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Performance Evaluation of Maize Hybrids (*Zea mays* L.)

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ABSTRACT

The study was conducted to evaluate the performance of 100 maize hybrids and to assess the association between yield and yield component traits of maize hybrids. The Experiment was carried out in randomized complete block designs (RCBD) with three replications in 2017 main cropping season. The analysis of variance revealed significant differences between hybrids for all measured parameters. The highest and lowest grain yield were recorded for VH132059 (11.11ton/ha) and VH141651 (6.06 ton/ha) respectively. Among the Hybrids VH15471 and VH15884 were early maturing varieties, while VH11153 and VH112944 are late maturing hybrids. Higher phenotypic coefficient of variation (PCV) and Genotypic coefficient of variation (GCV) were recorded for the traits plant aspect, ear aspect, number of cobs per plant and grain yield. High heritability and high genetic advance were recorded for plant height, number of grain per row and cob length VH132059 and VH11128 are good performed hybrids.

Introduction

Maize (*Zea mays* L.) is the third most important cereal crop after wheat and rice. Improving maize production is considered to be one of the most important strategies for food security in the developing countries (Iqbal *et al.*, 2001). Maize grain today is recognized worldwide as a strategic food and feed crop that provides an enormous amount of protein and energy for humans and livestock (FAOSTAT, 2008).

Maize production in the area suffers much from low fertility, low management, lack of improved varieties, and very severe infections of foliar diseases like turcicum leaf blight, high infestations of striga and stalk borers (Assefa, 1998). As a result, evaluating the performance of hybrid maize genotypes in specific agro ecology on different traits is very crucial. Maize improvement in India started an century ago and several promising hybrids and composite varieties were introduced and evaluated at different locations (Benti *et al.*, 1997).

However, the changing environmental conditions affect the performance of maize genotypes which requires a breeding program that needs to take into account the consequences of environment and genotype interaction in the selection and release of improved varieties. Hence, the overall objectives of this study were to evaluate the performance of the tested hybrid maize and to identify superior maize germplasms for better productivity to maize growers.

Materials and Methods

The experiment was laid out in a randomized complete block design (RCBD) with three replications composed of 100 hybrids (Table 1) conducted under rain fed condition during 2016 in *kharif* season at Agricultural and Horticultural Research Station, Kathalagere, Davangere district under University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka.

Each plot comprised of 5.1m long with the spacing of 0.60m between rows and 0.30m between plants. Two seeds were planted per hill and later thinned out to one healthy plant. The recommended fertilizer dose (urea@150 kg/ha and DAP@150 kg/ha) was used. DAP fertilizer was applied once at planting while urea was applied twice equally at planting and at knee height stage of the crop. All other management practices were uniformly applied to all experimental plots as per package of practice.

Data were recorded on plot and plant basis for the following characteristics; days to 50% anthesis, days to50% silk emergence, days to maturity, grain yield, plant height, ear height and number of cobs/plant.

Analysis of variance (ANOVA) was done by using INDOSTAT software. The phenotypic and genotypic coefficients of variation were estimated according to the method suggested by Burton and De Vane (1953).

Broad sense heritability (h2) expressed as the percentage of the ratio of the genotypic variance to the phenotypic variance as described by Allard (1960).

Results and Discussion

Analysis of variance

The results of analysis of variance (ANOVA) of the quantitative traits of the tested genotypes are presented in (Table 2). The analysis of variance result showed that there were considerable amount of variation between the tested hybrids. Results showed highly significant variation ($p<0.01$) for days to 50% anthesis, days to 50% silking, days to 50% maturity, plant height, plant aspect, cob weight, cob length and number of grains per row and significant variation ($p<0.05$) for ear height, ear aspect, number of cobs per plant, grain yield. This result is in agreement with the findings of Soza *et al.,* (1996); Sallah *et al.,* (2001); Ram Reddy *et al.,* (2013). Maximum grain yield (11.11 ton/ha) was observed for VH132059 whereas the minimum grain yield (6.06 ton/ha) was recorded for VH141651 (Table 2).

Phenotypic and genotypic variation

The phenotypic variance was separated into genotypic and environmental variances to estimate the contribution of each to the total variation. The minimum (0.2) and maximum (50.9) percentages of phenotypic coefficient of variation (PCV) were observed for plant height and number of diseased cobs, respectively.

The PCV values for number of diseased cobs and ear height were high. It indicates on these traits the phenotypic difference between the tasted genotypes is high. PCV values for number of cobs per plant, cob weight and number of grains per row, stand count at harvest and cob length were medium. It indicates the phenotypic difference between the tested maize genotypes with the above traits is moderate (Bello *et al.,* 2012; Golam *et al.,* 2014). Days to maturing, plant height, days to anthesis, days to silking and grain yield had low PCV values (Ram Reddy *et al.*, 2012). Low PCV observed for days to maturing, plant height, days to anthesis and days to silking Genotypic coefficient of variation measures the genetic variability with in a character. The extent of the environmental influence on any character is indicated by the magnitude of the differences between the genotypic and phenotypic coefficients of variation. Large differences reflect high environmental influence, while small differences reveal that the influence of environment on the genetic variance is low (Manjunatha *et al.,* 2018). The small difference between PCV and GCV of these traits indicated the possibility of genetic improvement of the traits. Genotypic coefficients of variability (GCV) values were low for days to maturing, days to anthesis and days to silking. Medium GCV was observed for plant height, ear height, number of cobs per plant, number of grain per row, cob weight (Golam *et al.,* 2014).

Higher PCV and GCV were recorded for the traits number of cobs per plant, grain yield and number of diseased cobs. It shows that the selection can be effective for these traits and also indicated the existence of substantial variability, ensuring ample scope for their improvement through selection. From this result by selecting the genotype with higher number of cobs per plant, better grain yield and less number of diseased cobs can improve the grain yield of maize.

The difference between PCV with the corresponding GCV values was relatively higher for plant height, ear aspect andgrain yield, indicating the higher influence of the environment on the traits. However, this difference was comparatively low for days to anthesis, days to silking, days to maturing, number of grain per row, stand count at harvest and cob length. The small difference indicating that there is a minimal influence of environment on the expression of these traits. In addition, it indicates the presence of sufficient genetic variability for observed traits may facilitate the selection process. Therefore, selection based on phenotypic performance of the traits would be effective to bring considerable improvement in these traits.

Heritability and genetic advance

Heritability is the proportion of genetic variance and phenotypic variance. It is a major parameter for the selection of superior population improvement method. Knowledge about heritability of quantitative traits of a crop plant is of extreme interest to plant breeders. The heritability estimates detected for the characters studied ranged between 39.7% for number of cobs per plant to98.9% for date of anthesis. High levels of heritability were estimated for days to anthesis, days to silking, days to maturing, plant height, number of grains per row, stand count at harvest and cob length (Beyene, 2005); Muhammad (2009) for days to anthesis and number of grains per row Sarlangue *et al.,* (2007).

High heritability of the above traits indicated that influence of environment on these characters is negligible or low. Therefore, selection can be effective on the basis of phenotypic expression of these traits in the individual plant by implementing simple selection methods. Medium heritability was recorded for ear height, number of cob per plant, cob weight, grain yield. The moderate levels of heritability indicated that this trait was moderately influenced by environmental factors (Lorenzana and Bernardo, 2008). Genetic advance under selection (GA) refers to the improvement of traits in genotypic value for the new population compared with the base population less than one cycle of population at a given intensity (Singh, 2001).

Table.1 List of hybrids

1	VH131306	VH131306	51	VH112744	VH112744
2	VH133273	VH133273	52	VH141640	VH141640
3	VH141552	VH141552	53	VH121082	VH121082
4	VH125	VH125	54	VH11128	VH11128
5	VH11431	VH11431	55	ZH112035	ZH112035
6	VH11301	VH11301	56	VH123389	VH123389
7	VH11441	VH11441	57	VH141651	VH141651
8	VH113012	VH113012	58	VH123061	VH123061
9	VH13296	VH13296	59	VH12328	VH12328
10	VH13305	VH13305	60	VH13554	VH13554
11	VH13306	VH13306	61	VH141682	VH141682
12	VH13700	VH13700	62	VH15911	VH15911
13	VH13729	VH13729	63	ZH115995	ZH115995
14	VH13740	VH13740	64	KH141554	KH141554
15	VH112888	VH112888	65	VH16161	VH16161
16	VH11131	VH11131	66	VH122850	VH122850
17	VH11153	VH11153	67	VH131199	VH131199
18	VH112944	VH112944	68	VH123031	VH123031
19	VH11134	VH11134	69	VH11812	VH11812
20	VH13917	VH13917	70	VH131376	VH131376
21	VH1640	VH1640	71	VH133765	VH133765
22	VH132079	VH132079	72	VH153409	NK30
23	VH132059	VH132059	73	VH153410	Swarna
24	VH151139	VH151139	74	VH153411	Mukta
25	VH132169	VH132169	75	VP15297	African tall
26	VH16100	VH16100	76	TA5024	TA5024
27	VH123015	VH123015	77	TA5104	TA5104
28	VH1230	VH1230	78	TA5114	TA5114
29	VH161055	VH161055	79	TA5144	TA5144
30	VH15471	VH15471	80	TA5084	TA5084
31	VH15496	VH15496	81	VH112651	NK6240
32	VH132461	VH132461	82	VH112649	900MGold
33	VH1652	VH1652	83	VH131025	DKC8101
34	VH15884	VH15884	84	VH112667	30V92
35	VH1660	VH1660	85	VH153412	D2244
36	VH15537	VH15537	86	VH112655	HTMH5101
37	VH141618	VH141618	87	VH131019	P3396
38	VH112972	VH112972	88	31Y45	31Y45
39	VH11150	VH11150	89	VH151758	Pratap QPM Hybrid-1
40	VH11138	VH11138	90	AH1223	9108
41	VH1253	VH1253	91	DHM121	DHM121
42	VH12264	VH12264	92	WIN Orange	WIN Orange
43	VH11130	VH11130	93	Hema	Hema
44	VH112906	VH112906	94	VH171212	Ravi-81
45	VH113027	VH113027	95	VP1760	Pant Sankar Makka-3
46	VH12241	VH12241	96	VH171213	P3502
47	VH151280	VH151280	97	VH171214	HTMH5106
48	VH131026	VH131026	98	VH171215	DKC9144
49	VH141229	VH141229	99	VH171254	Shaktiman-4
50	VH112740	VH112740	100	VH151757	Shaktiman-5

Table.2 Estimates of range, mean and genetic parameters on the tested maize hybrids

	Grain yield	Days to Anthesis	Days to Silking	Plant height	Ear height	Ear position	Lodging root	Cobs/plant
Mean	8.17	51.3	54.9	260.8	107.4	0.42	2.9	1.10
Min	3.74	45.1	49.4	196.6	77.3	0.32	-1.4	0.65
Max	12.14	56.7	59.7	294.2	136.6	0.52	70.8	1.63
Lower Limit	0.00	50.0	50.0	30.0	30.0	0.10	0.0	0.00
Upper Limit	15.00	110.0	110.0	250.0	200.0	0.70	101.0	3.00
Phenotypic Variance	1.76	10.3	9.2	324.5	140.4	0.00	73.9	0.02
Error Variance	0.62	3.7	3.2	138.4	79.4	0.00	17.5	0.01
Genotypic Variance	1.14	6.5	6.0	186.1	61.0	0.00	56.4	0.01
Heritability	0.65	0.6	0.7	0.6	0.4	0.15	0.8	0.66

The genetic advance as percent of mean (GA%) was high for plant height, ear height, plant aspect, ear aspect, cob weight, number of grains per row, stand count at harvest, grain yield, number of diseased cob and cob length (Emmanuel, 2013). Genetic advance as percent of mean was moderate for days to 50% anthesis, days to 50% silking and number of cobs per plant. Genetic advance as percent of mean was low for days to 50% maturity (Badu *et al.*, 2012).

In view of the fact that, high heritability does not always indicate a high genetic gain, heritability should be used together with genetic advance in predicting the ultimate effect for selecting superior varieties. In this study, high heritability and high genetic advance were recorded for plant height number of grains per row, stand count at harvest and cob length which could be considered as essential traits for maize improvement by selection (Bello *et al.*, 2012).

The study showed variation for almost all the traits studied among the tested hybrids, which is an indication of the presence of sufficient variability and can be exploited through selection. The significant difference in grain yield and other agronomic traits among various hybrids were probably due to diverse back ground from which the hybrids where developed. VH132059 and VH11128 were shown higher grain yield compared to others. Consequently, these hybrids can be a preferable choice for further crop improvement. The higher grain yield of the above genotypes could be correlated to the higher number of grain per row and cob weight. Among the tested hybrids VH15471 and VH15884 are early maturing, while VH11153 and VH112944 are late maturing varieties.

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