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RESEARCH PAPER

Growth, yield and economics of maize (*Zea mays* L.) hybrids under varying fertility levels during *kharif* in Andhra Pradesh

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Abstract: A field experiment was conducted during *Kharif* 2024 to evaluate the performance of pre-release field corn (*Zea mays* L.) hybrids under varying fertility regimes in sandy loam soils of Andhra Pradesh. The trial was laid out in a split-plot design with three fertility levels in the main plots [100% RDF (200:60:50 N:P_2O_5:K_2O kg ha^{-1}), 125% RDF (250:75:62.5 N:P_2O_5:K_2O kg ha^{-1}) and 150% RDF (300:90:75 N: P_2O_5:K_2O kg ha^{-1})] and four maize hybrids (IW 8477, JKMH 4059, RCRMH 20, and BIO 9544) in the sub-plots, replicated thrice. Application of 150% RDF significantly improved plant height, yield attributes, grain yield (7206 kg ha^{-1}) and economic returns (Rs. 86,757 ha^{-1} net returns & B:C ratio of 2.17). Among the hybrids, JKMH 4059 found as superior, recording the highest grain yield (7698 kg ha^{-1}) and profitability (Rs. 100,191 ha^{-1} net returns & B:C ratio of 2.40). It is therefore concluded that maize hybrid JKMH 4059 under 150% RDF can be recommended for achieving higher yield and profitability during *Kharif* season for Andhra Pradesh.

Keywords: Field corn • Fertility levels • Grain yield • Profitability

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Introduction

Maize (*Zea mays* L.), popularly grown as field corn, is one of the most important cereal crops worldwide, ranking after rice and wheat in terms of area and production. It is recognized for its high yield potential, wide ecological adaptability and diverse end uses in food, feed and industry. Globally, it serves as a major source of food, livestock feed and industrial raw materials, making it indispensable to agricultural economies. In India, maize occupies a prominent place in the cropping systems due to its versatility and economic significance.

The *Kharif* season accounts for a substantial share of maize cultivation in the country, often under rainfed or partially irrigated conditions, where fluctuations in soil fertility and nutrient availability strongly influence productivity. With the rising demand for maize as food, livestock feed and industrial raw material, there is a pressing need to identify hybrids that can sustain high and stable yields under variable fertility situations (Murugudu *et al.,* 2023).

Among the production factors, nutrient management is of paramount importance. Maize is highly responsive to nitrogen (N), phosphorus (P) and potassium (K), and its nutrient requirement is considerably higher than many cereals. Fertility levels not only determine vegetative vigor but also influence key yield attributes such as cob size, kernel number and grain filling. Imbalanced fertilization reduces crop performance, while excessive nutrient use escalates production costs and environmental risks (Kannan *et al.,* 2013).

Genotype × nutrient management interactions are known to play a decisive role in governing maize yield and profitability, as nutrient use efficiency and responsiveness vary across hybrids and environments (Kumar *et al*., 2015). However, information on the performance of pre release field corn hybrids under varying fertility levels during the *Kharif* season remains limited, particularly in Andhra Pradesh.

Therefore, the present study was conducted to evaluate the growth, yield and economic returns of pre-release maize hybrids under different fertility regimes, with the aim of identifying suitable hybrid × fertility combinations for maximizing productivity and profitability in Andhra Pradesh.

Materials and methods

A field experiment was conducted during *Kharif,* 2024 at the Agricultural Research Station, Peddapuram, Andhra Pradesh (17.08°N latitude and 82.13°E longitude) to evaluate the performance of field corn (*Zea mays* L.) hybrids under different fertility levels. The experimental soil was sandy loam in texture, low in organic carbon (0.40%), available nitrogen (210 kg/ha) and potassium (161 kg/ha), and medium in available phosphorus (39 kg/ha).

The trial was laid out in a split-plot design with three replications. The main plot plots consisted of three fertility levels: 100% RDF (200:60:50 kg N:P_2O_5:K_2O/ha), 125% RDF (250:75:62.5 kg N:P_2O_5:K_2O/ha) and 150% RDF (300:90:75 kg N: P_2O_5:K_2O/ha). The sub-plots comprised four maize hybrids: IW 8477 (9243C), JKMH 4059, RCRMH 20 and BIO 9544 . Nutrients were applied through urea, single superphosphate and muriate of potash. The entire phosphorus dose was applied as basal, nitrogen was supplied in three equal splits (basal, knee-high, tasseling), and potassium in two equal splits (basal and tasseling). Standard crop management practices, including weeding and plant protection measures, were followed to ensure optimum growth.

For data collection, five representative plants were randomly tagged in each plot to record growth and yield attributes including plant height, days to 50% tasseling and silking, cob length, cob girth, kernel rows per cob, kernels per row and 100-seed weight. Grain yield was harvested from the net plot area, adjusted to 12% moisture content and expressed on a hectare basis. Stover yield was recorded after sun-drying the harvested biomass. Economic analysis was undertaken by calculating the cost of cultivation, gross and net returns and the benefit–cost ratio per hectare, using prevailing market prices of maize grain and stover during the season. All experimental data were statistically analyzed following the procedure of Gomez and Gomez (1984) and treatment differences were tested for significance at the 5% probability level.

Results and discussion

Growth and phenology

Fertility management significantly influenced plant stature and crop phenology (Table 1). Application of 150% RDF produced the tallest plants (203.0 cm), while plants under 100% RDF remained shorter (188.6 cm). The increase in height under higher fertility can be attributed to better nutrient availability, especially nitrogen, which enhanced vegetative vigor and biomass accumulation. Similar findings were reported by Rajput *et al.* (2023), who observed that nitrogen enrichment promotes enhanced nutrient uptake and robust growth.

Genotypic variation was evident among the tested hybrids. JKMH 4059 and RCRMH 20 attained heights 205.8 and 204.3 cm, whereas the check hybrid BIO 9544 was significantly shorter (169.1 cm). Such differences may be explained by variation in nutrient assimilation efficiency, which directly influences plant architecture and genetic characters of hybrid. This observation is in line with the reports of Hirel *et al*. (2001) and Sanchez *et al*. (2023), who emphasized that genetic variability in nitrogen uptake efficiency governs differences in plant stature.

Crop phenology was also influenced by fertility levels. Days to tasseling and silking were delayed under lower fertility (100% RDF), whereas higher fertility (125% and 150% RDF) hastened flowering. This trend indicates that balanced nutrient supply accelerates crop development by ensuring adequate assimilates for reproductive transition. Among hybrids, JKMH 4059 flowered the earliest (50.6 days to tasseling), while BIO 9544 was the latest (53.0 days). Similar results were documented by

Table 1. Growth and phenology of maize hybrids as influenced by fertility levels during *Kharif,* 2024

Treatments	Plant height (cm)	Plants (‘000/ha)	Cobs (‘000/ha)	Days to 50% tasseling	Days to 50% silking
Main plot: Fertility levels					
100 % RDF	188.6	77.4	72.9	53.2	55.5
125 % RDF	192.2	76.8	70.6	51.9	53.8
150 % RDF	203.0	77.1	72.3	51.2	53.4
SEm ±	2.57	0.44	1.01	0.1	0.26
CD (P = 0.05)	10.1	NS	NS	0.37	1.0
CV (%)	5.0	2.0	4.8	0.6	1.6
Sub-plot: Maize hybrids					
IW 8477 (9243C)	199.2	74.5	64.6	54.0	56.0
JKMH 4059	205.8	79.6	77.2	50.6	52.6
RCRMH 20	204.3	77.4	71.5	50.8	53.0
BIO9544	169.1	77.2	74.3	53.0	55.3
SEm ±	3.58	0.92	1.38	0.1	0.14
CD (P = 0.05)	10.6	2.73	4.1	0.3	0.43
CV (%)	6.0	4.0	5.7	0.6	0.8
Interaction	NS	NS	NS	NS	NS

Murugudu *et al*. (2023), who highlighted that higher fertility levels lead to earlier onset of reproductive stages. Overall, the results demonstrate that both nutrient supply and genotype distinctly affected growth and phenology, with higher fertility enhancing vegetative vigor and early reproductive transition, and JKMH 4059 found as the most responsive hybrid.

Yield attributes

Fertility levels exerted a marked influence on yield attributes (Table 2). Application of 150% RDF significantly improved 100-seed weight (32.4 g), cob length (17.1 cm) and cob girth (15.1 cm) as compared to 100% RDF. The enhancement in yield attributes under higher fertility can be attributed to increased nutrient supply, which promoted assimilate partitioning towards reproductive organs and improved grain filling. These findings are consistent with Gul *et al.* (2015) and Amanullah *et al*. (2014), who reported that adequate NPK levels favor cob development and seed weight.

Among hybrids, JKMH 4059 consistently exhibited superior cob morphology, with the highest cob length (17.3 cm), cob girth (15.8 cm), kernel rows per cob (15), and kernels per row (34.6). These improvements translated into better reproductive efficiency compared to other entries. The variation among hybrids confirms the genotype-specific responses reported by Ullah *et al*. (2025). The interaction effect of fertility levels and hybrids was not statistically significant, indicating that hybrids maintained their relative superiority across nutrient regimes.

Grain and stover yield

Grain yield was strongly influenced by fertility management (Table 2). Application of 150% RDF resulted in the highest grain yield (7206 kg ha^{-1}) and stover yield (9055 kg ha^{-1}), significantly surpassing 100% RDF (5762 and 7611 kg ha^{-1}, respectively). The yield advantage under higher fertility is attributed to extended photosynthetic activity, enhanced dry matter accumulation, and greater sink capacity. Similar observations were reported by Dawadi and Sah (2012) and Paramasivan *et al*. (2011). Hybrid performance was distinct and significant. JKMH 4059 produced the maximum grain yield (7698 kg ha^{-1}) and stover yield (9791 kg ha^{-1}), outperforming the check BIO 9544 (6971 and 8906 kg ha^{-1}, respectively). The superior productivity of JKMH 4059 can be linked to its early flowering, larger cob size, and better nutrient utilization efficiency. These results corroborate the findings of Khan *et al.* (2011) and Ullah *et al.* (2025), who emphasized genotype × nutrient interactions as decisive for yield outcomes. No significant interaction effect of fertility levels and hybrids was observed on yield.

Table 2. Yield parameters and yield of maize hybrids under varying fertility levels during *Kharif,* 2024

Treatments	100-seed weight (g)	Cob length (cm)	Cob girth (cm)	No of kernel rows per cob	No of kernels per row	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})
Main plot: Fertility levels							
100 % RDF	25.1	15.1	14.0	13.4	30.7	5762	7611
125 % RDF	29.6	16.3	14.8	14.0	32.9	6408	8306
150 % RDF	32.4	17.1	15.1	14.6	35.0	7206	9055
SEm ±	0.61	0.14	0.07	0.1	0.38	136.8	168.8
CD (P = 0.05)	2.40	0.57	0.26	0.28	1.52	537.3	662.7
CV (%)	7.3	3.2	2.0	2.0	4.1	7.3	7.0
Sub-plot: Maize hybrids							
IW 8477 (9243C)	22.8	15.4	13.5	13.0	31.9	5102	6835
JKMH 4059	35.1	17.3	15.8	15.0	34.6	7698	9791
RCRMH 20	26.9	15.8	14.4	14.0	31.5	6063	7763
BIO9544	31.5	16.1	14.8	14.1	33.0	6971	8906
SEm ±	0.93	0.23	0.17	0.23	0.41	217.5	288.1
CD (P = 0.05)	2.8	0.70	0.50	0.67	1.23	646.2	856.1
CV (%)	9.6	4.4	3.4	4.8	3.8	10.1	10.4
Interaction	NS	NS	NS	NS	NS	NS	NS

Table 3. Economics of maize hybrids as influenced by fertility levels during *Kharif,* 2024

Treatments	Gross returns (Rs/ha)	Cost of cultivation (Rs/ha)	Net Returns (Rs/ha)	B:C
Main plot: Fertility levels				
100 % RDF	128198	68615	59583	1.87
125 % RDF	142567	71099	71468	2.00
150 % RDF	160342	73584	86757	2.17
SEm ±	3045.6		3045.6	0.04
CD (P = 0.05)	12279.1		11957.0	0.15
CV (%)	7.3		14.5	7.2
Sub-plot: Maize hybrids				
IW 8477 (9243C)	113521	71099	42422	1.59
JKMH 4059	171290	71099	100191	2.40
RCRMH 20	134901	71099	63802	1.89
BIO9544	155096	71099	83997	2.17
SEm ±	4840.8		4840.8	0.7
CD (P = 0.05)	14494.3		14380.7	0.20
CV (%)	10.1		20.0	10.0
Interaction	NS		NS	NS

Economics

Economic analysis highlighted the combined influence of fertility and genotype on profitability (Table 3). Application of 150% RDF recorded the maximum net returns (Rs. 86,757 ha^{-1}) with a benefit–cost (B:C) ratio of 2.17, despite higher cultivation costs. This demonstrates that yield gains at higher fertility levels adequately compensated for additional input costs, leading to better profitability. Similar conclusions were drawn by Kumar *et al*. (2015), who noted that higher fertilizer levels enhance returns despite increased expenses.

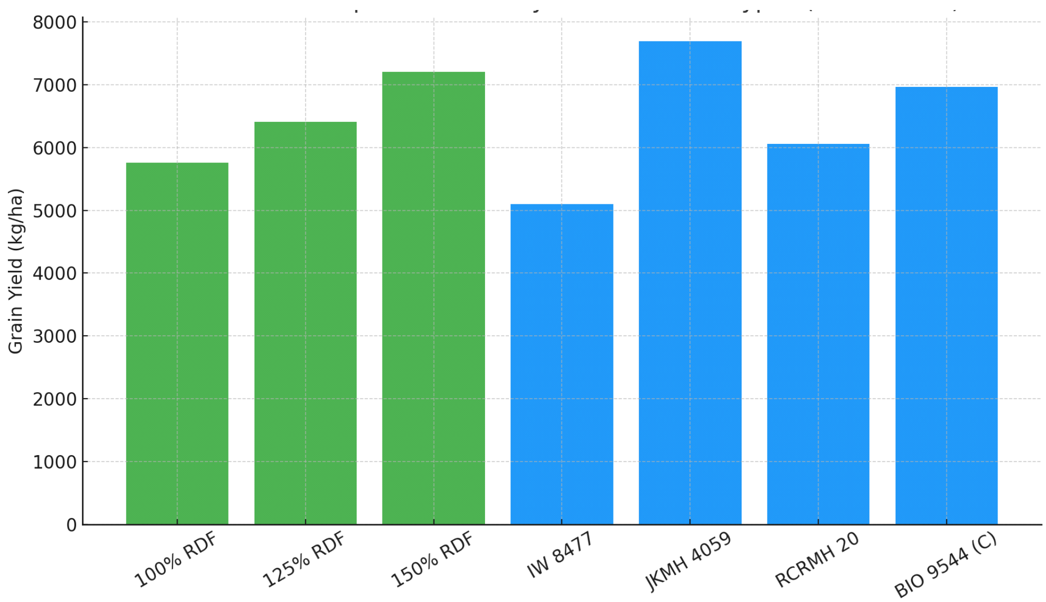

Figure 1. Grain yield of maize as influenced by fertility levels and hybrids (*Kharif* 2024)

Hybrid-wise performance also showed clear differences. JKMH 4059 was the most remunerative, recording net returns of Rs. 100,191 ha^{-1} and a B:C ratio of 2.40, outperforming the check hybrid BIO 9544 (Rs. 83,997 ha^{-1}; B:C ratio 2.17). This establishes JKMH 4059 as the most profitable option under Kharif conditions of Andhra Pradesh. The results align with Pal and Bhatnagar (2012) and Murugudu *et al.* (2023), who reported that hybrid choice in combination with nutrient management determines profitability.

Conclusion

The study demonstrated that fertility management plays a crucial role in improving maize productivity under *Kharif* conditions of Andhra Pradesh. Application of 150% RDF enhanced crop growth, yield attributes, grain production and profitability compared to lower fertility levels. Among the hybrids, JKMH 4059 proved superior in both productivity and economic returns, consistently outperforming the standard check. Therefore, cultivation of JKMH 4059 under 150% RDF can be recommended for achieving sustainable yield and profitability for Andhra Pradesh during the *Kharif* season.

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