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Studies on Frequency Distribution of Sorghum Downy Mildew Resistant BC_2F_1 Progenies in Maize

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A B S T R A C T

The objective of this study was to investigate the distribution of progressive selection generations in order to define the maximum efficiency of increasing yield in relation to the stage of selection procedure. 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 twelve biometrical characters of five SDM resistant progenies *viz.,* UMI 79/936-C1-3, UMI 79/936-C1-7 UMI 79/936-C1-29, UMI 79/936-C1-67 and UMI 79/936-C1-101 were used for frequency distribution studies. These studies revealed that negative skewness was observed in most of the BC_2F_1 progenies for days to 50% tasseling, days to 50% silking, days to maturity, plant height, ear height, cob length, cob diameter, number of rows per cob, number of grains per row, and shelling %. Therefore for these characters the presence of duplicate epistasis gene action was confirmed and the gain is faster with mild selection and rapid with intense selection. In the case of progenies *viz.,* UMI 79/936-C1-3, UMI 79/936- C1-29 and UMI 79/936- C1-67 showed positive skewness for cob weight, 100 grain weight and grain yield per plant. The progeny UMI 79/936-C1-7 showed positive skewness for almost all the characters under study. Therefore these characters were governed by complementary gene action. The gain is slower with mild selection but is faster with intensive selection.

Introduction

Maize belongs to the tribe Maydeae of the grass family *Poaceae*. Zea (zela) was derived from an old Greek name for a food grass. The genus Zea consists of four species of which *Zea mays* L. is economically important. The other zea sp., referred to as teosintes, is largely wild grasses native to Mexico and Central America (Doeblay, 1990). The number of chromosomes in *Zea mays* is 2 n = 20. It is cultivated globally being one of the most important cereal crops worldwide. Maize is not only an important human nutrient, but also a basic element of animal feed and raw material for manufacture of many industrial products. Every part of the maize plant has economic value the grain, leaves, stalk, tassel, and cob can all be used to produce a large variety of food and nonfood products. The products include corn starch, maltodextrins, corn oil, corn syrup and products of fermentation and distillation industries. It is also being recently used as biofuel.

Maize is a versatile crop grown over a range of agro climatic zones. In fact the suitability of maize to diverse environments is unmatched by any other crop. 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).

Frequency distribution is an organized tabulation/graphical representation of the number of individuals in each category on the scale of measurement.It allows the researcher to have a glance at the entire data conveniently. It shows whether the observations are high or low and also whether they are concentrated in one area or spread out across the entire scale. Thus, frequency distribution presents a picture of how the individual observations are distributed in the measurement scale. It also gives the cumulative and relative frequency that helps to interpret the data more easily.

Skewness describes the degree of departure of a distribution from symmetry and kurtosis characterizes the peakedness of a distribution. In a frequency distribution of a segregating generation, skewness could result when certain combinations of genes are lethal or when there is incomplete linkage of certain genes controlling the trait or when there is presence of epistasis or due to non additive effects (dominance or over dominance) or due to the presence of genotype x environment interaction or when one gene has much larger effect than others.

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.

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 *Kharif* 2012. BC_2F_1 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. Five SDM resistant progenies *viz.*, UMI 79/936-C1-3, UMI 79/936-C1-7 UMI 79/936-C1-29 UMI 79/936-C1-67 and UMI 79/936-C1-101 were used for frequency distribution studies. In these five progenies the data on twelve quantitative characters viz., days to 50% tasseling, days to 50% silking, plant height, Ear height, Cob length, Cob diameter, Number of rows per cob, Number of kernels per row, Cob weight, Yield per plant, 100 grain weight and shelling percentage were recorded.

Frequency distribution

The phenotypic data of BC_2F_1 along with the parents were utilized for studying the frequency distribution in days to 50% tasseling, days to 50% silking, plant height, Ear height, Cob length, Cob diameter, Number of rows per cob, Number of kernels per row, Cob weight, Yield per plant, 100 grain weight and shelling percentage 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.

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,

$${\mu^2}_2 = \frac{1}{N}\sum fi(Xi - \bar{X})^2$$

$${\mu^2}_3 = \frac{1}{N}\sum fi(Xi - \bar{X})^3$$

$${\mu^2}_4 = \frac{1}{N}\sum fi(Xi - \bar{X})^4$$

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

A frequency distribution graph is a diagrammatic illustration of the information in the frequency table. A histogram is a graphical representation of the variable of interest in the *X* axis and the number of observations (frequency) in the *Y* axis. Percentages can be used if the objective is to compare two histograms having different number of subjects.

A histogram is used to depict the frequency when data are measured on an interval or a ratio scale.

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 of BC_2F_1 progenies

Positive skewness was observed in the progeny UMI 79/936-C1-3 for the traits *viz.*, cob length (0.18), no.of.rows per cob (0.40), cob weight (0.27), and yield per plant (0.42) remaining traits showed negative skewness.

Table.1 Skewness and Kurtosis observed in the SDM resistant progenies of BC2F1 generation

TRAITS	79/936-C1-3		79/936-C1-7		79/936-C1-29		79/936-C1-67		79/936-C1-101	
	Skewness	Kurtosis	Skewness	Kurtosis	Skewness	Kurtosis	Skewness	Kurtosis	Skewness	Kurtosis
Days to 50 per cent tasseling	-0.21	-1.20	0.62	-0.81	-0.72	-0.60	-0.81	0.44	0.33	-1.65
Days to 50 per cent silking	-0.24	-1.96	-0.04	-1.68	-0.39	-0.90	0.53	0.03	0.33	-1.65
Plant height (cm)	-0.15	-2.59	0.14	-0.95	-0.45	0.03	-0.51	-0.55	-0.64	-1.11
Ear height (cm)	-0.25	-2.63	0.25	0.18	0.33	0.28	-0.20	-1.76	0.04	-0.96
Cob length	0.18	-2.31	-0.62	-1.42	-0.05	1.49	-0.23	-0.20	-0.04	-1.03
Cob diameter	-1.65	2.59	0.06	-1.82	-0.08	0.42	-0.28	-0.90	-0.64	-0.12
No.of crows per cob (cm)	0.40	-0.18	0.17	-0.64	-1.06	2.13	-0.28	-1.39	-0.48	-0.48
No.of kernels per row (cm)	-0.16	-2.50	0.54	-1.26	0.34	-0.50	0.10	-1.01	0.14	-0.24
Cob weight (g)	0.27	-2.32	-0.24	-1.15	0.33	0.99	0.19	-0.98	-0.53	-1.14
Yield per plant (g)	0.42	-3.12	0.48	-0.80	0.34	0.40	0.30	-0.22	-0.30	-1.38
100 Grain weight (g)	-0.02	-2.76	0.38	-1.99	0.44	-0.28	0.11	-0.30	0.24	-1.61
Shelling %	-0.84	0.66	-0.68	-0.44	-1.04	1.94	-1.64	2.00	-0.26	-0.79

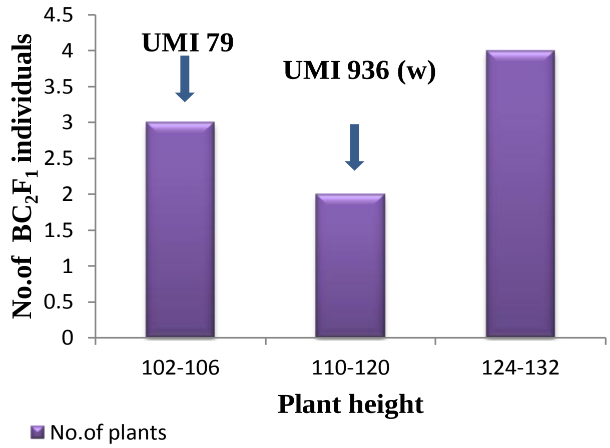

Fig. 3. Frequency distribution for plant height of UMI 79/936 –C1-7 in BC_2F_1 generation

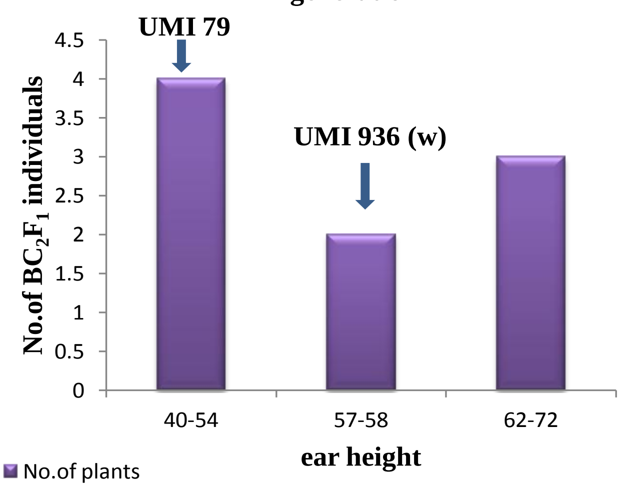

Fig. 4. Frequency distribution for ear height of UMI 79/936 –C1-7 in BC_2F_1 generation

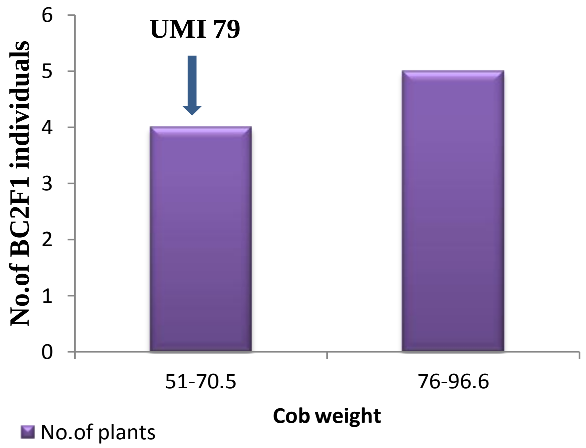

Fig. 5. Frequency distribution for cob weight of UMI 79/936 –C1-7 in BC_2F_1 generation

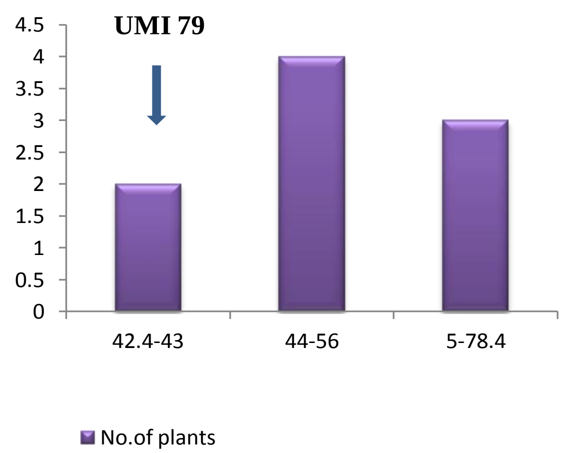

Fig. 6. Frequency distribution for yield per plant of UMI 79/936 –C1-7 in BC_2F_1 generation

Positive kurtosis was observed for the traits cob diameter (2.59) and shelling % (0.66) remaining traits exhibited negative kurtosis. In the progeny UMI 79/936-C1-7, most of the yield contributing characters showed positive skewness *viz., cob* diameter (0.06), number of rows per cob (0.17), number of grains per row (0.54), yield per plant (0.48) and 100 grain weight (0.38) except days to 50% silking (-0.04), cob length (-0.62), cob weight (-0.24), and shelling % (-0.68) which were observed to show negative skewness. All the traits exhibited negative kurtosis for this progeny except ear height (0.18) which showed positive kurtosis (Table. 1).

For the progeny UMI 79/936-C1-29 showed positive skewness for the following traits *viz.*, ear height (0.33), number of grains per row (0.34), cob weight (0.33), and yield per pant (0.34), 100 grain weight (0.44) where remaining traits exhibited negative skewness. Positive kurtosis was noted for the traits *viz.*, plant height (0.03),ear height (0.28),cob length (1.49),cob diameter (0.42), no.of.rows per cob (2.13),cob weight (0.99), yield per pant (0.40) remaining traits exhibited negative kurtosis *viz.*, days to 50% tasseling (-060), days to 50% silking (-0.90), number of grains per row (-0.50) and 100 grain weight (-0.28).

Progeny UMI 79/936-C1-67 exhibited positive skewness for the traits *viz.*, days to 50% silking (0.53), number of grains per row (0.10), cob weight (0.19), yield per plant (0.30), and 100 grain weight (0.11) remaining traits were observed to register negative skewness. Days to 50% tasseling (0.44), days to 50% silking (0.03), and shelling % (2.00) showed positive kurtosis remaining traits showed negative kurtosis in this progeny. The progeny UMI 79/936-C1-101, exhibited positive skewness for the traits *viz.*, days to 50% tasseling (0.33), days to 50% silking (0.33), ear height (0.04),100 grain weight (0.24) while all the other traits showed negative skewness. In this progeny negative kurtosis was observed for all the traits under study.

To conclude that the present study reveals that negative skewness was observed in most of the BC_2F_1 progenies for days to 50% tasseling, days to 50% silking, days to maturity, plant height, ear height, cob length, cob diameter, number of rows per cob, number of grains per row, and shelling %. Therefore for these characters the presence of duplicate epistasis gene action was confirmed and the gain is faster with mild selection and rapid with intense selection. In the case of progenies *viz.*, UMI 79/936-C1-3, UMI 79/936- C1-29 and UMI 79/936- C1-67 showed positive skewness for cob weight, 100 grain weight and grain yield per plant. The progeny UMI 79/936-C1-7 showed positive skewness for days to 50% tasseling, plant height, ear height, cob diameter, number of rows per cob, number of grains per row, 100 grain weight and grain yield per plant. Therefore these characters were governed by complementary gene action. The gain is slower with mild selection but is faster with intensive selection. Similar results have been reported in maize by Suresh kumar (2013) and Sruthy Menon (2014). All the BC_2F_1 progenies recorded negative kurtosis for the traits under study except UMI 79/936-C1-29. Indicating the wider variability and scope for further selection among the progenies.

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