Phenotypic Characterization, Genetic Variability and Correlation Studies among Maize Landraces of Manipur

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Abstract

The study was carried out to characterize and access the genetic parameters and character association for eight morphological traits of forty maize landraces collected from 9 districts of Manipur. The accessions were characterized according to three important phenotypic traits, *viz*., Kernel Colour, Kernel Shape and Kernel Row Arrangement. There were great variations amongst the accessions with regard to kernel colour and kernel shape. Out of the total accessions different kernel colours were observed *viz*., yellow (9), variegated (9), white (8), black (6), red (4), purple (2), brown (1) and orange (1). Variations due to kernel shape are leveled (25), rounded (10), indented (2), pointed (1), sharply pointed (1), and shrunken (1). Variation due to kernel row arrangement are regular (23), irregular (7), straight (6) and spiral (4). The analysis of variance revealed highly significant differences for all the traits under study indicating adequate for selection. The high estimates for PCV and GCV were obtained for No. of kernels cob^{-1}, 100 kernel wt. and seed yield 5 sq. m^{-1} revealing that the landraces have a broad genetic background that will respond positively to selection for improving these traits. The correlation coefficients analysis show that the days to maturity and number of kernels cob^{-1} had significant and positive correlation with seed yield.

1. Introduction

Maize (*Zea mays* L.), the sole cultivated member of genus *Zea* and tribe Maydeae, ranks as one of the important cereal crops in the world after wheat and rice. The variability amongst maize landraces exceeds the variability in any other crop species. Maize genetic resources constitute an immensurable treasure for humankind. The great diversity of environments and conditions have created the basis for the development of maize varieties well adapted to harsh conditions of soil and climate as well as to biotic stresses. World collections of maize comprise about 12,000 accessions that are represented in 256 races, of which about 30 are in the process of extermination (Machado et al., 1998). It is estimated that only around 2% of the maize germplasm is utilized in breeding programs and an important fraction is cultivated and conserved by small landholder farmers. While most of the genetic variability is represented within and between landraces maintained by the traditional family farming systems (Marshall, 1977) but there is a growing trend in developing countries to adopt improved maize varieties, primarily to meet market demand.

In Mexico, only 20% of the corn varieties grown 50 years ago remain in cultivation. The narrowing of genetic diversity in modern maize varieties emphasizes the importance of conserving and characterizing genetic traits for future plant breeding. However, efforts related to intensive characterization and effective utilization of these genetic resources in breeding programmes have been limited. In this regard CIMMYT has taken the lead in preserving and charactering maize germplasm. It has the world's largest collection of maize accessions, with over 17,000 lines (CIMMYT, 2006).

India also harbours diverse maize germplasms. An extensive collection of germplasm from the NEH region has been made by researchers at the Indian Agricultural Research Institute, New Delhi. It has been shown that the two primitive Sikkim maize strains (Sikkim Primitive 1 and Sikkim Primitive 2) were different from the primitive Mexican races. Significant variability in plant, ear, and tassel characteristics of maize landraces has been observed in North-eastern part of India.

Indian maize races have been classified under four categories i.e. primitive group, advanced or derived group, recent introduction and hybrid races. The National Gene Bank at New Delhi houses about 6,000 indigenous accessions primarily from the NEH region. Systematic and comprehensive evaluation of this germplasm is being attempted for agronomically useful traits (Sharma et al., 2009). Repetition of same sentence (should be omitted). Intensive efforts have been initiated in the last few years on phenotypic as well as molecular characterization of the maize landraces in India. However, there is lack of research for the landraces available in different parts of Manipur. In view of the current situation a study was carried out at KVK, Senapati, Manipur, under WOS-A, sponsored by DST, Govt. of India with the objective to characterize and access the genetic parameters and character association of eight morphological traits and select the landraces with important agronomic traits and the most potential for future breeding programs.

2. Materials and Methods

A total of 40 (Forty) landraces were collected from 9 districts of Manipur, that is, 10 from Tamenglong, 8 from Ukhrul, 4 from Chandel, 4 from Thoubal, 2 from Bishnupur, 2 from Imphal East and 2 from Imphal West districts. The landraces were evaluated at the experimental field of KVK, Senapati (Latitude 24 37' N, Longitude 93 42'E, Altitude 1100 m above MSL and average rainfall 1725.7 mm during *Kharif* 2010). The soil of the experimental field is clayey having pH from 5-5.8 and organic carbon content is 1% to 1.1%. The experiment was laid out in randomized complete block design with three replications. Each landraces were sown in raised bed of 5×1 m^2 size accommodating 2 rows each of 5 m length with spacing of 60×30 cm. The recommended package of practices was followed to raise a good crop. The observations were recorded from five randomly selected plants in each plot in each replication on days to 50% silking, Plant height (cm), Days to maturity, No. of cobs $plant^{-1}$, Cob length (cm), No. of kernels cob^{-1}, 100 kernel wt. (g), Seed yield 5 sq. m^{-1}(kg). The plot mean values were subjected to analysis of variance. The genotypic and phenotypic coefficients of variation (GCV and PCV) were estimated according to the method outlined by Burton (1952). Correlation coefficients were calculated as explained by Singh and Chaudhary (1985).

3. Results and Discussion

The accessions were characterized according to three important phenotypic traits, viz., Kernel Colour, Kernel Shape and Kernel Row Arrangement. There were great variations amongst the accessions with regard to kernel colour and kernel shape (Table 1). Out of the total accessions different kernel colours were observed viz., yellow (9), variegated (9), white (8), black (6), red (4), purple (2), brown (1) and orange (1). Variations due to kernel shape are leveled (25), rounded (10), indented (2), pointed (1), sharply pointed (1), and shrunken (1). Variation due to kernel row arrangement are regular (23), irregular (7),

Table 1: Grain characteristics of maize landraces collected from Manipur

Accession No.	Kernel colour	Kernel shape	Kernel row arrangement	Collection source	Population type
Ukhrul 1	Yellow	Pointed	Irregular	Village market	Landraces
Ukhrul 2	Yellow	Level	Spiral	Village market	Landraces
Ukhrul 3	Variegated (Red & Yellow)	Level	Regular	Village market	Landraces
Ukhrul 4	Variegated (More Black)	Level	Irregular	Village market	Landraces
Ukhrul 5	Variegated (White &Yellow)	Rounded	Straight	Village market	Landraces
Ukhrul 6	Variegated (More White)	Rounded	Irregular	Village market	Landraces
Ukhrul 7	White	Level	Regular	Village market	Landraces
Ukhrul 8	White	Level	Regular	Village market	Landraces
Tamenglong 1	Brown	Shrunken	Irregular	Village market	Landraces
Tamenglong 2	Purple	Level	Straight	Village market	Landraces
Tamenglong 3	White	Rounded	Regular	Village market	Landraces
Tamenglong 4	Black	Level	Regular	Village market	Landraces
Tamenglong 5	Yellow	Indented	Spiral	Village market	Landraces
Tamenglong 6	Variegated (More black)	level	Regular	Village market	Landraces
Tamenglong 7	Variegated (More white)	Level	Irregular	Village market	Landraces
Tamenglong 8	Red	Level	Spiral	Village market	Landraces
Tamenglong 9	Variegated	Level	Irregular	Village market	Landraces
Tamenglong 10	Variegated	Level	Regular	Village market	Landraces

Continue

Imphal West 1	White	Rounded	Regular	Village market	Landraces
Imphal West 2	Yellow	Level	Regular	Village market	Landraces
Bishnupur 1	Black	Level	Regular	Farmer's farm store	Landraces
Bishnupur 2	White	Sharply pointed	Straight	Village market	Landraces
Senapati 1	Yellow	Rounded	spiral	Village market	Landraces
Senapati 2	White	Rounded	Straight	Village market	Landraces
Senapati 3	Red	Level	Regular	Village market	Landraces
Senapati 4	Variegated	level	Irregular	Village market	Landraces
Churachandpur 1	Yellow	Indented	Straight	Farmer's farm store	Landraces
Churachandpur 2	White	Rounded	Regular	Farmer's farm store	Landraces
Churachandpur 3	Yellow	Rounded	Straight	Farmer's farm store	Landraces
Churachandpur 4	Black	Level	Regular	Farmer's farm store	Landraces
Chandel 1	Red	Level	Regular	Farmer's farm store	Landraces
Chandel 2	Black	Level	Regular	Farmer's farm store	Landraces
Chandel 3	Yellow	Level	Regular	Farmer's farm store	Landraces
Chandel 4	Orange	Rounded	Regular	Farmer's farm store	Landraces
Thoubal 1	Red	Level	Regular	Farmer's farm store	Landraces
Thoubal 2	Black	Level	Regular	Village market	Landraces
Thoubal 3	Yellow	Level	Regular	Village market	Landraces
Thoubal 4	Purple	Level	Regular	Village market	Landraces
Imphal East 1	White	Rounded	Regular	Village market	Landraces
Imphal East 2	Black	Level	Regular	Village market	Landraces

straight (6) and spiral (4). The analysis of variance revealed significant differences among the accessions for all the traits under study indicating adequate scope for selection of superior and diverse genotypes. The extent of variability measured in terms of range, grand mean, phenotypic coefficients of variation (PCV), genotypic coefficients of variation (GCV), heritability (broad sense) are presented in Table 2.

The narrow differences between phenotypic and genotypic coefficients of variation were observed for all the characters indicating the less influence of environment on expression of characters studied except for no. of cobs plant^{-1}. The high estimates of PCV and GCV were obtained for seed yield, no. of kernels cob^{-1}, 100 kernel wt. and no. of cobs plant^{-1} and revealed that genotypes have a broad genetic background as well as good potential that will respond positively to selection for improving these characters. The moderate PCV and GCV values were observed for cob length and Plant height indicating substantial amount of genetic variability. The characters, viz., days to 50% silking and days to maturity had lower estimates of PCV and GCV indicating a limited opportunity to improve these characters. These results were largely in accordance with those reported by Satyanarayan and Sai Kumar (1995). High value for heritability was found for all the characters studied except for no. of cobs plant^{-1}.

The phenotypic correlation coefficient for 7 characters is presented in Table 3. The phenotypic correlation coefficient revealed that no. of kernels cob^{-1} and days to maturity exhibited positive and significant association seed yield. Similar result with regard to correlation coefficient of seed yield with no. of kernels cob^{-1} have been reported Singh and Singh (1993), Rahman et al. (1995), Wang et al. (1997) and Rana et al. (2000).

Table 2: Estimates of genetic parameters for eight characters in maize landraces of Manipur

Characters	Range	Mean	PCV (%)	GCV (%)	H^2 (%) (Broad sense)
Days to 50% silking	54.00-84.00	71.20	8.65	8.35	93.29
Plant height (cm)	103.00-215.40	177.47	16.02	15.96	99.17
Days to maturity	96.00-130.00	112.05	5.57	5.324	91.34
No. of cobs plant^{-1}	1.00-2.00	1.23	25.93	16.87	42.31
Cob length (cm)	7.00-22.00	14.61	22.54	20.73	84.57
No. of kernels cob^{-1}	77.50-422.00	211.44	32.33	32.27	99.63
100 kernel wt. (g)	9.50-29.96	18.33	26.29	25.22	92.01
Seed yield 5 sq. m^{-1} (kg)	0.75-3.02	1.61	39.79	37.19	87.38

Table 3: Phenotypic correlation coefficients among eight characters in maize landraces of Manipur

Characters	Plant height (cm)	Days to maturity	No. of cobs plant^{-1}	Cob length (cm)	No. of kernels cob^{-1}	100 kernel wt. (g)	Seed yield 5 m^{-2} (kg)
Days to 50% silking	0.781	0.793**	0.136	0.292	0.116**	-0.068	0.198
Plant height (cm)		0.706**	0.062**	0.290**	0.141	-0.046**	0.127
Days to maturity			0.082	0.212	0.096	-0.114**	0.081**
No. of cobs plant^{-1}				-0.089**	-0.061**	0.082**	0.100
Cob length (cm)					0.267	-0.153**	0.004
No. of kernels cob^{-1}						0.341	0.627**
100 kernel wt. (g)							0.574

**= Significant at p=0.05

Among other characters 100 kernel wt. have positive and significant correlation with no. of cobs plant^{-1}. No. of kernels cob^{-1} have positive and significant correlation with days to 50% silking. Cob length, no. of cobs plant^{-1} and days to maturity has positive and significant correlation with plant height. The result of correlation revealed that no. of kernels cob^{-1} is an important character for improvement of seed yield. Therefore selection for the improvement of no. of kernels cob^{-1} will lead to the simultaneous improvement in seed yield.

4. Conclusion

There are significant differences for all the traits under study indicating adequate scope for improvement through selection. The high estimates for PCV and GCV were obtained for no. of kernels cob^{-1}, 100 kernel wt. and seed yield indicated that the landraces have a broad genetic base that will respond positively to selection for improving these traits. The correlation coefficients analysis showed that days to maturity and no. of kernels cob^{-1} had significant and positive correlation with seed yield. Therefore this character should be kept in mind while making selection for improvement in seed yield.

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