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INHERITANCE IN INTER-GENERIC CROSSES BETWEEN *CAJANUS* AND *ATYLOSIA* SPECIES

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ABSTRACT

Inheritance of six oligogenic traits, namely, leaflet shape, twining nature, pod hairiness, growth habit, seed strophiole and seed colour, were studied in four intergeneric crosses involving two cultivars of *C. cajan* and three species of *Atylosia*. The genes responsible for leaflet shape, growth habit and seed colour showed incomplete dominance. For the remaining characters, dominant gene expression was recorded. The F_2 segregation revealed that leaflet shape, pod hairiness and seed colour were governed by a single gene. The twining nature, seed strophiole, and growth habit were governed by two genes.

Index words : *Cajanus cajan*, *Atylosia* spp, pigeonpea, intergeneric crosses, inheritance.

Pigeonpea or redgram (*Cajanus cajan* (L.) Millsp.) is a predominant pulse crop of the Indian subcontinent and constitutes a very important source of protein in vegetarian diets. The grain yield of pigeonpea, in general, is low and unstable due to reasons such as flower drop, disease and insect susceptibility and photosensitivity, and could be overcome through transfer of specific genes or gene combinations from related wild *Atylosia* species. To organise a systematic breeding programme, an understanding of the inheritance pattern of botanical characters is necessary so that the segregating populations can be handled effectively.

MATERIALS AND METHODS

Seeds were obtained from the Genetic Resources Unit, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). The passport information of the test materials is given in Table 1. The experiment was carried out between 1977 and 1980 at the Agricultural Experimentation Farm of the Banaras Hindu University, Varanasi, India. Cross pollinations were made during the winter season of 1977-78. The F_1s and F_2s and the parental

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species were grown in subsequent years. For examining the inheritance of botanical traits namely leaflet shape, twining nature, pod hairiness, growth habit, seed strophiole and seed colour, observations were recorded in the following four intergeneric crosses.

(i) *C. cajan* cv. Pant A2 × *A. albicans*
(ii) *C. cajan* cv. Pant A2 × *A. scarabaeoides*
(iii) *A. cajanifolia* × *C. cajan* cv. Pant A 2
(iv) *A. cajanifolia* × *C. cajan* cv. UPAS 120

The parental species and the F_1 hybrids were examined for meiosis, pollen and ovule fertility. The parental species, F_1 hybrids and the segregating F_2 populations were also scored for botanical characteristics. Statistical fitness for the inheritance of botanical characters was calculated by Chi-square test. The Chi-square value obtained for each ratio was compared with the table value for the appropriate number (n—1) of degrees of freedom and the probability limits.

TABLE 1 : *Passport information of the material used in the study*

Species	Accession No.* at ICRISAT	Source	Collected from
C. cajan cv. Pant A2	ICP 6973	GBPUAT, Pantnagar	—
C. cajan cv. UPAS 120	ICP 6971	,,	—
A. albicans	JM 2356	ICRISAT	Tirumala Hill, Chittoor Dist., A.P., India
A. cajanifolia	JM 2739	,,	Bailadila Hill top, Bastar Dist., M.P., India
A. scarabaeoides	ICP 7464	IIT, Kharagpur	Western Ghats, India

*ICP = ICRISAT Pigeonpea Accessions, JM = L.J.G. van der Maesen

RESULTS AND DISCUSSION

Observations on meiosis, pollen and ovlue fertility and pod set were made on F_1 hybrids and the parental species, which will be discussed in a separate publication. The expression of the botanical characters in the parents and the F_1's and the segregation patterns in the F_2's have been given in Table 2 and will be discussed here one by one.

Leaflet shape : In the two intergeneric hybrids between Plant A 2 and *A. albicans* and *A. scarabaeoides*, F_1 plants were intermediate with respect to leaflet shape expression. In F_2 three phenotypic classes were exhibited meaning that the character is governed by a single partially dominant gene (L_L). Reddy (1973) working on cross of *C. cajan* and *A. lineata* found a ratio of 3 lanceolate : 1 ovate whereas his observations on the other cross (*C. cajan* × *A. scarabaeoides*) were in line with our findings.

Twining nature : The inheritance of twining nature has been studied for the first time. The F_1 of cv. Pant A2 × *A. scarabaeoides* was non-twining, hence twining nature is recessive. The segregation of F_2 plants into a ratio of 13 non-twining : 3 twining indicated that two genes govern this character, one inhibits the expression of the other when dominant. The genes involved in the expression of this character have been designated as **IITT** where **II** is an inhibitor.

Pod hairiness : F_1 plants between Pant A 2 and *A. scarabaeoides* had this trait. F_2 plants segregated into 3 hairy: 1 non-hairy ratio. Similar ratio of 3:1 was reported by Reddy (1973) from the *Cajanus* × *Atylosia* crosses. However, Reddy *et al.* (1980) observed two phenotypic ratios 3 : 1 and 13 : 3 in crosses of *A. scarabaeoides* with two different pigeonpea accessions. The gene symbols suggested are **HpHp** and **hphp** for hairy and non-hairy podded characters, respectively.

Growth habit : Reddy (1973) obtained a ratio 13 erect : 3 spreading in intergeneric cross of *C. cajan* and *A. scarabaeoides*. However, in the present investigation which also involved similar species the growth habit of the F_1 was almost intermediate to the parents. The large variation in F_2 plants could be grouped into 3 classes, 1 erect : 1 spreading : 14 intermediate, which suggested that two genes with partial dominance are responsible for this trait. This ratio is being reported for the first time. The gene symbol assigned to the erect parent is Eg_1Eg_1 Eg_2Eg_2 and to the creeping parent is eg_1eg_1 eg_2eg_2. The other gene combinations represented the various grades of semi-spreading/semi-erect habits (intermediate), observed in the F_2 populations.

Seed strophiole : Seed strophiole inheritance was examined in three crosses, Pant A2 × *A. scarabaeoides*, *A. cajanifolia* × Pant A2 and *A. cajanifolia* × UPAS 120. The strophiole presence was expressed in F_1, and 15 : 1 ratio in F_2 generation was obtained suggesting that two genes with duplicate gene action are involved in expression of this character, unlike the earlier reports of Reddy (1973) and Reddy *et al.* (1980) who reported 9 : 7 and 13 : 3 F_2 ratios, respectively. The genes proposed are SS_1 SS_2 for strophiolated seeds and ss_1 ss_2 for non-strophiolated seeds.

TABLE 2 : *Inheritance of certain qualitative traits in wide crosses of Cajanus and Atylosia species*

Character	♀ Parent	♂ Parent	F_1	F_2 Segregation			X^{2*}
				Observed (No.)		Expected ratio	
Leaflet shape	Lanceolate (cv. Pant A2)	Obovate (*A. albi.*)	Intermediate	Lanceolate Intermediate Obovate	11 15 9	1 : 2 : 1	0.325 (0.90—0.75)
	Lanceolate (cv. Pant A2)	Obovate (*A. scar.*)	Intermediate	Lanceolate Intermediate Obovate	80 138 52	1 : 2 : 1	1.500 (0.50—0.25)
Twining nature	Non-twining (cv. Pant A2)	Twining (*A. scar.*)	Non-twining	Non-twining Twining	230 40	13 : 3	0.836 (0.50—0.25)
Pod hairiness	Non-hairy (cv. Pant A2)	Hairy (*A. scar.*)	Hairy	Non-hairy Hairy	200 70	3 : 1	0.046 (0.90—0.75)
Growth habit	Erect (cv. Pant A2)	Spreading (*A. scar.*)	Semi-spreading	Erect Semi-spreading Spreading	18 243 9	1 : 14 : 1	0.407 (0.90—0.75)
Seed strophiole	Absent (cv. Pant A)	Present (*A. scar.*)	Present	Present Absent	247 6	15 : 1	0.759 (0.50—0.25)
	Present (*A. cajif.*)	Absent (cv. Pant A2)	Present	Present Absent	145 16	15 : 1	0.447 (0.75—0.50)
	Present (*A. cajif.*)	Absent (cv. UPAS120)	Present	Present Absent	155 10	15 : 1	0.001 (<0.90)
Seed colour	Orange (cv. Pant A2)	Black (*A. scar.*)	Grey	Orange Grey Black	67 143 43	1 : 2 : 1	2.752 (0.50—0.25)
	Black (*A. cajif.*)	Orange (cv. Pant A2)	Grey	Orange Grey Black	30 98 33	1 : 2 : 1	2.881 (0.25—0.10)
	Black (*A. cajif.*)	Orange (cv. UPAS 120)	Grey	Orange Grey Black	62 71 32	1 : 2 : 1	3.929 (0.25—0.10)

* Figure in parenthesis indicates the range of probability.

Seed colour : Genetics of seed colour was studied in three crosses (Table 2.) The seeds from the F_1 plants showed intermediate colour (Grey) with respect to the parents. In F_2, three phenotypic classes in 1 : 2 : 1 ratio suggested that the characteristic is governed by single partially dominant gene. In the intergeneric crosses, this trait has been examined for the first time and the gene symblols assigned are **Osc Osc** for orange seed colour, and **osc osc** for black colour.

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REFERENCES

Reddy, L.J. (1973). Inter-relationships of *Cajanus* and *Atylosia* species as revealed by hybridization and pachytene analysis. Ph. D. thesis, IIT, Kharagpur, India.

Reddy, L.J., J.M. Green and D. Sharma (1980). Genetics of *Cajanus cajan* (L.) Millsp. × *Atylosia* species. Proc. Intl. Workshop on Pigeonpea, Patancheru, A.P., **2** : 39—50.