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Genetic Variability Study of Different Morpho-Physiological and Quality Traits in Maize Genotypes (*Zea mays* L.)

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Abstract Present study was undertaken with 18 maize genotypes growth in two environments in randomized block design following standard package of practices for maize at research field, RAU, Pusa, Bihar. Observations were recorded on eight morpho-physiological and quality traits. CML 467 was the best and significantly out yielded with an average yield of 75.18 g/plant followed by CML 165 (63.32 g/plant), LM 13 (61.90 g/plant) and HKI 586 (61.71 g/plant) over the environments. Higher magnitude of phenotypic variance and PCV observed then genotypic variance and GCV for all the traits under atudy. The maximum genotypic variance was observed for kernels per ear whereas maximum genotypic coefficient of variation was observed for ear height. Heritability in broad sense was found highest for plant height and ear height whereas minimum heritability was recorded for days to maturity. The characters with high heritability and high genetic advance were plant height and ear height suggested that phenotypic selection for these traits would be effective.

Keywords Maize inbred, Heritability, Variability.

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Introduction

Genetic improvement in traits of economic importance along with maintaining sufficient amount of variability is always the desired objective in maize breeding programs. Grzesiak [1] and Ihsan et al. [2] observed considerable genotypic variability and reported significant genetic differences for morphological parameter for maize genotypes. This variability is a key to crop improvement. Although, the genotypes can perform better in varying environments and also good in quality parameters. Some scientists have claimed that under specific condition they are best in comparison of local varieties [3]. Thus a thorough understanding of those factors, which might affect the yield in strains and varieties of aromatic rice in different environ-

Table 1. Analysis of variance and component of variability for different morpho-physiological and quality traits of aromatic rice. **Significant at p=0.01.

Character	Analysis of variance				
	Repl. MSS (2df)	Treat. MSS (29df)	Error MSS (58df)	CD at 5%	Mean±SEm
Days to 50% tasseling	0.56	30.00**	2.96	2.85	86.23 ± 0.96
Days to 50% silking	1.93	15.55**	0.95	1.62	87.33 ± 0.54
Days to 75% dry husk	0.72	8.6**	1.58	2.09	115.02 ± 0.70
Plant height (cm)	0.22	516.5**	1.17	1.79	135.01 ± 0.60
Ear height (cm)	0.005	407.5**	0.88	1.55	58.95 ± 0.52
Ear length (cm)	1.08	7.12**	0.78	1.47	15.94 ± 0.49
No. of kernels/ear	1643.6	3204.5**	518.8	57.79	308.53 ± 12.78
Grain yield (g/plant)	21.59	289.6**	27.75	0.74	51.86 ± 2.95

Table 1. Continued.

Character	Variability components								
	Range	VE	ECV	VG	GCV	VP	PCV	h^2	GA
Days to 50% tasseling	82 - 95	2.96	1.99	9.01	3.48	11.97	4.01	0.75	5.36
Days to 50% silking	84.16 - 91.16	0.96	1.12	4.86	2.52	5.82	2.76	0.83	4.13
Days to 75% dry husk	112.6 - 118.8	1.59	1.09	2.33	1.32	3.92	1.72	0.59	2.42
Plant height (cm)	103.1 - 155	1.17	0.80	171.79	9.70	172.96	9.74	0.99	26.90
Ear height (cm)	36.8 - 81.53	0.88	1.59	135.55	19.75	136.43	19.81	0.99	23.90
Ear length (cm)	12.63 - 19.0	0.78	5.56	2.11	9.11	2.90	10.68	0.72	2.55
No. of kernels/ear	232.3 - 365.9	518.88	7.38	895.23	6.69	1414.11	12.18	0.63	49.04
Grain yield (g/plant)	38.1 - 75.1	27.75	10.15	87.30	18.01	115.06	20.68	0.75	16.76

ments is important and may serve as a basis for their rational utilization for improvement. The relative performance of a genotype is not always similar in the different environment and environment play an important role in phenotypic expression of genotypes. A population which can adjust its genotypic as phenotypic state in response to environmental fluctuation in such a way that it gives high and stable economic return can be termed as well buffered.

Breeding strategies should be emphasis on high yielding maize genotypes over varying environments. Most of the maize genotypes available in the region are average yielding, photoperiod sensitive and grown in both *kharif* and *rabi* season in rain fed as well as irrigated ecosystem. The quantitative measurement of individual character provides the basis for an interpretation of analysis of variance. The available variability in a population can be partitioned into heritable and genetic advance. The genetic variability available in any crop species including maize would be of a great value in planning an efficient breeding programme for their improvement. To understand the usable variability, grouping and choice of genetically divergent parents for hybridization depends upon categorization of breeding materials of different geographical origin. To accomplish success in maize improvement program, it is necessary to collect information on genetic variability, for obtaining superior genotypes in latter generations. The objective of the present study was to evaluate genetic variability among 18 maize inbred lines for eight morphological and quality traits to identify the best lines.

Materials and Methods

The experimental materials for present investigation were generated from 18 maize inbred lines obtained from AICRP, Dholi Center. All the lines had diverse origin.

The experiment was subjected to field trial for two seasons i.e. during the *rabi* season (2014-15) and *kharif* 2015 in randomized block design with three replication. Each entry was raised in two rows spaced at 75 cm with an interplant distance within a row was maintained at 25 cm. Normal cultural practices for raising a successful crop were followed uniformly throughout the experiment. Five randomly selected plants were used to take the eight agronomical and quality parameter data from each plot of each replication every season.

Mean range of different genotypes for various traits in and over the environments have been studied. Analysis of variance has also been done for each of twenty one characters on pooled environments. Coefficient of genotypic and phenotypic variation, heritability (broad sense) and genetic advance was calculated as per method [4].

Results and Discussion

The analyses of variance of different genotypes of maize for different agronomic traits are shown in Table 1. It indicated that the difference among genotypes for all the traits under study. It also suggested the presence of ample genetic variability among the genotypes. Shahrokhi and Khorasani [5] also observed significant variation among genotypes for days to silking, days to anthesis, plant height, ear height, kernel number, rows number, 1000-kernel weight and yield. Ahmed [6] also observed significant variation among maize genotypes for yield, ear length, ear diameter, number of kernels/ear, 1000-kernel weight, days to maturity, days to silking, plant height and ear height. Prasanna et al. [7] noted that genetic variability for most of the yield and yield contributing traits in maize were very high and amenable to genetic enhancements.

The presence of considerable wide range (Table 1) of variability for different characters amongst the studied genotypes might be due to the fact that they had diverse genetic origin and might also have different geographic background, which is well reflected from their originating certer and pedigree backgrounds. Varing range of mean performance were also reflected in data (Table 2). The genotype CML 470 was found significantly superior for days to tasseling, silking and maturity to other genotypes over the seasons, whereas, the genotype CML 196 and CML 471 were superior for ear height and ear length, respectively. The highest grain yield was observed for CML 467.

Measure of variability and selection are of great value in any plant breeding program. Variability provides the valuable material resources to breeder for redesigning the genotypes with broadened and wider genetic base along with area for their adaptation. Genotypic coefficient of variation together with heritability and genetic advance is considered as good estimate of genetic improvement to be expected from selection on phenotypic basis. A trait having high heritability and high genetic advance is considered under control of additive gene, which highlights the usefulness of plant selection based on phenotypic performance.

Genotypic and phenotypic coefficient of variation, heritability in broad sense and genetic advance as per cent of mean for quantitative and qualitative traits in maize under study are presented in Table 1. Higher phenotypic variances observed for all the characters under study than their genotypic variances, indicating importance of non genetic factors. More pronounced differences between phenotypic and genotypic variances observed for grain yield, days to 50% flowering and days to maturity and pronounced differences of moderate magnitude for plant height, over the years. Pronounced differences with high and moderate magnitude expressed in these characters reflected importance of non genetic factors which might have played an important role in manifestation of these attributes. These are in accordance with the findings of Salami et al. [8], Bello et al. [9] and Anshuman et al. [10] who reported that phenotypic variance was much higher then genotypic variance.

Higher phenotypic coefficient of variation was observed than genotypic coefficient of variation indicating importance of non-genetic factors. The high genotypic coefficient of variation was recorded with maximum value for ear height [11] followed by yield and plant height. Similarly the higher phenotypic coefficient of variation was observed for grain yield [12]

Table 2. Mean performance of maize genotypes for morphological and quality parameters over the years.

Genotypes	Days to 50% tasseling	Days to 50% silking	Days to 75% brown husk	Plant height (cm)	Ear height (cm)	Ear length (cm)	Number of kernels/ear	Grain yield/plant (g)
CML 467	91.83**	84.67**	113.00	145.30**	55.23**	17.57*	365.93**	75.18**
CML 468	85.17	86.17	114.83	122.33**	40.50**	14.77	232.37**	38.10**
CML 469	83.17	85.17*	116.17	103.10**	36.80**	14.43*	281.97	43.82
CML 470	95.00**	90.83**	118.83**	116.90**	45.43**	15.97	286.40	41.62*
CML 471	85.00	86.33	114.50	148.63**	64.23**	19.00**	300.20	54.83
CML 373	88.83	89.17*	115.00	136.77	64.10**	16.47	286.60	48.43
CML 115	83.17*	85.00**	114.67	132.40**	59.57	15.13	338.53	47.00
CML 196	85.50	87.33	114.33	150.13**	81.53**	16.80	318.80	47.88
CML 465	86.00	88.67	117.00	130.00**	49.30**	16.90	344.53	57.17
LM 13	84.17	86.50	113.17	155.07**	68.10**	16.90	314.03	61.88*
DH 2012	88.50	90.50**	117.83	119.87**	51.67**	12.63**	292.33	40.83*
HK 1162	84.50	86.00	114.83	145.10**	72.67**	17.07	307.87	52.15
HK 1323B	82.67*	84.17**	113.00	140.27**	73.97**	15.90	343.93	59.83
HK 1586	84.17	86.00	112.67*	142.40**	61.30**	16.33	343.60	61.70*
HK 11105	84.17	85.50*	113.83	138.70**	61.40**	14.43*	333.87	48.85
CML 161	86.67	89.17*	115.17	129.90**	52.77**	13.97**	285.70	50.03
CML 165	87.00	89.67**	115.50	138.10**	66.07**	15.27	300.20	63.32*
CML 163	87.17	91.17**	116.17	135.37**	57.47	17.43*	276.80	40.70*
Mean	86.23	87.33	115.02	135.01	58.95	15.94	308.53	51.86
CV %	1.99	1.12	1.09	0.80	1.59	5.56	7.38	10.15

followed by ear height and kernals per ear. The pronounced differences with high and low magnitude expressed in characters reflected importance of non-genetic factors which might have played an important role in manifestation of attributes. Sizeable value of genotypic coefficient of variation in respect of above mentioned characters indicates high genetic and very little environmental influence for such characters suggesting that these characters may be relied upon for the purpose of selection of phenotypic basis. Rafiq et al. [13], Badawy [14] and Kumar et al. [15] also reported the phenotypic variance was much higher than genotypic variance.

The genotypic coefficient of variances does not determine the magnitude of variance, which is heritable and for which breeders are always concerned. The GCV together with the estimates of heritability provides clear picture of genetic advance expected from selection. Therefore, heritability measures the transmission of characters and separates the portion of environmental variability from phenotypic expression. Heritability can be defined as the proportion of the phenotypic variation that is due to genetic cause and expressed in per cent.

In present study, high heritability was observed for most the traits except maturity and kernels per ear, which reflected moderate heritability. The characters with high heritability were plant height, ear height, days to silking and tasseling reflected greater contribution of genetic factors, where as low heritability traits like grain yield and ear length revealed importance of non-genetic factors for this polygenic dependent character. High heritability for ear length and 1000-kernel weight was also recorded by Noor et al. [16]. Aminu and Izge [17) studied high heritability for plant height and yield/plant. Very high heritability (above 90%) was observed for plant height, ear height, number of kernels/ear, 1000-kernel weight and yield/plant [9, 10].

Genetic advance provides information of expected genetic gain resulting from selection of superior genotypes. It is also expressed as per cent of mean to know the expected gain over means of original parental population studied. Panse and Sukhatme [18] reported that high heritability coupled high genetic advance might be due to the preponderance of additive gene action and this suggested that the selection in early generations may be effective for improvement of these traits.

In the present investigation, genetic advance was calculated as per cent of mean. Kernels per ear, Plant height and ear height had high genetic advance as percent of mean. All these characters also high heritability so, selection of genotype on the basis of these traits in early generations will be more effectively reliable. The characters with high heritability and high genetic advance were namely plant height, ear height, where as the character with high heritability and moderate genetic advance was grain yield. Character exhibiting high heritability may not necessarily give high genetic advance. Bello et al. [9] recorded higher genetic advance for plant height, number of kernels/ear and yield/plant.

Conclusion

The phenotypic variance and phenotypic coefficient of variation was found higher than genotypic variance and genotypic coefficient of variation for all the traits under study. The maximum genotypic variance was observed for kernels per ear followed by plant height and ear height, whereas maximum genotypic coefficient of variation was observed for ear height. followed by days to silking and tasseling, whereas minimum heritability was found in maturity. The character with high heritability and high genetic advance were plant height, ear height and kernels per ear. Based on high heritability and high genetic advance the above mentioned characters reflected their usefulness in selection breeding program, such characters have importance of both the additive and non-additive genetic effects for their manifestation.

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