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Studies on Transgressive Segregation in Double Cross F_2Population of *Kharif* Sorghum (*Sorghum bicolor* (L.) Moench)

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ABSTRACT

The present investigation was undertaken at Sorghum Research Station V.N.M.K.V. Parbhani during kharif 2017. Total 15 genotypes including 14 double cross F_2 population, and one check i.e. PVK 809 were evaluated in randomized block design, replicated twice with an objectto Identify desirable Transgressive segregants in F_2 population of double crosses of sorghum. Present study revealed that cross I, cross II, cross III, cross IX and cross XI expressed the highest Transgressive segregants for plant height, panicle length, no. of primaries per panicle, no. of grains per panicle, test weight, grain yield per plant and fodder yield per plant.

Keywords: *Sorghum, Double cross F_2 population, Transgressive segregation*

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INTRODUCTION

In genetics, transgressive segregation is the formation of extreme phenotypes, or transgressive phenotypes, observed in segregated hybrid populations compared to phenotypes observed in the parental lines. The appearance of these transgressive (extreme) phenotypes can be either positive or negative in terms of fitness. If both the parents' favourable alleles come together, it will result in a hybrid having a higher fitness than two parents. Genetic studies indicate that transgressive segregation mostly results from the appearance, in individual genotypes, of combinations of alleles from both parents that have effects in the same direction (complementary gene action2, 4). That is, hybrid individuals that combine 'plus' alleles from both parents or 'minus' alleles from both parents are likely to have extreme phenotypes. Transgressive breeding aims at isolating gene combinations (recombinants) which possesses new characters or a higher intensity of a trait. These genotypes are superior to either parents. Transgressive segregants are produced by crossing parents possessing desired traits in the required intensity, but controlled by different set of genes, tends to ensure release of transgressive segregants. A character absent in the original parents may appear in the segregating generations (3). In recombination breeding contribution of desirable plus genes by each parent gives rise to transgressive segregants. It can be used as a positive tool in sorghum breeding.

MATERIALS AND METHODS

Experimental material for present investigation consists of 14 F_2 populations derived from double crosses of elite *kharif* sorghum genotypes and one check PVK 809. These genotypes were evaluated at Sorghum Research Station, VasantraoNaikMarathwadaKrishiVidyapeeth, Parbhani during *Kharif* 2017-18. 30 plants from each of the F_2 were randomly selected for recording observations. The experiment was laid in Randomised Block Design with three replications. 10 rows of each F2s in each replication were sown following a spacing of 45cm and 15 cm between and within rows. Observations were recorded for the eleven characters.

RESULTS AND DISCUSSION

Transgressive segregants are produced by crossing parents possessing desired traits in the required intensity, but controlled by different set of genes, tends to ensure release of transgressive segregants. A character absent in the original parents may appear in the segregating generations (3).In recombination breeding contribution of desirable plus genes by each parent gives rise to Transgressive segregants. Although Transgressive segregants includes lines which fall outside the range of performance of either parents, but only those being superior to better parent are of practical value. Therefore, a breeder is more concerned with obtaining higher frequency of Transgressive segregants in segregating population as it provides him a better scope for exercising selection to improve productivity. It can be used as a positive tool in sorghum breeding. Hence, the present study was undertaken to generate the transgressants possessing more number of desirable attributes.

The studies revealed that Transgressive segregants were recorded in each of the fourteen crosses for days to 50 % flowering (Table 1). The range of percent Transgressive segregants is 3.3 to 20 %. The highest Transgressive segregants % i.e, 20 and 16.6 % were observed in the cross I and cross XI (Table 4).Thissuggested that these crosses transgressed more desirable Transgressive segregants as compared to the other crosses and may be utilized for the isolation of early genotypes in later generations.

In case of plant height (Table 1), the range of transgressive segregation % is of 3.3 to 36.6 %. The highest percent Transgressive segregants i.e, 36.6 and 30 % were observed in the cross II and cross I than rest of the crosses. The range of percent transgressive segregation is of 3.3 to 26.6 % for panicle length. The highest Transgressive segregants i.e, 26.6% and 23.3 % were observed in the cross XI and I, respectively (Table 4). This indicates scope for selection of high grain yield in these crosses as panicle length is significantly correlated to high grain yield.

Number of primaries also showed significant and positive association with grain yield, it is the one of the potent trait for indirect selection for higher yield. The studies noticed that Transgressive segregants were recorded in each of the fourteen crosses for number of primaries per panicle. In case of number of primaries per panicle, the range of percent transgressive segregation is of 3.3 to 20 % (Table 1). The highest percent Transgressive segregants i.e, 20 and 13.3 % were observed in the cross I and cross III(Table 4). Transgressive segregants were also recorded in each of the fourteen crosses for test weight (Table 2). The highest pecent Transgressive segregants were observed in the cross II (13.3%) and cross IX (10%). Information on the association between the genetic parameters of seed weight and selection in segregating populations should help to predict beneficial cross combinations to accelerate the development of large seed genotypes without compromising the yield.

With regards to grain yield per plant, wide range of percent Transgressive segregants (3.3 to 30 %) was witnessed (Table 2). The highest Transgressive segregants i.e, cross III produced highest percent (30%) followed by cross IX with 26.6 % of Transgressive segregants. Further for field grade score the range of transgressive segregation is of 3.3 to 13.3 % (Table 4). The highest percent Transgressive segregants i.e, 13.3 and 10 % were observed in the cross I and cross VII. In this way, Maximum frequency of Transgressive segregants was for grain yield per plant, for panicle length, no. of primaries per panicle, fodder yield per plant and test weight.

In conclusion transgressive individuals with values exceeding the better parent were observed in all the crosses for all the traits under study. This indicates that the parents possess different alleles and genes governing respective characters indicating the scope to bring in beneficial alleles into a single genotype through rigorous selection and evaluation of the segregants for different characters along with selection for yield to arrive at a desirable plant type through selection in later generations.

Smith (5) observed that there was no limitation on type of characters, which might respond to transgressive breeding. He recoded transgressive segregation for various agronomic characters. Tripathi *etal*. (6) reported maximum number of Transgressive segregants for panicle length and test weight. From the study of Exotic x Indian crosses of *kharif* sorghum, they observed seven Transgressive segregants for yield. Bhag Mal and Mishra (1) recorded positive transgressive segregation for plant height and panicle thickness indicating that the prospects are good for the recovery of the plant types with improved yield and quality from this material.

Finally we noticed that cross I, cross II, cross III, cross IX and cross XI expressed the highest Transgressive segregants for plant height, panicle length, no. of primaries per panicle, no. of grains per panicle, test weight, grain yield per plant and fodder yield per plant.

Table 1 Number of transgressive segregants and extended limits for grain yield, plant height and field grade score in double cross F_2 population

Traits	Days to 50 % flowering		Plant height		Panicle Length		Number of primaries per panicle	
Cross Number	Increasing Parent and its mean	Number of transgressive segregants and extended limits	Increasing Parent and its mean	Number of transgressive segregants and extended limits	Increasing Parent and its mean	Number of transgressive segregants and extended limits	Increasing Parent and its mean	Number of transgressive segregants and extended limits
I	47708 (69)	6 (64)	IVT 4001 (143)	9 (240)	IVT 4001 (22)	7 (30)	AKR 426 (58)	6 (68)
II	PMS 8B (70)	4 (65)	PMS 98B (128)	11 (225)	PMS 98B (25)	6 (32)	PMS 8B (55)	4 (63)
III	KR 123 (71)	4 (66)	AKSV 181 (155)	7 (230)	AKSV 181 (27)	5 (31)	KR 123 (59)	4 (66)
IV	135413 (68)	3 (64)	SFR 8 (220)	5 (235)	SFR 8 (29)	2 (33)	PVK 400 (56)	2 (62)
V	PMS 71B (72)	2 (66)	135413 (158)	3 (225)	135413 (26)	1 (30)	PMS 71B (59)	1 (62)
VI	AKR 426 (71)	2 (65)	AKR 426 (124)	4 (195)	AKR 426 (23)	3 (28)	I 26 (60)	2 (66)
VII	KR 133 (72)	3 (67)	WANI (170)	2 (200)	WANI (24)	2 (27)	WANI (61)	2 (68)
VIII	WANI (66)	1 (64)	KR 123 (135)	1 (196)	KR 123 (25)	1 (29)	135413 (58)	1 (65)
IX	1017B (67)	4 (63)	1017B (178)	6 (185)	1017B (27)	6 (31)	1017B (61)	4 (66)
X	PVK 400 (73)	3 (66)	PMS 71B (158)	3 (200)	PMS 71B (28)	2 (31)	SFR 8 (62)	3 (70)
XI	C 43 (70)	5 (64)	C 43 (178)	9 (205)	C 43 (24)	8 (30)	C 43 (57)	4 (66)
XII	KR 196 (69)	1 (65)	KR 196 (142)	3 (200)	KR 196 (27)	2 (31)	KR 196 (67)	2 (72)
XIII	KR 125 (67)	2 (63)	KR 125 (134)	2 (187)	KR 125 (28)	2 (32)	KR 125 (59)	3 (70)
XIV	AKR 492 (69)	2 (64)	AKR 492 (136)	1 (198)	AKR 492 (26)	3 (30)	AKR 492 (55)	1 (63)

Table 2 Number of transgressive segregants and extended limits for grain yield, plant height and field grade score in double cross F_2 population

Traits	Grain yield		Test weight		Field grade score	
Cross Number	Increasing Parent and its mean	Number of transgressive segregants and extended limits	Increasing Parent and its mean	Number of transgressive segregants and extended limits	Increasing Parent and its mean	Number of transgressive segregants and extended limits
I	AKR 426 (37)	8 (50)	IVT 4001 (1.4)	3 (1.7)	47708 (4)	4 (3)
II	PMS 8B (41)	7 (53)	PMS 8B (1.5)	4 (1.8)	PMS 8B (5)	2 (3)
III	KR 123 (42)	9 (59)	AKSV 181 (1.6)	3 (1.9)	KR 123 (4)	3 (2)
IV	PVK 400 (29)	5 (49)	135413 (1.5)	1 (1.8)	135413 (3)	1 (2)
V	PMS 71B (45)	4 (51)	KR 123 (1.3)	2 (1.7)	PMS 71B (5)	1 (3)
VI	I 26 (36)	3 (48)	I 26 (1.7)	2 (2.0)	AKR 426 (5)	2 (4)
VII	WANI (44)	3 (50)	KR 133 (1.8)	3 (2.1)	KR 133 (4)	3 (2)
VIII	135413 (46)	1 (50)	WANI (1.4)	1 (1.9)	WANI (6)	2 (4)
IX	1017B (45)	8 (52)	PMS 28B (1.4)	3 (2.0)	1017B (3)	2 (2)
X	SFR 8 (32)	5 (48)	SFR 8 (1.9)	2 (2.2)	PVK 400 (4)	3 (3)
XI	C 43 (39)	9 (46)	C 43 (1.6)	2 (2.0)	C 43 (3)	1 (1)
XII	KR 196 (38)	3 (48)	AKR 426 (1.4)	1 (1.9)	KR 196 (5)	2 (3)
XIII	KR 125 (42)	2 (50)	KR 125 (1.6)	2 (2.1)	KR 125 (4)	2 (2)
XIV	AKR 492 (33)	4 (48)	AKR 492 (1.4)	1 (1.9)	AKR 492 (6)	3 (4)

Table 3 Number of trangressive segregants obtained in double cross F_2 population of *kharif* sorghum

Cross No.	Number of transgressive segregants in each character										
	DF	PH	PL	PW	NPr/P	NGr/P	TW	GY	FY	FGrS	TGrS
I	6	9	7	5	6	4	3	8	6	4	3
II	4	11	6	3	4	3	4	7	4	2	2
III	4	7	5	2	4	3	3	9	3	3	1
IV	3	5	2	1	2	2	1	5	5	1	4
V	2	3	1	2	1	1	2	4	2	1	2
VI	2	4	3	2	3	2	2	3	3	2	3
VII	3	2	2	3	2	2	3	3	1	3	3
VIII	1	1	1	2	1	3	1	1	2	2	1
IX	4	7	6	1	4	1	3	8	2	2	1
X	3	3	2	2	3	2	2	5	3	3	2
XI	5	9	8	4	4	1	2	9	1	1	3
XII	1	3	2	2	2	3	1	3	4	2	2
XII	2	2	1	1	3	2	2	2	2	2	1
XIV	2	1	3	2	1	2	1	4	2	3	3

Table 4 Per cent transgressive segregants in each 14 crosses

Sr No.	Traits	Per cent transgressive segregants													
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV
1	DF	20	13.3	13.3	10	6.6	6.6	10	3.3	13.3	10	16.6	3.3	6.66	6.6
2	PH	30	36.6	23.3	16.6	10	13.3	6.66	3.3	13.3	10	30	10	6.6	3.3
3	PL	23.3	20	16.6	6.6	3.3	10	6.6	3.3	20	6.6	26.6	6.6	3.3	10
4	PW	16.6	10	6.6	3.3	6.6	6.6	10	6.6	3.3	6.6	13.3	6.6	3.3	6.6
5	NPr/P	20	13.3	13.3	6.6	3.3	10	6.6	3.3	13.3	10	13.3	6.6	10	3.3
6	NGr/P	13.3	10	10	6.6	3.3	6.6	6.6	10	3.3	6.6	3.3	10	6.6	6.6
7	TW	10	13.3	10	3.3	6.6	6.6	10	3.3	10	6.6	6.6	3.3	6.6	3.3
8	GY	26.6	23.3	30	16.6	13.3	10	10	3.3	26.6	16.6	30	10	6.6	13.3
9	FY	20	13.3	10	16.6	6.6	10	3.3	6.6	6.6	10	3.3	13.3	6.6	6.6
10	FGrS	13.3	6.6	10	3.3	3.3	6.6	10	6.6	6.6	10	3.3	6.6	6.6	10
11	TGrS	10	6.6	3.3	13.3	6.6	10	10	3.3	3.3	6.6	10	6.6	3.3	10

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