Indian J. Pulses Res. 7(2) : 162-164,1994

Inheritance of dwarfness in pigeonpea

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Excessive vegetative growth and the tall growth habit in pigeonpea limits the efficiency of management options, particularly those relating to chemical control of insect pests. A considerable reduction in plant height through genetic means could make this crop more amenable to pesticide application. Twelve sources of dwarfness (D_o to D_{11}) which differ in plant height, branching pattern, number of nodes and internode length are maintained at ICRISAT (1) but limited information is available about the genetic control of dwarfness in these sources. The inheritance of D_o, D_6, PD_1 (D_7), and PBNA (D_8) dwarfing genes have been reported (2,3). Other researchers (4,5) have reported the inheritance of dwarfness, but these genetic stocks are not available in the ICRISAT gene bank and it is not known whether these dwarfs are genetically similar or dissimilar to the dwarf sources maintained at ICRISAT Center. This study was undertaken to determine the inheritance of D_1 dwarf.

The D_1 dwarf plant type was identified from a cross ICPX 73081 (EC 100465 x GW3-191-1) at ICRISAT Centre. This dwarf type is of medium to long-duration and has an indeterminate growth habit. It attains a plant height of approximately one metre (92 ± 0.26 cm). Its internodes are condensed, and its branches appear to radiate from a restricted region of the stem, 8 ± 0.8 cm above ground level.

D_1 dwarf plants were crossed with four tall cultivars : Prabhat and Pant A-2 (short-duration), No. 148 (medium-duration), and NP(WR) 15 (long -duration), at ICRISAT Centre. In the following year, the F_1's were backcrossed to the D_1 dwarf. They were also selfed to produce F2 seed, this involved covering the plants with muslin cloth bags. The parents, F_1, F_2, and backcross generations were grown to study the resulting segregation patterns. The number of plants in the F_2 generation ranged from 60 to 380, and in the backcross generation from 94 to 124. Plants in each generation were classified into dwarf and normal types. The data were subjected to a X^2 test to determine the significance of differences between observed and expected ratios.

All the four F_1 hybrids between D_1 and normal tall parents produced tall plants, suggesting that D_1 dwarfness was under the control of recessive allele(s).

Analysis of the segregating generations (Table 1) confirmed a single gene control with dwarfness inherited as a monogenic, homozygous, recessive trait. In the F_2 generation, the segregation pattern was in the ratio of 3 normal : 1 dwarf, except in the cross between D_1 and No. 148 which deviated from that segregation pattern and produced fewer dwarf plants than expected. However, the test cross ratio for this cross fitted well with

Table 1 Segregation pattern for normal and D_1 dwarf pigeonpea types in F_2 and backcross generations at ICRISAT Center

Cross	No. of plants observed			Expected ratio	X^2	Range of probability
	Gen.	Normal	Dwarf			
D_1 x Prabhat	F_2	60	16	3:1	0.62	0.50-0.30
(D_1 x Prabhat) x D_1	BC_1F_1	94	109	1:1	1.10	0.30-0.20
D_1 x Pant A-2	F_2	100	22	3:1	3.15	0.10-0.05
(D_1 x Pant A-2) x D_1	BC_1F_1	124	109	1:1	0.96	0.50-0.30
D_1 x No. 148	F_2	380	93	3:1	7.18	0.01-0.00
(D_1 x No. 148) x D_1	BC_1F_1	114	103	1:1	0.54	0.50-0.30
D_1 x NP(WR)-15	F_2	93	17	3:1	5.33	0.05-0.02
(D_1 x NP(WR)-15) x D_1	BC_1F_1	120	129	1:1	0.32	0.70-0.50

the expected ratio of 1 dwarf : 1 normal. The deviation observed in the F_2 generation of the cross involving the cultivar No. 148 might be due to out-crossing in the F_1 generation. Although F_1's were selfed by covering plants with muslin cloth bags, the possibility of chance out-crossing due to damage to the selfing bags cannot be ruled out. In the back-crosses segregation for 1 normal : 1 dwarf was observed (Table 1) providing further evidence of single gene segregation.

Reports by some earlier researchers (4, 5) indicated that dwarfness was controlled by a single recessive gene. However, in another study it was observed that the D_6 dwarf was under the influence of two recessive genes; t_1 and t_2 (2). On the basis of F_1, F_2, F_3 segregation, and test crosses of three dwarfs (D_6, PD_1, and PBNA) with four normal cultivars (ICPL 1, BDN 1, ICPL 366, and NP(WR) 15, it was observed that the dwarf phenotype in all three dwarfs was controlled by a single recessive gene (3). Furthermore, the allelic relationship among them was found similar for D_6 and PD_1, but in PBNA a different allele controlled dwarfness. In another study on allelic relationship where a ten-dwarf parents F_1 diallel was made, the results indicated that dwarfness in D_1 was non-allelic to the other nine dwarfs studied (6). Recent studies on the allelic relationship of D_1 and D_{11} dwarfs in F_1's, F_2, and backcross generations indicated that dwarfness in D_1 and D_{11} genotypes was controlled by two different recessive genes (7).

At ICRISAT Center the D_1 dwarf gene has been transferred to promising cultivars of short-, medium and long-duration.

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