

Evaluation of pre release hybrids of maize for yield potential in rainfed ecosystems of coastal Andhra Pradesh

I. Sudhir Kumar • V. Sujatha • P. Munirathnam • G. Prasanthi

Abstract This study aimed to evaluate the phenological, morphological, and yield related performance of 12 pre-release maize hybrids under rainfed conditions in Coastal Andhra Pradesh during Kharif 2022. Significant genetic variability was observed among genotypes for traits such as days to 50% pollen shedding, silking, plant height, ear height, ear yield, kernel yield and shelling percentage. Hybrids like PH 420186, NK 6240, PAC 751 and PDHM 171213 demonstrated strong performance. Notably, PH 1534 combined early maturity, compact plant structure and a competitive yield, making it suitable for moisture-stressed environments. The findings emphasize that improving maize resilience and yield in coastal ecosystems requires a focused approach to hybrid selection.

Keywords: Ear yield • Rainfed • Pre-release hybrid • Maize

Introduction

Maize (*Zea mays* L.) is one of the most important cereal crops, known for its wide adaptability across varied agro-climatic conditions. Globally, it is called the “queen of cereals” due to its highest genetic yield potential among cereal crops. In India, maize is cultivated over 11.2 million hectares, producing 42.3 million tonnes with an average productivity of 3.78 t/ha (Indiastat.com, 2024-25). In Andhra Pradesh, maize is a crucial crop for both food and

industrial uses. According to 2023-24 data, it is grown on approximately 2.91 lakh ha with a production of 19.04 lakh tonnes, achieving an average productivity of 6.54 t/ha-ranking the state 13th nationally (angrau.ac.in).

District-level statistics highlight Bapatla (11.42 t/ha), Eluru (11.84 t/ha), and Vizianagaram (7.03 t/ha) as top performers (angrau.ac.in). Beyond food, maize plays a critical role in supporting the poultry, livestock and industrial sectors, serving as a raw material for starch, dextrose, syrup, flakes, ethanol, and other products (Indiastat.com; angrau.ac.in). Recognizing its strategic value, the Government of Andhra Pradesh has included maize as a key “growth engine” crop under its Swarna Andhra 2047 initiative, aimed at boosting farmers income and supporting bioethanol production. Overall, maize’s significance lies in its high productivity, lower water requirements compared to rice, and versatility across food, feed, and industrial value chains, making it a vital crop for food security, income diversification, and agro-industrial growth in the region.

Maize cultivation in the rainfed ecologies of Andhra Pradesh faces several agronomic challenges. These areas experience erratic and uneven rainfall distribution, often resulting in moisture stress during critical stages of crop growth. According to Singh *et al.* (2020), maize yield under rainfed conditions is highly dependent on moisture availability at flowering and grain-filling stages, with yield losses reaching up to 40 per cent under severe moisture stress. In this context, the timely identification and deployment of maize hybrids with high yield potential and enhanced stress tolerance is essential. These improved genotypes can play a pivotal role in stabilizing maize production, increasing resilience to climatic variability, and improving the livelihoods of farmers in rainfed ecosystems.

✉ I. Sudhir Kumar: i.sudhirkumar@angrau.ac.in

AICRP Maize, ANGRAU-ARS, Peddapuram, Kakinada District, Andhra Pradesh, India

Received: 11 November 2024/ Accepted: 07 July 2025

© Maize Technologists Association of India 2025

Rainfed maize cultivation in these areas plays a crucial role in the livelihoods of small and marginal farmers. Despite the region's significant agricultural potential, maize yields remain sub-optimal due to challenges such as unpredictable monsoon patterns, poor soil fertility, and the lack of region-specific, high-performing hybrids (Reddy *et al.*, 2020; Rao *et al.*, 2019). Developing and evaluating genotypes under specific agro-ecological zones is essential to ensure their suitability and consistent performance (Singh *et al.*, 2021; Kaur *et al.*, 2023). Pre-release evaluation not only helps identify superior hybrids but also establishes a robust pipeline for seed-sector readiness and farmer-level adoption (Kumar *et al.*, 2023). Despite advances in maize hybrid development, limited data is available on the performance of pre-release hybrids specifically under the rainfed lowland and upland conditions of Coastal Andhra Pradesh. Therefore, identifying maize hybrids with improved adaptability and stability for rainfed ecosystems is essential to boost productivity and support farmer livelihoods.

Materials and methods

The present study was conducted during *kharif* 2022 with 12 pre-release maize hybrids, under rainfed conditions at the ARS, Peddapuram, is located at 17.070°N latitude, 82.140°E longitude and an altitude of 46.2 meters above mean sea level. The soil type of the region is sandy loam, with an average temperature of 27.3°C and mean annual rainfall of 988.6 mm. Each plot consisted of six rows, each 4 meters in length, with a spacing of 60 cm between rows and 20 cm between plants. All recommended agronomic practices were followed uniformly across the experiment. Observations were recorded on seven traits from five randomly selected plants per plot. The traits studied included, days to 50% pollen shed, days to 50% silking, plant height, ear height, ear yield, kernel yield and shelling percentage. The collected data were subjected to analysis of variance (ANOVA) using the method outlined by Panse and Sukhatme (1961). Statistical analysis was performed using OPSTAT software.

Results and discussion

The ANOVA revealed highly significant differences among the 12 maize hybrids for all seven traits, highlighting substantial phenotypic diversity under rainfed conditions.

Table 1. Analysis of variance

Characters	Mean sum of squares		
	Replications (df : 1)	Genotypes (df : 11)	Error (df : 23)
Days 50% pollen shed	2.042	1326.011	1.587
Days to 50% silking	2.667	1402.303	1.030
Plant height (cm)	337.500	27608.710	737.500
Ear height (cm)	104.167	6554.167	208.712
Ear yield (kg/ha)	35497.040	5186782.400	345043
Kernel yield (kg/ha)	6435.375	3949483.800	447414.20
Shelling %	0.482	4164.658	3.884

Among the phenological traits, early flowering and silking were observed in BIO 9681, BIO 9544, and PDHM 153227, with 50% pollen shedding and silking achieved within 48–50 days (Table 1). Early maturity is particularly advantageous in rainfed agriculture, where terminal drought stress often limits productivity. Other hybrids, such as PH 1534, PH 420009, and NK 6240, also exhibited early phenological development, making them promising candidates for short-season environments. These results are consistent with the findings of Kumar *et al.* (2023) and Smith *et al.* (2024).

In terms of growth traits, PH 420147 and NK 6240 recorded the greatest plant heights (233 cm and 230 cm, respectively), while BIO 9544 exhibited the shortest stature (202 cm) but performed exceptionally well in yield. Ear height, a critical trait for harvesting efficiency, was highest in PH 420147 (110 cm) (Table 2). Several other genotypes including PH 420208, PH 420009, PDHM 171213, PH 1534, PDHM 19053, and BIO 9681 also demonstrated optimal ear placement. These observations align with earlier reports by Wang *et al.* (2023) and Jiban Shrestha (2019).

The yield performance of genotypes showed, BIO 9544 standing out with the highest ear yield (12,141 kg/ha) and kernel yield (10,321 kg/ha), along with early flowering and a strong shelling percentage. It was followed by PH 420186, NK 6240, PAC 751, and PDHM 171213, all of which recorded ear yields above 9,800 kg/ha and demonstrated desirable growth characteristics.

Notably, PH 1534 combined early maturity, compact growth, and a good ear yield of 9,803 kg/ha, making it highly suitable for cultivation in rainfed conditions. Recent studies have highlighted the importance of selecting hybrids that combine early flowering, compact growth, and superior yield performance for rainfed systems. Kaur

Table 2. Mean performance of maize genotypes

Genotypes	Days to 50% Pollen shed	Days to 50% silking	Plant height (cm)	Ear height (cm)	Ear yield (kg/ha)	Shelling (%)	Kernel yield (kg/ha)
PH 420208	50	51	213	102	8266	89.0	7348
PH 420009	49	51	215	105	8039	87.3	7032
PDHM 171213	51	52	228	107	9854	84.7	8350
PH 1534	49	51	212	102	9803	83.2	8156
BIO 9544 ©	49	50	202	97	12141	85.0	10321
PH 420186	51	53	228	98	10646	85.3	9080
NK 6240 ©	49	51	230	97	10630	86.5	9188
PH 420147	50	51	233	110	8764	88.3	7744
PDHM 19053	49	51	220	102	8456	84.7	7154
PAC 751 ©	52	53	220	100	10359	88.8	9199
PDHM 153227	49	50	217	98	8289	90.3	7477
BIO 9681 ©	48	50	220	105	9012	88.0	7930
Mean	49.6	51.2	219.9	101.8	9521.6	86.8	8248
C.V (%)	3.97	3.85	10.82	15.42	22.14	5.06	8.32
S.E.	1.14	1.14	13.73	9.07	1153.80	2.55	396.37
C.D. 5%	3.913	2.234	59.721	31.793	1292.875	4.338	1472.227

et al. (2023) and Singhal *et al.* (2024) reported that early maturity and high kernel recovery are key predictors of yield stability in drought-prone areas.

The mean shelling percentage among the maize genotypes ranged from 83.2 per cent in PH 1534 to 90.3 per cent in PDHM 153227. Genotypes such as PH 420208, PH 420009, NK 6240, PH 420147, PAC 751, PDHM 153227, and BIO 9681 recorded higher shelling percentages, indicating their superior performance in terms of grain recovery. These findings suggest that shelling percentage can serve as an important selection criterion in maize improvement programs. Singh *et al.* (2021) also reported that higher shelling percentage is associated with improved post-harvest efficiency in maize.

Conclusion

Based on the assessment of phenology, growth, yield, and shelling efficiency, the genotypes BIO 9544, PH 1534, NK 6240, and PDHM 171213 were identified as the most promising for rainfed cultivation in coastal Andhra Pradesh. These hybrids exhibited a well-balanced combination of early maturity, high yield potential and favorable agronomic traits, making them strong candidates for further evaluation, commercial cultivation, and inclusion in breeding programs aimed at enhancing maize productivity in water-limited environments.

References

- Kaur, G., Sharma, R. & Verma, A. (2023). Morpho-physiological trait association with grain yield in pre-release maize hybrids under moisture stress. *Journal of Applied and Natural Science*, **15**(1): 105–112.
- Kumar, P., Verma, S., Singh, A. & Yadav, V. (2023). Evaluation of pre-release maize (*Zea mays* L.) hybrids for yield stability and adaptability under rainfed conditions. *Indian Journal of Agricultural Sciences*, **93**(1): 88–94.
- Kumar, R., Sharma, V. & Yadav, S. (2023). Impact of drought stress on phenological traits and yield performance in Indian maize (*Zea mays* L.) hybrids. *Indian Journal of Genetics and Plant Breeding*, **83**(1): 55–62.
- Panse, V. G. & Sukhatme, P. V. (1964). *Statistical Methods for Agricultural Research Workers*, ICAR, New Delhi. pp 287.
- Rao, P. S., Ramesh, K. & Sreelatha, D. (2019). Evaluation of maize hybrids for yield and drought tolerance in eastern coastal Andhra Pradesh. *Journal of Research ANGRAU*, **47**(3): 15–21.
- Reddy, B. V. S., Kumar, A. A. & Rao, K. N. (2020). Performance of maize hybrids under rainfed conditions in coastal agro-ecosystems. *Indian Journal of Agronomy*, **65**(2): 205–210.
- Shrestha, J., Gurung, D. B., Koirala, K. B. & Rijal, T. R. (2019). Performance evaluation of maize in Jumla district of Nepal from yielding perspective. *International Journal of Applied Biology*, **3**(2): 2019.
- Singh, B., Kumar, A., Meena, R. P. & Sahu, R. K. (2021). Genetic variability, heritability and correlation studies for grain yield and its contributing traits in maize (*Zea mays* L.). *Journal of Pharmacognosy and Phytochemistry*, **10**(3): 1918–1922.

- Singh, R., Yadav, R. S., Kumar, S. & Meena, R. K. (2021). Genotype $\times$ environment interaction and stability analysis for grain yield in maize (*Zea mays* L.) under rainfed conditions. *Indian Journal of Genetics and Plant Breeding*, **81**(4): 548–555.
- Singhal, A., Gupta, M. & Reddy, P. (2024). Yield stability and the role of early maturity in drought-prone maize environments. *Field Crops Research*, **295**: 108-119.
- Smith, J. A., Torres, R. & Li, M. (2024). Early-maturing maize hybrids enhance drought escape and yield stability in semi-arid climates. *Agricultural Systems*, **212**: 103720.
- Wang, B., Li, Y., Zhou, J., Liu, M., Zhang, X. & Zhao, C. (2023). High-throughput Lidar-based phenotyping reveals genetic variation in plant architecture and its association with lodging resistance in maize. *Remote Sensing*, **15**(4): 964.