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STUDIES ON HYBRIDS AND TRANSGRESSIVE SEGREGATES IN WIDE CROSSES OF MUNGBEAN AND URDBEAN

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ABSTRACT

Interspecific hybrids involving four genotypes of mungbean (*Vigna radiata* L.) as female and the three genotypes of urdbean (*Vigna mungo* L.) as male were studied. Genotypes influenced crossability, germination, survival and fertility of F_1s. The crossed seeds were shrivelled and the F_1s were partially fertile, late maturing and intermediate in morphology. Purple colour of the stem was dominant over green colour. Only 2 out of 6 hybrids, namely, BHUM 1 x Pant U 30 and T 44 x T 9 resulted in fertile F_1s which reached maturity. Fertility of the progenies improved from F_2 to F_4 generations. Desirable transgressive segregates observed in the advanced generations open up new avenues for amelioration of these crops.

Key words: Mungbean, urdbean, interspecific hybridization, transgressive segregation.

Mungbean has certain desirable traits over urdbean and vice versa [1]. To recombine the desirable traits of both parents, interspecific hybridization have been attempted in the past [2–7]. The hybrids were either completely sterile [6] or partially fertile [2–5, 7] and usually produced parental types in segregating generations [8]. The present study aims to observe the effect of parental lines on crossability, germination, survival and fertility and to assess the usefulness of the recombinants for the genetic enhancement of mungbean and urdbean.

Four promising genotypes, namely, T 44, ML 326, PDM 54 and BHUM 1, of mungbean (*Vigna radiata* L. Wilczek) and three genotypes of urdbean (*Vigna mungo* L. Hepper), viz., T 9, Pant U 30 and BHUU 1 were crossed in line x tester fashion. Reciprocal crosses were also attempted. The crossed seeds along with their parents were directly sown in earthen pots to raise F_1s. The F_2 and corresponding individual F_3 and F_4 progenies along with the parents were grown and evaluated for different attributes (Tables 1, 2). Crossability was calculated as the percentage of true hybrid pods (with shrivelled seeds) set out of total buds crossed.

The germination was noted 20 days after sowing and seedlings survival 30 days after germination and at pod maturity. Pollen viability was scored in 2% acetocarmine solution. Observations on certain yield traits and reaction to *Cercospora* leaf spot were recorded and compared with the parental lines.

Only 6 out of 12 interspecific crosses were successful when mungbean was used as female parent. The crossability ranged from 2.3 to 12.5% (Table 1). The genotype-dependent differences in crossability were attributed to polymorphism for gene loci controlling crossability [9]. The crossed pod usually exhibited steepness towards the basal side and contained 2–8 shrivelled seeds against 8–9 smooth seeds in the female parents. Some hybrid seeds even with ruptured testa were viable.

Table 1. Per cent crossability, germination, survival and fertility of the parents, F_1, F_2, F_3 and F_4 progenies of interspecific crosses between mungbean and urdbean

Parent/progeny	Crossability	Germination	Survival		Pollen fertility
			30 days after sowing	pod maturity	
Parents:					
Mungbean	—	91.7	98.2	98.2	97.6 ± 0.15
Urdbean	—	92.4	97.9	97.9	98.6 ± 0.16
Total	—	92.0	98.1	98.1	98.0 —
F_1 generation:					
T 44 x T 9	4.5	52.6	40.0	40.0	5.1 ± 2.32
BHUM 1 x Pant U 30	12.5	66.7	37.5	37.5	25.4 ± 4.94
PDM 54 x Pant U 30	5.9	83.3	30.0	0.0	— —
PDM 54 x BHUU 1	2.6	50.0	0.0	0.0	— —
ML 326 x T 9	2.3	11.8	0.0	0.0	— —
ML 326 x BHUU 1	5.3	80.0	100.0	0.0	— —
Total	5.6	56.4	43.9	17.5	9.2 —
F_2 generation:					
T 44 x T 9	—	66.7	50.0	0.0	— —
BHUM 1 x Pant U 30	—	50.0	83.3	66.7	67.9 ± 7.60
Total	—	56.1	68.8	37.5	67.9 ± 7.60
F_3 generation:					
BHUM 1 x Pant U 30	—	41.7	94.0	88.0	85.2 ± 4.84
F_4 generation:					
BHUM 1 x Pant U 30	—	—	—	—	90.4 ± 4.73

Germination of the F_1 seeds varied from 11.8–83.3%, average 56.4%, as compared to 92% in the parental lines, whereas average germination was 56.1 and 41.7% in F_2 and F_3 generations, respectively (Table 1). Reduced germinations in F_3 as compared to F_2 as well as F_1 is not unexpected in wide crosses and may be due to decline in degree of heterozygosity, probably leading to the production of undesirable homozygous genotypes.

Seedling survival was more than 98% in the parents, but in F_1 it varied from 0.0 to 100% with variable mortality rates. Seedlings of the cross PDM 54 x BHUU 1 and ML 326 x T 9 grew slowly and died in early stages (before 30 days) but 30% of the seedlings of the cross PDM 54 x Pant U 30 survived up to 30 days after sowing. Likewise, the ML 326 x BHUU 1 hybrid plants grew normally at early stages but due to bud necrosis and leaf crinkling eventually died after 30 days. In two crosses, BHUM 1 x Pant U 30 and T 44 x T 9, though few plants died at early stages, the remaining F_1 plants attained pod maturity. The inviability or weakness of the F_1 seedlings could be due to disharmonies between genomes of the parental species; between genome(s) of one species and cytoplasm of others or between genotypes of F_1 zygote and genotypes of endosperm or maternal tissue [10, 11].

The F_1 plants were erect like those of mungbean but resembled urdbean in stem colour and leaf morphology. The purple stem colour appeared dominant over green colour. Most of the F_1 hybrids were of indeterminate type, late maturing and bore small club shaped pods containing 1–2 normal as well as shrivelled seeds.

The average pollen fertility of the two F_1s, i.e. T 44 x T 9 and BHUM 1 x Pant U 30, was 5.1 and 25.4%, respectively (Table 1). Due to poor seed setting in F_1 and high degree of lethality of F_2 progenies, none of the F_2 plants of the cross T 44 x T 9 survived till maturity. However, pod setting was satisfactory in the cross BHUM 1 x Pant U 30 and pollen fertility was 67.9, 85.2 and 90.4% in F_2, F_3 and F_4 generations, respectively, indicating an improvement in fertility as the generations advanced.

The differential sterility in the hybrids and recovery of fertile plants in the segregating generations, as noted in the present case, are attributed to cytoplasmic and chromosomal anomalies [8]. When favourable interactions exist between the alien genome and the cytoplasm, the alien genes express their full potential leading to the production of desirable segregates [7]. In the present case, alien genes seem to be interacting favourably in cross BHUM 1 x Pant U 30 and a number of desirable transgressive segregates were isolated in F_4 generation. Some of the segregates showed resistant reaction to *Cercospora* leaf spot and gave 2–6 times more yield as compared to the best parent through increased number of branches and pods per plant (Table 2). The seed colour of these segregates was either of parental type (green or black) or recombinant types (dull green with black spots or shiny mosaic green) which is in conformity with the earlier report of [12]. These findings indicate that elite

Table 2. Performance of the parents and five top yielding transgressive segregates isolated in F_4 generation of cross between mungbean and urdbean

Parent or segregate	Plant appearance	Seed colour	Plant height (cm)	No. of branches per plant	Pods per plant	Pod length	Seeds per pod	Yield per plant	Reaction to *Cercospora* leaf spot
Parents:									
Mungbean cv. BHUM 1	Mung	Green	59	2.3	18.0	6.1	8.6	6.1	Susceptible
Urdbean cv. Pant U 30	Urad	Black	35	4.2	20.0	4.1	4.7	5.6	Resistant
Segregates:									
F3-4-F4-2	Mung	Dull green with black spots	115	8.0	165.0	4.6	5.6	38.2	Resistant
F3-14-F4-9	Urad	Black	61	6.0	83.0	4.4	6.2	18.5	Resistant
F3-14-F4-1	Urad	Black	59	5.0	58.0	4.3	5.0	14.0	Resistant
F3-10-F4-8	Mung	Green	60	3.0	52.0	6.1	6.6	13.4	Moderately resistant
F3-14-F4-11	Urad	Shiny mosaic green	44	5.0	50.0	4.1	5.6	11.2	Resistant

populations may be obtained through interspecific hybridization which would be helpful in breaking the yield plateau of these important pulse crops.

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