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Studies on Skewness and Kurtosis of Sorghum Downy Mildew Resistant BC3F3 Progenies in Maize

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ABSTRACT

The present investigation was carried out at Eastern Block of the Central Farm Unit, Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India to identify the gene interaction for yield contributing characters to increase the yield. For this purpose nine biometrical characters of four SDM resistant progenies *viz.*, UMI 79/936-C1- 7-7-7-40, UMI 79/936-C1- 7-7-7-46, UMI 79/936-C1- 7-7-7-52 and UMI 79/936-C1- 7-7-7-80 were used for skewness and kurtosis studies. These studies revealed that in BC_3F_3 population, progeny UMI 79/936- C1-7-7-7-40 positive skewness for days to 50% tasseling, days to 50% silking, days to maturity, cob diameter, 100 grain weight and grain yield per plant and negative kurtosis was observed for the traits under study. The positive skewness indicates the presence of complementary epistatic gene action for the trait and the gain is slower with mild selection and gain is faster with intensive selection. The progenies UMI 79/936- C1-7-7-7-46, UMI 79/936- C1-7-7-7-52 and UMI 79/936-C1-7-7-7-80 showed positive skewness for 50% tasseling, days to 50% silking, days to maturity, cob length, cob diameter, 100 grain weight and grain yield per plant. Most of the traits under study showed negative kurtosis in BC_3F_3 population. The negative kurtosis indicate platykurtic curve which means that flat values are present in the distribution and complementary gene action. If selection for these characters were made intensively, the gain will be faster.

Introduction

Maize is an important cereal in many developed and developing countries of the world. In terms of breeding, it is one of the most studied species and has been used as a model in many situations. It is widely used for animal feed and industrial raw material in the developed countries where as the developing countries use it in general for feed. Globally, it is known as queen of cereals because it has the highest genetic yield potential among the cereals. Plant breeders are interested in developing cultivars resistant to pest and disease with improved yield and other phenological characters. In order to achieve this goal, the breeders had the option of selecting desirable genotype in early generations or delaying intense selection until advanced generations. Downy mildews are important maize diseases in many tropical regions of the world. They are particularly destructive in many regions of tropical Asia where losses in excess of 70% have been documented. Globally, downy mildew affected areas with significant economic losses are reported to be as high as 30% (Jeffers *et al.*, 2000).

Skewness helps us to draw the conclusion about the gene action for a particular trait. The positive skewness indicates the presence of complementary epistatic gene action for the trait and the gain is slower with mild selection and gain is faster with intensive selection. The negative skewness indicates the presence of duplicate epistasis gene action and the gain is faster with mild selection and rapid with intense selection (Snape and Riggs, 1975).

Kurtosis will occur if either a few genes are controlling the phenotypic distribution or there are inequalities in the additive genetic effects at different loci. Traits for which data showing leptokurtic distribution are usually those under control of relatively few segregating genes, whereas data showing a platykurtic distribution usually represent characters that are controlled by many genes. The positive values of kurtosis indicate leptokurtic curve while negative kurtosis indicate platykurtic curve and if values are zero, it indicates mesokurtic *i.e.* normal distribution. The platykurtic and leptokurtic nature indicates the wider and narrow variability of the population respectively. The platykurtic nature of the population will help in the selection programme due to wider variability in that population for the specific character.

Materials and Methods

The experiments were conducted in Eastern Block of the Central Farm Unit, Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India during *Rabi* 2014. BC_3F_3 population was used in the present study. It is derived from crossing the inbred UMI 79 which is susceptible for sorghum downy mildew and UMI 936(w) which has resistance for sorghum downy mildew and backcrossing progenies with UMI79. Two selfing was carried out to generate the population of BC_3F_2 and BC_3F_3. Four SDM resistant progenies *viz.*, UMI 79/936-C1- 7-7-7-40, UMI 79/936-C1- 7-7-7-46, UMI 79/936-C1- 7-7-7-52 and UMI 79/936-C1- 7-7-7-80 were used for skewness and kurtosis studies.

In these four progenies the data on nine quantitative characters viz., days to 50% tasseling, days to 50% silking, plant height, Ear height, Days to maturity, Cob length, Cob diameter, Yield per plant and 100 grain weight were recorded.

Frequency distribution

The phenotypic data of BC_3F_3 along with the parents were utilized for studying the frequency distribution in days to 50% tasseling, days to 50% silking, plant height, Ear height, Days to maturity, Cob length, Cob diameter, Yield per plant and 100 grain weight to know about the extremes in the population. It was calculated by taking minimum and maximum value of the trait. Then the difference between the maximum and minimum values is recorded as 'X' and the class interval is fixed as 10. Then the bin range was fixed by dividing the value 'X' with class interval. With the bin range, the frequency of population is obtained.

Skewness and Kurtosis were calculated using the frequency distribution (Kapur, 1980) of the characters mentioned.

β_1 = Skewness

If, $\beta_1 > 0$, then positively skewed
$\beta_1 < 0$, then negatively skewed
$\beta_1 = 0$, then symmetric distribution
β_2= Kurtosis

If, $\beta_2 > 1$, then leptokurtic
$\beta_2 < 1$, then platykurtic
$\beta_2 = 0$, then mesokurtic

$$\beta_1 = \frac{\mu_3^2}{\mu_2^2}$$

$$\beta_2 = \frac{\mu_4^2}{\mu_2^2}$$

Where,

$$\mu_2^2 = \frac{1}{N}\sum fi(Xi-\bar{X})^2$$

$$\mu_3^2 = \frac{1}{N}\sum fi(Xi-\bar{X})^3$$

$$\mu_4^2 = \frac{1}{N}\sum fi(Xi-\bar{X})^4$$

Where,
X_i is the individual observation
$\bar{X}$ is the mean of the character under observation and
N is the number of observations

Significance

The skewness and kurtosis was divided by the respective standard errors to calculate t value. The calculated't' value was compared with 't' table value with (n-1) degrees of freedom to assess significance.

$$SE_{\beta 1} = \frac{\sqrt{6}}{N}$$

$$SE_{\beta 2} = \frac{\sqrt{24}}{N}$$

Results and Discussion

Skewness helps us to draw the conclusion about the gene action for a particular trait. The positive skewness indicates the presence of complementary epistatic gene action for the trait and the gain is slower with mild selection and gain is faster with intensive selection. The negative skewness indicates the presence of duplicate epistasis gene action and the gain is faster with mild selection and rapid with intense selection (Snape and Riggs, 1975).

The positive values of kurtosis indicate leptokurtic curve while negative kurtosis indicate platykurtic curve and if values are zero, it indicates mesokurtic *i.e.* normal distribution. The platykurtic and leptokurtic nature indicates the wider and narrow variability of the population respectively. The platykurtic nature of the population will help in the selection programme due to wider variability in that population for the specific character.

Frequency distribution indicated that all the progenies showed positive skewness for the characters days to 50% tasseling, days to 50% silking, days to maturity, cob diameter and yield per plant. The traits *viz.*, days to 50% tasseling and days to 50 % silking ranged from 0.23 (UMI 79/936-C1-7-7-7-40) to 0.75 (UMI 79/936-C1-7-7-7-52) and 0.35 (UMI 79/936-C1-7-7-7-40) to 1.41 (UMI 79/936-C1-7-7-7-52) respectively. Days to maturity ranged from 0.38 (UMI 79/936-C1-7-7-7-46) to1.41 (UMI 79/936-C1-7-7-7-52).Cob diameter and yield per plant ranged from 0.21 (UMI 79/936-C1-7-7-7-52) to 1.28 (UMI 79/936-C1-7-7-7-46), 0.05 (UMI 79/936-C1-7-7-7-40) to 0.28(UMI 79/936-C1-7-7-7-46) respectively (Table 37).

The progeny (UMI 79/936-C1-7-7-7-40) exhibited negative skewness for the characters plant height, ear height and cob length.

All the progenies showed negative skewness for plant height and ear height, it ranged from -1.50 (UMI 79/936-C1-7-7-S7-S46) to -0.02 (UMI 79/936-C1-7-7-7-40) and -0.66 (UMI 79/936-C1-7-7-7-52) to -0.27 (UMI 79/936-C1-7-7-7-40) respectively.

Table.1 Skewness and Kurtosis observed in the SDM resistant progenies of BC3F3 generation

TRAITS	79/936-C1-7-7-S7-S40		79/936-C1-7-7-S7-S46		79/936-C1-7-7-S7-S52		79/936-C1-7-7-S7-S80	
	Skewness	Kurtosis	Skewness	Kurtosis	Skewness	Kurtosis	Skewness	Kurtosis
Days to 50 per cent tasseling	0.23	-0.97	0.38	-1.48	0.75	0.34	0.37	-3.90
Days to 50 per cent silking	0.35	-1.06	0.42	-0.86	1.41	1.50	0.75	0.34
Plant height (cm)	-0.02	-1.71	-1.50	2.61	-0.33	-2.01	-0.88	1.45
Ear height (cm)	-0.66	-0.57	0.32	-1.80	-0.27	-3.50	-0.60	-0.95
Days to maturity	0.53	-1.24	0.38	-1.48	1.41	1.50	1.12	1.46
Cob length (cm)	-0.20	-0.52	0.33	-0.66	0.10	-1.03	0.55	-1.65
Cob diameter (cm)	0.74	1.09	1.28	1.67	0.21	1.12	1.27	1.27
100 Grain weight (g)	0.08	-1.80	1.09	0.07	-0.05	-0.68	0.13	-0.62
Yield per plant (g)	0.05	-1.28	0.28	-2.09	0.09	-4.66	0.25	-1.47

Three progenies namely UMI 79/936-C1-7-7-7-46, UMI 79/936-C1-7-7-7-46 and UMI 79/936-C1-7-7-7-46 showed positive skewness for cob length. The progeny UMI 79/936-C1-7-7-7-40 (-0.52) showed negative skewness for cob length. For 100 grain weight except the progeny (UMI 79/936-C1-7-7-7-52) all other progenies showed positive skewness ranged from 0.13 (UMI 79/936-C1-7-7-7-80) to 1.09 (UMI 79/936-C1-7-7-7-46). One progeny UMI 79/936-C1-7-7-7-46 (0.07) showed positive kurtosis for 100 grain weight and remaining three progenies showed negative kurtosis ranged from -1.80 (UMI 79/936-C1-7-7-7-40) -0.62 (UMI 79/936-C1-7-7-7-80). All the progenies showed positive skewness and negative kurtosis for yield per plant range from 0.05 (UMI 79/936-C1-7-7-7-40) to 0.28 (UMI 79/936-C1-7-7-7-46) and -4.66 (UMI 79/936-C1-7-7-7-80) to -1.28 (UMI 79/936-C1-7-7-7-46) respectively.

To conclude that in BC_3F_3 population, progeny UMI 79/936- C1-7-7-7-40 positive skewness for days to 50% tasseling, days to 50% silking, days to maturity, cob diameter, 100 grain weight and grain yield per plant and negative kurtosis was observed for the traits under study. The positive skewness indicates the presence of complementary epistatic gene action for the trait and the gain is slower with mild selection and gain is faster with intensive selection. The progenies UMI 79/936- C1-7-7-7-46, UMI 79/936- C1-7-7-7-52 and UMI 79/936- C1-7-7-7-80 showed positive skewness for 50% tasseling, days to 50% silking, days to maturity, cob length, cob diameter, 100 grain weight and grain yield per plant. Most of the traits under study showed negative kurtosis in BC_3F_3 population. The negative kurtosis indicate platykurtic curve which means that flat values are present in the distribution and complementary gene action. If selection for these characters were made intensively, the gain will be faster. This result is in corroboration with the findings of Tamilkumar (2012) and Aarthi (2012) for grain yield per plant.

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