International Journal of Applied Research
Journal HP: www.intjar.com, ISSN: 2411-6610

Study on genetic diversity of maize inbreds

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ARTICLE INFO

Article history

Accepted 24 November 2016
Online release 17 May 2017

Keyword

Genetic diversity,
Maize (*Zea mays* L.)
Cluster
D^2 statistics

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ABSTRACT

A field experiment was undertaken to analyze the genetic divergence of maize inbreds under normal soil moisture condition with an aim to develop high yielding maize hybrids. The experiment was undertaken at Regional Agricultural Research station, Jamalpur during rabi season 2009-2010. The genotypes were grouped into eight clusters. It was observed that all inter cluster distances were larger than all intra-cluster distances. The highest inter cluster distance was observed between cluster II & VII followed by II & V, I & II, IV & VII and II & VI. The highest intra cluster distance noticed in cluster V and the lowest in cluster III. The mean value for yield, yield components and growth parameters were highest in cluster III but lowest value for yield in cluster VI and growth parameters in Cluster IV. The 100 grain weight, plant height, ear height and ASI (Anthesis Silking Interval) contributed considerably to total divergence. Results obtained from this study indicate that the genetically diverged genotypes in these distinct clusters could be used as parents in hybridization program for getting desirable hybrid(s).

Introduction

Maize (*Zea mays* L.) is one of the important cereal crops in the world as well as developing countries like Bangladesh. It is the highest producing grain crop having multiple uses. Hybrid maize has much higher yield potentiality than those of synthetics and composites. Knowledge of germplasm diversity and of relationship among elite breeding materials has a significant impact on the improvement of crop plants (Hallauer et al. 1988). Maize breeders are consistently emphasizing the importance if diversity among parental genotypes as a significant factor contributing to heterotic hybrids (Ahloowalia & Dhawan, 1963; Hallauer 1972). The D^2 analysis is an useful tool for quantifying the degree of divergence between biological population at genotypic level and in assessing relative contribution of different components to the total divergence both intra and inter cluster level (Murty & Arunachalan, 1966; Sachan & Sharma, 1971). This is why present study was undertaken to analyze the genetic divergence of maize inbreds under normal soil moisture condition and to develop high yielding maize hybrids.

Materials and methods

The experiment was undertaken at Regional Agricultural Research station, Jamalpur during rabi season 2009-10 to estimate genetic diversity among 64 genotypes of maize (*Zea mays* L). Seeds of each entry were sown on 08 December 2009 in single row 2 m long. Spacing was maintained 75 × 20 cm from entry to entry and plant to plant respectively. One plant was kept hill after thinning. Fertilizers were applied @ 120, 80, 20, 5 and 1 kg/ha of N, P_2O_5, K_2O, Zn and B respectively. Other intercultural operations were done timely to raise the crop uniformly. Irrigations were applied as and when necessary. Ten randomly selected plants were used for recording observations on plant height, ear height and SPAD value. Top most fully expanded leaf was used for recording data of SPAD value when the plants were knee height stage. Other data were recorded on whole plot basis. Genetic divergence was estimated following Mahalanobis (1936) generalized distance (D^2) extended by Rao (1952). Tocher's method (Rao, 1952) was followed for determining the group constellations. Canonical analysis was also done according to Rao (1964) to confirm the results of cluster and D^2 analysis. Analysis was done using the GENSTAT 5.0 computer software.

Results and discussion

Genetic diversity was estimated by Mahalanobis D^2 statistics and the sixty four genotypes were grouped into eight clusters (Table 1). Ivy et al (2007) studied with 25 CIMMYT maize inbreds and the lines were fell into 5 clusters and Hoque et al (2008) worked with 38 maize inbreds and grouped into 6 clusters. From the Table 2, the highest inter-cluster distance was observed between cluster II & VII followed by II & V, I & II, IV & VII and II & VI. So, attempt should be taken for selection of parents from those maximum divergent clusters may manifest maximum heterosis. Murty and Anand (1966) observed a positive correlation between specific combining ability and the degree of genetic diversity. Similar conclusion was also drawn by Amiruzzaman et al (2008). On the contrary, Mian and Bahl (1989) reported that the parents separated by D^2 value of medium magnitude generally showed higher heterosis. It was also observed that all inter-cluster distances were larger that than all intra

cluster distances. It suggests that genotypes included within a cluster had less diversity among themselves. This is corborated with the findings of Ivy et al (2007) and Kadir (2010). The highest intra cluster distance was observed in cluster V and the lowest was in cluster III.

The cluster means of various characters are presented in Table 3. The highest mean value for yield/plant, cob length, 100 grain weight, plant height, ear height, days to 50% tasseling and days to 50% silking was observed in cluster III indicated that High yielding, tall & late maturing plants were situated in this cluster. The lowest mean value for yield/plant, cob girth, 100 grain weight was observed in cluster VI indicated that the plants of this cluster were low yielder. The lowest ear height, days to 50% tasseling and days to 50% silking and low plant height was observed in cluster IV indicated that plants of cluster IV were dwarf statured and early maturing. The mean value for grain yield in cluster II was the 2nd highest and yield contributing characters were also high, plant height was moderate which indicated that plants of this clusters are moderate statured and high yielder. Hoque et al (2008) and Kadir (2010) also observed similar phenomenon in their studies in maize. Moreover, the relative greenness (SPAD value) was high and ASI was the lowest in cluster II which is a good sign for high yield. Less ASI increased more chance of synchronization. Zaidi et al (2010) observed negative correlation of ASI and positive correlation of SPAD value with yield. Endang et al (1971) have stated that the clustering pattern could be utilized in choosing parents for cross combinations which likely to generate the highest possible variability for effective selection of various economic traits. Under such condition Chaudhury et al., (1975) suggested that selection for one type from each cluster and testing them by a series of diallel analysis may prove to be highly fruitful.

Table 1. Distribution of 64 maize inbreds in different clusters under normal soil moisture condition.

Cluster	No. of inbreds	Inbred lines included in different clusters
I	10	BML36, BIL30, BIL104, BIL114, BIL128, BIL176, BIL189, BIL198, BIL207, BIL208
II	3	BIL110, BIL184, BIL199
III	7	BIL26, BIL65, BIL77, BIL79, BIL107, BIL127, BIL173
IV	3	BIL19, BIL172, BIL182
V	16	BML3, BIL43, BIL113, BIL169, BIL174, BIL177, BIL178, BIL183, BIL185, BIL192, BIL193, BIL194, BIL195, BIL196, BIL197, BIL201
VI	8	BIL102, BIL168, BIL171, BIL175, BIL179, BIL181, BIL200, BIL202
VII	12	BIL76, BIL101, BIL109, BIL111, BIL180, BIL186, BIL187, BIL188, BIL203, BIL204, BIL205,BIL206
VIII	5	BIL97, BIL108, BIL170, BIL190, BIL191

Table 2. Inter and intra-cluster (bold) distance (D^2) for 64 maize inbred lines obtained by canonical variety analysis) under normal soil moisture condition.

Cluster	I	II	III	IV	V	VI	VII	VIII
I	**0.874**							
II	14.103	**0.706**						
III	5.941	8.620	**0.524**					
IV	7.985	6.687	4.316	**0.902**				
V	2.842	14.813	7.640	8.206	**0.938**			
VI	4.231	12.737	6.682	6.050	2.561	**0.833**		
VII	5.929	19.456	11.797	12.886	4.685	7.100	**0.789**	
VIII	5.117	9.927	4.401	3.271	4.939	2.864	9.623	**0.745**

Table 3. Cluster means for 13 different characters of 64 maize inbred lines under normal soil moisture condition.

Characteristics	I	II	III	IV	V	VI	VII	VIII
Yield plant^{-1} (g)	71.08	91.80	96.02	76.04	61.84	41.22	45.65	63.15
Cob length (cm)	12.78	12.97	14.70	13.14	11.68	12.22	12.16	12.50
Cob girth (cm)	12.12	13.93	13.50	12.37	11.88	10.90	10.99	11.93
Rows ear^{-1}	11.78	18.26	13.79	14.83	11.95	13.49	10.73	11.83
Grains plant^{-1}	247.43	395.29	309.38	317.61	209.92	251.72	165.68	275.37
100 Grain wt (g)	28.46	21.59	28.60	24.71	28.12	20.41	27.50	27.21
Plant height (cm)	147.98	117.27	148.96	111.45	103.01	115.67	125.10	97.28
Ear height (cm)	77.25	59.68	78.88	47.43	49.49	55.31	60.40	50.63
Days to 50% Tasseling	94.40	90.37	94.93	84.90	89.21	88.95	92.74	90.49
Days to 50% silking	98.54	93.20	98.59	88.56	92.59	92.76	96.62	94.89
ASI (days)	3.66	2.83	4.14	3.66	3.38	3.81	3.88	4.99
SPAD value	29.72	29.93	28.67	29.34	28.41	30.44	26.83	29.57

Table 4. Relative contributions of the 13 characters to the total divergence in maize under normal soil moisture condition.

Characteristics	Vector I	Vector II
Yield/Plant (g)	-0.0389	0.0642
Cob length (cm)	-0.1325	-0.1393
Cob girth (cm)	-0.2363	-0.0586
Row/ear (no.)	-0.0577	-0.0686
Grains/plant (no.)	-0.0681	-0.0110
100 Grain wt (g)	0.1155	0.0116
Plant height (cm)	0.0404	0.0215
Ear height (cm)	0.0195	0.0447
Days to 50% tasseling	-0.0291	0.0337
Days to 50% silking	-0.0381	0.0352
ASI (days)	0.0681	0.0948
SPAD value	0.0458	-0.0060

Contributions of characters towards divergence are presented in Table 4. SPAD value was positive for vector I. In case of vector II yield/plant, days to 50% tasseling and days to 50% silking were positive. Plant height, ear height, 100 grain wt and ASI were positive for both the vectors. The above results are partly agreed with many workers. Ahmed (2007) and Islam et al (2012) observed that days to tasseling, 1000 grain weight and grain yield/plant were major contributor to the divergence in maize. Amiruzzaman (2010) observed days to tasseling, anthesis silking interval, 1000 grain weight and grain yield/plant contributed considerably towards divergence. So, emphasis should be given for deciding the cluster to be chosen for the purpose of further selection and choice of parents for hybridization.

Conclusions

The crosses between inbred lines of cluster II with cluster V are expected to exploit heterosis for high yield & short statured plant. We could expect high yielding and early maturing maize hybrids by crossing between the inbred lines of clusters II & III with cluster IV. Hundred grain weight, plant height, ear height and ASI contributed maximum towards divergence. Hence major emphasis should be given on them for selecting parents for hybrids in maize.

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