivation. In India, maize is grown year-round across various regions due to its wide ecological adaptability (Murdia *et al*., 2016). It plays a key role in ensuring food and nutritional security, supporting livelihoods and enhancing economic resilience, particularly in rainfed and marginal farming systems.

Despite its potential, maize productivity is strongly influenced by the interaction of genetic factors, environmental conditions and agronomic management practices. Among these, planting density and nutrient management are especially critical (Sahoo *et al*., 2020). Plant population density affects intra-specific competition for resources such as light, water and nutrients, thereby influencing important yield attributes like cob number, kernel rows and grain weight. Additionally, as a nutrient-demanding crop, maize requires a substantial and timely supply of nitrogen, phosphorus and potassium for optimal growth and productivity.

To fully exploit the genetic yield potential of maize, it is essential to understand the interaction between genotype, planting geometry and fertilizer levels. This study was undertaken to evaluate the performance of pre-release medium-maturity maize genotypes under different planting densities and nutrient levels, with the aim of identifying optimal combinations for maximizing productivity and profitability under the agro-climatic conditions of Andhra Pradesh.

Material and methods

A field experiment was conducted during *kharif*, 2019 on sandy loam soils at the Agricultural Research Station, Peddapuram (17.08°N latitude and 82.13°E longitude), to study the response of pre-release medium-maturity maize genotypes to varying planting densities and nutrient levels. The soil at the experimental site was low in organic carbon (0.40 kg/ha), available nitrogen (204 kg/ha) and potassium (155 kg/ha) and medium in available phosphorus (38 kg/ha). During the cropping season, the total rainfall received was 711.1 mm across 43 rainy days. The mean maximum and minimum temperatures were 31.6°C and 23.8°C, respectively. Relative humidity ranged between 63.6 to 91 per cent. The experiment was laid out in a split – split plot design. In the main plot, two planting densities *viz*., D_1- 60 × 20 cm and D_2 - 50 × 20 cm; in the sub plot, two fertility levels *viz*., F_1:100% RDF- 200:60:50 kg NPK /ha and F_2: 150% RDF -300:90:75 kg NPK /ha and in the sub-sub plot, two genotypes *viz*., H_1- INDAM 1122, H_2 - BIO - 9544© were tried in three replications. Fertilizers were applied in the form of urea, single superphosphate and muriate of potash as per treatments. Crop protection measures were taken as necessary, and all recommended agronomic practices were followed to ensure a healthy crop stand. For data collection, five plants were randomly selected and tagged in each plot to record growth parameters and yield attributes. Yields from the net plot area were harvested and expressed on a per-hectare basis. Economic analysis, including cost of cultivation, gross returns, and net returns per hectare, was calculated based on prevailing local market prices for inputs and outputs. All data collected were statistically analyzed using the standard procedure outlined by Gomez and Gomez (1984). The results were interpreted and discussed at a 5% level of significance.

Results and discussions

Growth parameters and phenology

Planting density and fertility levels did not significantly affect most growth parameters of maize (Table 1).

Table 1. Growth, and phenology of maize as effected by varying planting densities, nutrient levels and genotypes during *kharif,* 2019

Treatments	Plant height (cm)	Plants ('000/ha)	Cobs ('000/ha)	Days to 50% tasseling	Days to 50% silking
Main plot: Plant density					
60 × 20 cm	156.7	75.7	73.7	49.0	52.1
50 × 20 cm	156.2	93.0	91.0	49.3	52.5
SEm ±	2.2	0.29	0.35	0.07	0.15
CD (P = 0.05)	NS	1.3	1.57	NS	NS
CV (%)	5.6	1.4	1.7	0.6	1.2
Sub plot: Fertility levels					
100% RDF	155.0	83.9	81.7	48.9	52.0
150% RDF	157.9	84.8	83.0	49.3	52.6
SEm ±	1.45	0.46	0.46	0.15	0.07
CD (P = 0.05)	NS	NS	NS	NS	0.23
CV (%)	3.7	2.2	2.2	1.3	0.5
Sub - sub plot: Maize hybrids					
INDAM 1122	167.7	85.6	83.6	47.4	50.6
H2- Bio 9544 ©	145.2	83.1	81.0	50.9	53.9
SEm ±	2.02	0.36	0.32	0.13	0.18
CD (P = 0.05)	6.23	1.1	0.99	0.40	0.55
CV (%)	5.2	1.7	1.6	1.1	1.4
Interaction	NS	NS	NS	NS	NS

However, higher plant height was observed with 150% RDF (157.9 cm), and with the plant spacing of 60 × 20 cm (156.7 cm). The increased plant height with higher fertilizer levels may be attributed to greater nutrient availability that supported vigorous vegetative growth, corroborating findings by Asghar *et al*. (2010). Among genotypes, INDAM 1122 showed significantly higher plant height (167.7 cm) at harvest compared to the check hybrid BIO 9544 (145.2 cm), which can be attributed to its genetic potential**.**

Significant differences were observed in plant and cob population per hectare due to planting density. The planting density 50 × 20 cm resulted in a significantly higher number of plants and cobs per hectare compared to planting density 60 × 20 cm. However, plant population was not significantly influenced by nutrient levels. These findings are in agreement with Bangarwa *et al.* (1988) and Lashkari *et al.* (2011). The genotype INDAM 1122 consistently recorded a greater number of plants and cobs per hectare than the check hybrid BIO 9544, which can be attributed to its superior genetic makeup. These results are in agreement with the findings of Rafiq *et al.* (2010).

Planting density and fertility levels did not significantly influence days to 50% tasseling and silking. However, genotype had a notable effect. INDAM 1122 flowered earlier, with 50% tasseling and silking occurring at 47.4 and 50.6 days, respectively, compared to 50.9 and 53.9 days in BIO 9544.

Yield attributes

Yield attributing characters *viz.*, cob length, cob girth, no. of kernel rows per cob and no. of kernels per row were not significantly influenced by planting densities and fertility levels (Table 2). However, 60 × 20 cm registered higher 100-seed weight (32.4 g). This was due to reduced competition and better availability of light, aeration and nutrients than 50 x 20 cm. These results are in conformity with the findings of Lashkari *et al.* (2011).

Regarding fertility levels, 150% RDF recorded a higher 100-seed weight (32.1 g) compared to 100% RDF, attributed to enhanced nutrient availability that favored seed development. This aligns with the findings of Ngairangbam *et al.* (2011). Among genotypes, INDAM 1122 recorded a significantly higher 100-seed weight (33.2 g) compared to BIO 9544, owing to its genetic potential. However, the interaction effect was not significantly influenced by both densities as well as fertility levels.

Table 2. Yield parameters and yield of maize as effected by varying planting densities, nutrient levels and genotypes during *kharif,* 2019

Treatments	100-seed weight (g)	Cob length (cm)	Cob girth (cm)	No. of kernel rows per cob	No. of kernels per row	Seed yield (t/ha)	Stover yield (kg/ha)
Main plot: Plant density							
60 × 20 cm	32.4	16.4	15.5	13.8	36.6	7.74	9.95
50 × 20 cm	31.2	16.1	15.2	13.6	35.6	8.17	10.37
SEm ±	0.54	0.07	0.08	0.14	0.46	174.9	188.3
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS
CV (%)	6.8	1.9	2.3	4.3	5.2	8.8	7.41
Sub plot: Fertility levels							
100% RDF	31.5	16.1	15.1	13.5	35.9	7.76	9.91
150% RDF	32.1	16.5	15.6	13.8	36.2	8.15	10.41
SEm ±	0.36	0.13	0.17	0.09	0.34	98.4	140.5
CD (P = 0.05)	NS	NS	NS	NS	NS	339.5	484.9
CV (%)	4.5	3.2	4.6	2.7	3.8	4.9	5.5
Sub - sub plot: Maize hybrids							
INDAM 1122	33.2	17.0	16.2	14.6	37.6	8.24	10.51
Bio 9544 ©	30.4	15.6	14.5	12.8	34.6	7.66	9.14
SEm ±	0.44	0.12	0.16	0.13	0.24	151.9	296.2
CD (P = 0.05)	1.36	0.37	0.51	0.41	0.73	467.9	NS
CV (%)	5.5	3.0	4.3	3.9	2.6	7.6	11.7
Interaction	NS	NS	NS	NS	NS	NS	NS

Grain and stover yield

The maize grain yield was not significantly influenced by planting density (Table 2). However, the planting density of 50 × 20 cm recorded numerically higher grain and stover yields (8,171.3 kg/ha and 10,368.9 kg/ha, respectively) compared to the 60 × 20 cm spacing. Among the fertility levels, application of 150% RDF resulted in higher grain and stover yields (8,150.8 kg/ha and 10,410.7 kg/ha, respectively) than 100% RDF, due to improved nutrient availability, which supported better crop growth and productivity.

Among the genotypes, INDAM 1122 recorded the highest grain yield (8,247.6 kg/ha) and stover yield (10,507.8 kg/ha), showing a 7.6 per cent yield advantage over the check hybrid BIO 9544 (7,666.5 kg/ha grain and 9,814.1 kg/ha stover yield). The superior performance of INDAM 1122 can be attributed to its higher genetic yield potential and efficient utilization of applied nutrients under favourable management conditions. These results corroborate the findings of Khan *et al*. (2011) and Paramasivan *et al*. (2011), who reported enhanced maize yields with increased nutrient application and appropriate genotype selection.

Economics

The data regarding economics and benefit-cost (B:C) ratio of maize as influenced by planting density and nutrient levels are presented in Table 3. The economic analysis was based on the prevailing market prices of inputs and outputs during the experimental period. Among all treatments, the hybrid INDAM 1122 under 50 × 20 cm spacing with 150% RDF (300:90:75 kg NPK/ha) recorded the highest net returns (Rs. 89,050/ha) and a B:C ratio of 2.39. In contrast, the lowest net returns (Rs. 68,176/ha) and B:C ratio of 2.16 were observed with BIO 9544 under 60 × 20 cm spacing with 100% RDF. The results are in accordance with findings of sivamurugan (2018).

Table 3. Economics of maize as effected by varying planting density, nutrient levels and genotypes during *kharif,* 2019

Treatments	Gross return (Rs./ha)	Cost of cultivation (Rs./ha)	Net Returns (Rs./ha)	B:C ratio
D1F1H1	137640	58837	78803	2.34
D1F1H2	127013	58837	68176	2.16
D1F2H1	145344	61969	83375	2.35
D1F2H2	135093	61969	73124	2.18
D2F1H1	144678	60787	83891	2.38
D2F1H2	137200	60787	76413	2.26
D2F2H1	152969	63919	89050	2.39
D2F2H2	140413	63919	76494	2.20

Conclusion

From the experimental findings, it can be concluded that INDAM 1122 is the most promising medium-maturity maize hybrid when grown at 50 × 20 cm spacing with 150% RDF (300:90:75 kg NPK/ha) under the agro-climatic conditions of Andhra Pradesh.

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