

Original Research Article

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## Variability Parameters Studies in Sorghum Downy Mildew Resistant BC<sub>3</sub>F<sub>3</sub> Progenies of Maize

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### ABSTRACT

The present experiment 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 best performing Sorghum Downy Mildew resistant progeny for agronomical traits. The objective of this study was to identify the better biometric performance of the resistant progeny. Nine biometrical characters of six SDM resistant BC<sub>3</sub>F<sub>3</sub> progenies viz., UMI 79/936-C1- 7-7-7-40, UMI 79/936-C1- 7-7-7-46, UMI 79/936-C1- 7-7-7-48, UMI 79/936-C1- 7-7-7-52, UMI 79/936-C1- 7-7-7-80 and UMI 79/936-C1- 7-7-7-92 were used for variability studies. Variability analysis revealed that mean values of days to 50% tasseling and days to 50% silking for all the six progenies showed that mostly similar to recurrent parent. In the case of yield contributing characters viz., Cob length, Cob diameter, Yield per plant and 100 grain weight for all the progenies showed moderate to high levels of variability and heritability. Among the six progenies the progeny no. UMI 79/936-C1-7-7-7-80 and UMI 79/936-C1-7-7-7-92 showed better *per se* performance for yield contributing characters. It exhibited more mean values than the parents for the characters viz., Cob length, Cob diameter, Yield per plant, 100 grain weight. Based on the variability analysis the progeny no UMI 79/936-C1-7-7-7-80 and UMI 79/936-C1-7-7-7-92 were selected as the best progenies.

### Keywords

Variability analysis,  
Heritability and  
Genetic advance,  
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### Introduction

Maize (*Zea mays* L.) plays a unique role in world agriculture as a food, feed and industrial crop. It is the world's third most important crop after rice and wheat. 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).

Moreover, due to the economical cost of the chemicals and the emergence of chemical resistance in the downy mildew pathogens (Raymundo, 2000), the use of host plant resistance seems to be the most effective, economical and it is meant as a safer way of controlling SDM in maize (Rathore and Jain, 2000). The genetic information relating to host resistance is vital for making breeding decisions. Selection is effective when there is genetic variability among the individuals in a population. Hence, insight into the magnitude of genetic variability present in a population is of paramount importance to a plant breeder for stating a judicious breeding programme. Knowledge of heritability and genetic advance of the character indicate the scope for the improvement through selection. Heritability estimates along with genetic advance are normally more helpful in predicting the gain under selection than heritability estimates alone (Johnson *et al.*, 1955). Hence, the present studies were undertaken to identify the best performing SDM resistant progeny for yield contributing characters through variability analysis.

## 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<sub>3</sub>F<sub>3</sub> 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<sub>3</sub>F<sub>2</sub> and BC<sub>3</sub>F<sub>3</sub>. Six BC<sub>3</sub>F<sub>3</sub> progenies *viz.*, UMI 79/936-C1- 7-7-7-40, UMI 79/936-C1- 7-7-7-46, UMI

79/936-C1- 7-7-7-48, UMI 79/936-C1- 7-7-7-52, UMI 79/936-C1- 7-7-7-80 and UMI 79/936-C1- 7-7-7-92 were selected as resistant to sorghum downy mildew under sick plot condition.

In these six 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. The estimate of variability such as phenotypic and genotypic coefficient of variation (PVC and GCV) were calculated adopting the formula suggested by (Burton 1952). Heritability in broad sense was estimated by according to Lush (1950) and the genetic advance was calculated following Burton (1952) and Johnson *et al.*(1955). The data on the mean, co-efficient of variation, heritability and genetic advance as per cent of mean for six progenies are furnished in Table 1 to Table 6.

## Results and Discussion

The potentiality of a cross and any progeny is measured not only by mean performance but also on the extent of variability. Knowledge on nature and magnitude of genotypic and phenotypic variability present in any crop species plays an important role in formulating successful breeding programmes (Allard, 1960). The genetic advance is a useful indicator of the progress that can be expected as result of exercising selection on the pertinent population. Heritability in conjunction with genetic advance would give a more reliable index of selection value (Johnson *et al.*, 1955). Plant breeders are commonly faced with problems of handling segregating populations and selection procedures. Mean and variability are the important factors for selection. Mean serves as a basis for eliminating undesirable crosses or progenies. Variability helps to choose a

potential cross or progeny since variability indicates the extent of recombination for initiating effective selection procedures.

Selection of parents is one of the most important step in any breeding programme. Selection method can extract good cultivars if the parents used in the breeding programme are suitable. Therefore, an elite inbred UMI 79 was selected to introgress Sorghum Downy Mildew resistance from UMI 936(W). Inclusion of elite inbred as parent (UMI 79) will largely help to ensure the recovery of a high proportion of progenies with adaptation and quality that would in turn helpful in developing superior hybrids with SDM resistance. The important biometrical traits *viz.*, days to 50% tasseling, days to 50% silking, plant height, Ear height, cob length, cob diameter, Days to maturity, 100 grain weight and grain yield per plant were studied in the six SDM resistant progenies of BC<sub>3</sub>F<sub>3</sub> population (Table 1 to 6).

In the present investigation, analysis of variability parameters revealed that, the parent UMI 79 showed better *per se* performance than the donor parent for yield contributing characters *viz.*, number of rows per cob, number of grains per row, cob weight, 100 grain weight grain yield per plant and shelling %. In all the four progenies *viz.*, UMI 79/936-C1-3-2, UMI 79/936-C1-3-4, UMI 79/936-C1-7-2, and UMI 79/936-C1-7-7 for the character days to 50% tasseling and days to 50% silking showed low levels of phenotypic and genotypic co-efficient variation 2.72% (UMI 79/936-C1-3-2) to 4.10% (UMI 79/936-C1-3-4) and 2.69% (UMI 79/936-C1-7-2) to 6.50% (UMI 79/936-C1-3-2) respectively. These characters exhibited high levels of heritability 69.83% (UMI 79/936-C1-7-2) to 89.23% (UMI 79/936-C1-3-2) with low genetic advance as percent of mean from 4.20 to 6.71. The mean values for these two characters showed almost similar to recurrent parent 55.40 days and 57.40 days respectively. The

variability parameters *viz.*, PCV 13.28 % (UMI 79/936-C1-3-2) to 15.87% (UMI 79/936-C1-3-4) were found to be moderate for the trait plant height with low level to moderate level of GCV from 7.92% (UMI 79/936-C1-3-2) to 15.87% (UMI 79/936-C1-3-4). Moderate to high level of heritability was found in all the progenies from 33.33% (UMI 79/936-C1-3-2) to 89.23 % (UMI 79/936-C1-3-2). Cob length and Cob diameter showed low to moderate level of PCV and GCV with moderate to high levels of heritability in all the four progenies. Similar findings in maize were also reported by Rafique *et al.*, (2004), Abhirami *et al.*, (2005), Alake *et al.*, (2008) and Reddy *et al.*, (2013). Panwar *et al.*, (2013) also reported moderate variability for number of grains per row and cob diameter. All the progenies recorded moderate to high level of PCV for number of rows per cob ranged from 16.98% (UMI 79/936-C1-7-2) to 24.17 % (UMI 79/936-C1-3-4) and moderate levels of GCV from to 10.35% (UMI 79/936-C1-7-2) 18.70 % (UMI 79/936-C1-3-4) with high heritability (Table 1 to 4).

All the four progenies exhibited high PCV and GCV for cob weight ranged from 38.80 % (UMI 79/936-C1-7-2) to 47.32% (UMI 79/936-C1-3-4) and 22.96% (UMI 79/936-C1-3-2) to 35.45% (UMI 79/936-C1-3-4) respectively. It also showed high heritability ranged from 34.64% (UMI 79/936-C1-3-2) to 68.16% (UMI 79/936-C1-7-7) with high genetic advance. 100 grain weight found to high levels of heritability with high levels genetic advance as percent of mean. Yield per plant recorded high PCV and GCV ranged from 46.59% (UMI 79/936-C1-7-2) to 57.31 % (UMI 79/936-C1-3-2) and 27.42% (UMI 79/936-C1-7-2) to 37.29% (UMI 79/936-C1-3-2) respectively. It also recorded high heritability from 35.99 % UMI 79/936-C1-3-4 to 57.29% (UMI 79/936-C1-7-7) with high genetic advance. Vashishta *et al.*, 2013 observed high to moderate variability for number of grains per row and grain yield per plant.

**Table.1** Variability parameter observed in the BC<sub>3</sub> F<sub>3</sub> generation for UMI 79/936-C1 -7-7-7-40

Traits	Grand Mean			Range		Vp	Vg	PCV	GCV	h2	GA	GA(as percent of mean)
	P1	P2	BC <sub>3</sub> F <sub>3</sub>	Min.	Max.							
Days to 50 per cent tasseling	54.60	63.80	55.64	54.00	58.00	1.85	1.10	2.45	1.89	59.56	1.67	3.00
Days to 50 per cent silking	56.60	66.00	57.73	56.00	60.00	2.22	1.57	2.58	2.17	70.70	2.17	3.76
Plant height (cm)	86.60	104.40	93.73	86.00	102.00	35.02	31.47	6.31	5.99	89.86	10.95	11.69
Ear height (cm)	41.80	52.40	44.82	35.00	52.00	31.76	29.26	12.58	12.07	92.13	10.70	23.87
Days to maturity	99.60	107.80	102.91	101.00	106.00	3.29	2.54	1.76	1.55	77.21	2.89	2.80
Cob length (cm)	11.52	12.82	11.65	8.80	14.30	2.68	1.82	14.05	11.58	67.98	2.29	19.68
Cob diameter (cm)	10.48	11.06	9.75	7.50	13.20	2.51	1.53	16.25	12.68	60.91	1.99	20.38
Yield per plant (g)	14.44	13.12	14.24	10.40	17.80	7.66	5.41	19.44	16.33	70.57	4.02	28.27
100 Grain weight (g)	19.16	16.79	20.25	15.60	24.60	9.71	7.88	15.38	13.86	81.21	5.21	25.74

**Table.2** Variability parameter observed in the BC<sub>3</sub> F<sub>3</sub> generation for UMI 79/936-C1 -7-7-7-46

Traits	Grand Mean			Range		Vp	Vg	PCV	GCV	h2	GA	GA (as percent of mean)
	P1	P2	BC <sub>3</sub> F <sub>3</sub>	Min.	Max.							
<b>Days to 50 per cent tasseling</b>	54.60	63.80	55.67	54.00	58.00	2.67	1.92	2.93	2.49	71.87	2.42	4.34
<b>Days to 50 per cent silking</b>	56.60	66.00	57.83	56.00	60.00	2.17	1.52	2.55	2.13	70.00	2.12	3.67
<b>Plant height (cm)</b>	86.60	104.40	85.83	70.00	94.00	73.77	70.22	10.01	9.76	95.19	16.84	19.62
<b>Ear height (cm)</b>	41.80	52.40	44.00	40.00	49.00	14.80	12.30	8.74	7.97	83.11	6.59	14.97
<b>Days to maturity</b>	99.60	107.80	102.67	101.00	105.00	2.67	1.92	1.59	1.35	71.88	2.42	2.36
<b>Cob length (cm)</b>	11.52	12.82	11.77	9.50	14.30	2.76	1.90	14.11	11.72	68.94	2.36	20.04
<b>Cob diameter (cm)</b>	10.48	11.06	9.64	7.80	13.20	3.43	2.45	19.20	16.23	71.42	2.72	28.26
<b>100 Grain weight (g)</b>	14.44	13.12	13.14	10.40	17.80	7.12	4.86	20.30	16.78	68.33	3.76	28.58
<b>Yield per plant (g)</b>	19.16	16.79	20.00	15.60	24.60	14.46	12.64	19.02	17.78	87.39	6.85	34.23

**Table.3** Variability parameter observed in the BC<sub>3</sub> F<sub>3</sub> generation for UMI 79/936-C1 -7-7-7-48

Traits	Grand Mean			Range		Vp	Vg	PCV	GCV	h2	GA	GA (as percent of mean)
	P1	P2	BC <sub>3</sub> F <sub>3</sub>	Min.	Max.							
Days to 50 per cent tasseling	54.60	63.80	56.00	54.00	58.00	2.00	1.25	2.53	2.00	62.50	2.58	4.60
Days to 50 per cent silking	56.60	66.00	58.33	56.00	60.00	2.08	1.43	2.47	2.05	68.78	2.95	5.05
Plant height (cm)	86.60	104.40	88.67	81.00	95.00	50.33	46.78	8.00	7.71	92.95	13.58	15.32
Ear height (cm)	41.80	52.40	43.33	40.00	48.00	17.33	14.83	9.61	8.89	85.58	7.34	16.94
Days to maturity	99.60	107.80	103.00	101.00	105.00	4.00	3.25	1.94	1.75	81.25	3.35	3.25
Cob length (cm)	11.52	12.82	11.87	10.20	13.20	2.33	1.48	12.87	10.24	63.27	1.99	16.78
Cob diameter (cm)	10.48	11.06	10.57	9.30	12.10	2.01	1.03	13.43	9.62	51.32	1.50	14.20
100 Grain weight (g)	14.44	13.12	14.47	12.20	16.70	5.06	2.81	15.55	11.58	55.46	2.57	17.77
Yield per plant (g)	19.16	16.79	17.73	15.40	20.20	5.77	3.95	13.55	11.21	68.40	3.39	19.09

**Table.4** Variability parameter observed in BC<sub>3</sub> F<sub>3</sub> generation for 79/936 7-7-7-52

Traits	Grand Mean			Range		Vp	Vg	PCV	GCV	h2	GA	GA (as percent of mean)
	P1	P2	BC <sub>3</sub> F <sub>3</sub>	Min.	Max.							
Days to 50 per cent tasseling	54.60	63.80	55.75	54.00	58.00	2.92	2.17	3.06	2.64	74.29	2.61	4.69
Days to 50 per cent silking	56.60	66.00	58.00	57.00	60.00	2.00	1.35	2.44	2.00	67.50	1.97	3.39
Plant height (cm)	86.60	104.40	99.75	88.00	110.00	94.92	91.37	9.77	9.58	96.26	19.32	19.37
Ear height (cm)	41.80	52.40	48.00	41.00	54.00	36.67	34.17	12.62	12.18	93.18	11.62	24.22
Days to maturity	99.60	107.80	103.00	102.00	105.00	2.00	1.25	1.37	1.09	62.50	1.82	1.77
Cob length (cm)	11.52	12.82	10.88	9.50	12.30	1.44	0.59	11.04	7.04	40.59	1.00	9.23
Cob diameter (cm)	10.48	11.06	9.45	7.80	11.20	1.96	0.98	14.80	10.46	49.91	1.44	15.22
100 Grain weight (g)	14.44	13.12	18.63	15.70	21.50	6.09	3.83	13.25	10.51	62.97	3.20	17.19
Yield per plant (g)	19.16	16.79	19.50	16.80	22.40	7.40	5.58	13.95	12.11	75.35	4.22	21.65

**Table.5** Variability parameter observed in the BC<sub>3</sub> F<sub>3</sub> generation for UMI 79/936-C1 -7-7-7-92

Traits	Grand Mean			Range		Vp	Vg	PCV	GCV	h2	GA	GA (as percent of mean)
	P1	P2	BC <sub>3</sub> F <sub>3</sub>	Min.	Max.							
Days to 50 per cent tasseling	54.60	63.80	55.00	54.00	56.00	2.00	1.25	2.57	2.03	62.50	1.82	3.31
Days to 50 per cent silking	56.60	66.00	57.50	56.00	59.00	4.50	3.85	3.69	3.41	85.56	3.74	6.50
Plant height (cm)	86.60	104.40	88.50	86.00	91.00	12.50	8.95	3.99	3.38	71.60	5.21	5.89
Ear height (cm)	41.80	52.40	43.00	39.00	47.00	32.00	29.50	13.16	12.63	92.19	10.74	24.98
Days to maturity	99.60	107.80	104.50	103.00	106.00	4.50	3.75	2.03	1.85	83.33	3.64	3.48
Cob length (cm)	11.52	12.82	12.45	11.40	13.50	2.21	1.35	11.93	9.33	61.13	1.87	15.02
Cob diameter (cm)	10.48	11.06	10.15	9.10	11.20	2.21	1.23	14.63	10.90	55.56	1.70	16.74
100 Grain weight (g)	14.44	13.12	16.60	15.40	17.80	2.88	0.62	10.22	4.76	21.70	0.76	4.57
Yield per plant (g)	19.16	16.79	21.05	19.70	22.40	3.65	1.82	9.07	6.41	49.95	1.96	9.33

**Table.6** Variability parameter observed in the BC<sub>3</sub> F<sub>3</sub> generation for UMI 79/93C1 -7-7-7-80

Traits	Grand Mean			Range		Vp	Vg	PCV	GCV	h2	GA	GA (as percent of mean)
	P1	P2	BC <sub>3</sub> F <sub>3</sub>	Min.	Max.							
Days to 50 per cent tasseling	54.60	63.80	55.25	54.00	57.00	2.25	1.50	2.71	2.22	66.67	2.06	3.73
Days to 50 per cent silking	56.60	66.00	57.75	56.00	60.00	2.92	2.27	2.96	2.61	77.71	2.73	4.73
Plant height (cm)	86.60	104.40	89.20	80.00	96.00	35.20	31.65	6.65	6.31	89.91	10.99	12.32
Ear height (cm)	41.80	52.40	42.80	36.00	48.00	23.20	20.70	11.25	10.63	89.22	8.85	20.68
Days to maturity	99.60	107.80	103.60	102.00	106.00	2.30	1.55	1.46	1.20	67.39	2.11	2.03
Cob length (cm)	11.52	12.82	11.64	10.20	13.60	2.06	1.21	12.34	9.43	58.46	1.73	14.86
Cob diameter (cm)	10.48	11.06	10.44	9.30	12.60	1.82	0.84	12.93	8.79	46.24	1.29	12.32
100 Grain weight (g)	14.44	13.12	16.14	12.60	19.80	7.67	5.41	17.16	14.42	70.59	4.03	24.95
Yield per plant (g)	19.16	16.79	20.50	16.80	24.50	9.57	7.74	15.09	13.57	80.93	5.16	25.15

Among the four progenies UMI 79/936-C1-7-7 showed better *per se* performance for yield contributing characters. It showed highest mean value than the parents for the characters namely cob length (15.35 cm), cob diameter (13.50 cm), number of rows per cob (19.92), number of kernels per rows (20.20), cob weight (58.50g) and yield per plant (60.25g). It also recorded high level of heritability and genetic advance. This is the indication of predominance of additive gene action. This is desirable for selection since these traits are least influenced by the environment. The selection for these traits is likely to accumulate more additive genes leading to further improvement in their agronomic performance. Similar results were obtained by Vashishta *et al.*, (2013) and by Bekele and Rao (2014) and Panwar *et al.*, (2013) for grain yield per plant (58.52), plant height (37.09) and ear height.

To conclude that the study revealed that among the four progenies studied the progeny UMI 79/936-C1-7-7 showed better *per se* performance for the yield contributing characters. It also recorded moderate to high variability and high heritability with high genetic advance for cob weight and yield per plant. So the progeny no UMI 79/936-C1-7-7 was identified as best progeny in regards to better biometrical performance. It may serve as basis material for developing single cross maize hybrids resistant to sorghum downy mildew with high yield.

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