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RESEARCH PAPER

Performance of medium duration maize genotypes for yield and yield attributes under rainfed conditions in Peddapuram, Andhra Pradesh

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Abstract A field experiment was conducted to evaluate the yield response of maize genotypes and identify most promising medium duration genotypes during *kharif,* 2022 at Agricultural research station with 32 genotypes along with 4 checks. Observations on various parameters i.e. days to 50% anthesis, days to 50% silking, plant height, ear height, moisture %, shelling % and grain yield were recorded. Highly significant differences were found among genotypes for grain yield and other yield contributing traits. The medium duration genotype RCRMH 20, BH 417189, EH 3968, BH 417144 and LMH 2257 registered high grain yield. Among all the genotypes RCRMH 20 recorded the highest grain yield of 7.6 (t/ha) which was found to be on par with the standard check hybrid BIO 9544 (7.6 t/ha). The traits days to 50% anthesis, ear height, moisture % and shelling % were positively and significantly correlated with yield.

Keywords: Genotypes • Grain yield • Correlation

Introduction

Maize (*Zea mays* L.) is an important cereal in many developed and developing countries of the world. It is widely used for animal feed and industrial raw material in the developed countries whereas the developing countries use it in general for feed. In Indian agriculture, maize occupies a prominent position and each part of the maize plant is put to one or the other use and nothing goes as waste. In India it is the second most important cereal crop in terms of area. production and productivity after rice and maize is primarily used for feed (60 %) followed by human food (24%), industrial (starch) products (14%) beverages and seed (1% each). Thus. maize has attained an important position as industrial crop as 75% of its produce is used in starch and feed industries. In Andhra Pradesh, maize is important as a staple food, animal feed and raw material for various industries including starch, oil and alcoholic beverages. It's also used in pharmaceuticals, cosmetics, film and textile industries.

In India, it is grown in an area of 9.8 million hectares with an annual production of 33.62 million tonnes and productivity of 2394 kg per ha (https://www.indiastat.com). In Andhra Pradesh, maize was cultivated in an area of 2.92 lakh ha with a production and productivity of 19.04 lakh tonnes and 6543 kg/ha respectively contributing 5.34% to India's total production. (des.ap.gov.in. 2023-24).

Maize is the only food cereal crop that can be grown in diverse seasons/ecologies. In India, maize is principally grown in two seasons *viz*., rainy (*kharif*) and winter (*rabi*). *kharif* maize represents around 83% of maize area in India. While, *rabi* maize correspond to 17% of maize area. Over 70% of *kharif* maize area is grown under the rainfed condition with prevalence of many biotic and abiotic stresses (Indian Maize Scenario-ICAR-IIMR). Agriculture in Andhra Pradesh is dependent on rainfall whose amount and distribution is crucial for performance of agriculture. The higher variability in rainfall induced greater fluctuations in the crop yields. The influence of South-West monsoon is predominant. Normal

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rainfall due to South-West Monsoon is 601.4 mm while the actual rainfall recorded is 640.2 mm with a deviation of 6% during the period between 01st June to 30th Sep 2022 for coastal Andhra Pradesh.

However, maize crop is being affected due to drought caused by uneven distribution of rainfall. The climate change is making droughts more severe and prolonged making water supplies more difficult to obtain. Maize is generally tall and broad-leaved and a severe drought during seedling or early growth stages causes leaf curling and stunted growth (Song, 2015, Lu, 2011, Saglam, 2014 and Effendi, 2019). Maize is subjected to drought stress due to a lack of moisture which affects seedling emergence, early vegetative growth, photosynthetic capacity, reproductive growth, fertilization, seed formation and yield (Khalili, 2013; Aslam, 2013 and Sah, 2020). Drought stress inhibits pollen production by interfering with the induction of anthesis in male flowers (Herrero, 1981). In addition. drought stress during flowering may have a greater effect on the development of female flowers (silks) than male flowers significantly reducing kernel set with yield losses of up to 25, 50 and 21%. respectively (Sah *et al*., 2020).

Multiple factors determine the quantity and quality of crop yield. It is difficult to explain how plants integrate all processes associated with crop yield. but it is for sure that all the yield determining factors are affected by drought stress. A reduction in water availability reduces photosynthesis leading to fewer resources available to plants for investment into reproduction and flowers. Drought reduces flower size and number, pollen and pollen viability (Waser and Price, 2016), the amount and quality of nectar affecting overall pollination (Carvell *et al*., 2016). Pollination is directly related to the fruit and seed yield. Grain yield decreases up to 14% under moderate while >40% under severe drought (Hammad and Ali, 2014). Drought reduces photosynthetic rate while the photo transpiration process is increased simultaneously. so reduced grain weight could be the result of impairment of the physiological and biochemical process.

So rainfed environments are subject to high risk of crop loss due to drought and submergence as those environments limit the scope for increasing yields. Varietal improvement is therefore the most promising approach for increasing productivity. To achieve this the present study was conducted to evaluate the performance of different maize genotypes under rainfed conditions and to assess the relationship among the characters.

Materials and methods

The experiment was laid out in RBD with three replications during *kharif* 2022 at Agricultural Research station, Peddapuram. The treatments consisted of 32 medium duration maize genotypes along with four standard genotypes i.e. CMH 08 292, LG 34.05, DHM 121, Bio 9544. Observations were recorded on days to 50% anthesis, days to 50% silking, plant height, ear height, moisture %, shelling % and grain yield per hectare. Standard month wise meteorological data during the crop growth period was presented in the Table 1. The statistical analysis was carried out using RAISINS RCBD 1.2.0.

Results and discussion

The mean performance of the maize genotypes across all evaluated traits is presented in Table 2. Significant variations were observed among genotypes as evidenced through ANOVA presented in the Table 3, indicating broad genetic diversity suitable for targeted breeding programme.

Table 1. Standard month wise meteorological data during the crop growth period.

Weather parameter	June	July	August	September	October
Rainfall (mm)	55.3	290.8	269.8	213.3	47.8
Decennial average	75	195	165	177	167
Deviation (%)	-26.3	49.1	63.5	20.5	-71.4
Number of Rainy days	6	14	12	7	5
Maximum Temperature (°C)	34.2	31.8	32.8	31.8	33
Minimum Temperature (°C)	27.1	25.8	26	25.5	25.4
Maximum Relative humidity (%)	91.3	96.7	97	98.9	98.8
Minimum Relative humidity (%)	60.3	72.6	70.2	75.2	68.3

Days to 50% anthesis and days to 50% silking

Days to 50% anthesis ranged from 47.4 (AH 3003) to 52.6 (Bio 9544) with a mean of 49.6. Days to 50% silking ranged from 49.8 (AH 3003) to 54.1 (LG34.05) with a mena of 51.9 days. Genotypes with delayed anthesis under rainfed conditions are typically associated with drought tolerance and adaptive traits that help them cope with water stress. Longer vegetative phase help maintain green leaf area for a longer time supporting reproductive development despite delayed anthesis. Drought-tolerant genotypes often maintain a shorter anthesis-silking interval (ASI) which is a key determinant for yield stability (Smith *et al*., 2020). Genotypes with

Table 2. Mean performance of 32 maize genotypes under rainfed conditions

S.No.	Genotypes	Days to 50% anthesis	Days to 50% silking	Plant height (cm)	Ear height (cm)	Shelling %	Moisture %	Grain yield (t/ha)
1	RCRMH 20	50.3	52.2	213.2	105.1	82.4	19.1	7.6
2	Bio 9544 (C)	52.6	53.8	191.4	103.3	82.3	22.9	7.6
3	BH 417189	49.8	51.8	229.4	112.6	80.5	20.8	7.5
4	EH 3968	48.2	50.9	215.2	115.1	84.0	21.9	7.4
5	BH 417144	48.8	51.4	206.3	106.0	81.0	21.8	7.3
6	LMH 2257	51.6	53.9	234.3	126.0	70.3	21.9	7.0
7	AH 3003	47.4	49.8	201.9	112.9	69.7	22.8	6.9
8	CMH 08 292 (C)	50.7	52.4	230.9	122.2	75.2	20.4	6.8
9	AH 3002	47.9	51.3	191.9	97.4	80.7	22.0	6.3
10	MMH 22-41	48.2	51.5	231.1	127.6	77.3	21.5	6.0
11	PH 22-420208	48.1	50.4	187.2	103.7	76.9	21.5	6.0
12	IMH9 221	50.1	52.0	212.5	104.6	78.3	19.5	5.9
13	KMH 22-4	51.5	52.6	214.3	114.2	74.4	23.8	5.8
14	GDH 22-1911	48.8	50.3	183.9	99.4	69.9	21.8	5.6
15	LG 34.05 (C)	51.4	54.1	220.6	110.4	77.2	21.4	5.4
16	MMH 22-51	47.5	49.9	188.5	100.7	84.7	23.4	5.3
17	DHM 121 (C)	51.3	53.8	205.8	104.6	72.4	24.8	5.0
18	IMH2 22K-14	51.1	52.8	211.3	122.9	77.2	21.4	5.0
19	PH 22-420186	48.1	50.3	195.9	107.4	82.5	24.4	4.9
20	IMH 10-21K3	49.5	52.4	194.7	94.3	82.5	18.4	4.9
21	CHC 2201	48.7	51.5	219.6	119.2	79.8	19.7	4.9
22	MMH 1906	48.8	51.4	177.4	80.8	71.7	23.4	4.8
23	BUMH 1591	48.7	50.8	185.7	101.3	75.4	17.9	4.6
24	CHC 2202	51.4	53.7	222.8	111.8	77.4	23.9	4.5
25	IMH9 222	51.3	53.4	210.8	111.9	73.5	19.4	4.5
26	KMH 22-1	49.1	53.3	200.5	115.6	78.1	24.4	4.1
27	CHC 2203	48.5	50.1	196.3	107.9	70.4	19.8	3.9
28	IMH2 22K-13	48.2	50.5	207.2	106.5	70.0	19.4	3.7
29	IMH 10-21K2	49.2	51.4	214.6	111.2	70.3	22.5	3.7
30	PH 22-420146	51.5	53.9	220.3	113.8	71.6	19.4	3.3
31	IMH 10-21K1	47.5	49.9	186.8	104.1	70.8	21.8	3.0
32	RH 19111	51.7	53.4	187.0	96.1	70.5	20.6	2.9
	Mean	49.6	51.9	205.9	108.4	76.2	21.5	5.3
	Minimum	47.4	49.8	177.4	80.8	69.7	17.9	2.9
	Maximum	52.6	54.1	234.3	127.6	84.7	24.8	7.6

shorter ASI are preferable for drought-prone environments, while longer ASI genotypes might require further evaluation for stress adaptation.

Plant height (cm) and ear height (cm)

Plant height varied from 177.4 (MMH 1906) to 234.3 (LMH 2257) with a total mean of 205.9. Taller genotypes may benefit from higher light interception but could be prone to lodging. Ear height varied from 119.2 (CHC 2201) to 127.6 (MMH 22-41) averaging 108.4 cm. Elevated ear placement may facilitate mechanical harvesting but requires stability assessments. Plant architecture influences resource partitioning and lodging resistance. Genotypes with moderate height and ear placement could offer a balance between yield potential and field resilience.

Moisture % and shelling %

The moisture% ranged from 17.9 (BUMH 1591) to 24.8 (DHM 121) with a mean of 21.5 while, the shelling% was recorded between 69.7 (AH 3003) and 84.7 (MMH 22-51) with an average of 76.2. Higher moisture in genotypes could impact post-harvest drying costs while, high shelling % reflects efficient grain recovery, a critical trait for commercial hybrids. High shelling % and low moisture content are desirable for storage and processing.

Grain yield (t/ha)

Grain yield ranged significantly from 2.9 t/ha (RH 19111) to 7.6 t/ha (RCRMH 20 and Bio 9544), with a mean of 5.3 t/ha. Top-performing genotypes *viz*., RCRMH 20 (7.6 t/ha), BH 417189 (7.5 t/ha) and EH 3968 (7.4 t/ha) consistently excelled in multiple traits when compared to the standard genotypes CMH 08-292 (6.8 t/ha) LG 34.05 (5.4 t/ha) other than Bio 9544 (7.6 t/ha) suggesting pleiotropic effects for superior genetic potential. The high yield potential of these genotypes may stem from their balanced trait combination in terms of moderate ASI and high shelling %. However, evaluation of these hybrids across multiple environments is needed to confirm stability.

Correlation between yield components and grain yield of maize genotypes

Yield and yield component trait analysis provides a framework for identifying potentially useful traits for yield improvement. In the present study, kernel yield recorded significant and positive association with days to 50% anthesis, ear height, shelling %, moisture % *viz.* 0.632, 0.234, 0.169 and 0.541 respectively (Table 4). A positive correlation between desirable characters is favourable to

Table 3. Analysis of variance (ANOVA) for hybrids of maize under rainfed condition in the coastal Andhra Pradesh

SoV	df	Days to 50% anthesis	Days to 50% silking	Plant height (cm)	Ear height (cm)	Shelling %	Moisture %	Grain yield (t/ha)
Treatment	31	7.07**	5.83**	749.8**	287.35**	106.4**	70.32**	5.82**
Block	2	10.67**	10.67**	10.67**	10.67**	56319.98**	9.43**	10.5**
Error	62	0.0000	0.0000	0.0000	0.0000	39.5503	0.0383	0.0007

SoV = Source of Variation. DF = Degrees of Freedom; Mean squares are provided for each character; * indicates significance at 5% level. ** indicates significance at 1% level.

Table 4. Estimates of correlation coefficient for seven characters in 32 maize genotypes

SoV	Days to 50% anthesis	Days to 50% silking	Plant height (cm)	Ear height (cm)	Shelling %	Moisture %	Grain yield (t/ha)
Days to 50% anthesis	1						
Days to 50% silking	-0.055	1					
Plant height (cm)	-0.071	0.911	1				
Ear height (cm)	0.325	0.379	0.441	1			
Shelling %	0.243	0.194	0.241	0.819	1		
Moisture %	0.700	-0.251	-0.175	0.208	0.197	1	
Grain yield (t/ha)	0.632	-0.265	-0.230	0.234	0.169	0.878	1

the plant breeder because it helps in the simultaneous improvement of both characters (Premlatha and Kalamani, 2009). These results indicate that with an increase in ear height, shelling %, moisture % there could be a corresponding increase in grain yield. Similar results were reported earlier by several workers employing association of different characters like ear height, shelling % (Nagarajan *et al*., 2017) and moisture % (Prakash *et al*., 2019).

Conclusion

It can be concluded from the present investigation that genotype RCRMH 20 was found to be, BH 417189, EH 3968, BH 417144, LMH 2257 showed superior yield under rainfed conditions through lower ASI, higher shelling % with moderate plant an dear heights. The high performing genotypes identified in the present study can be advanced for further testing in the targeted locations for confirming the yield superiority.

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