The joint segregation (Table 2) and the test of independence or linkage of characters (X^2 value = 463 **) as suggested by Panse and Sukhatme (1957) clearly brought out the fact that the characters such as duration, leaf colour, resistance to sterility mosaic disease and growth habit were controlled by single major genes (monogenic) and are located on the same chromosome (homologous) in both the parents and are tightly linked together in coupling phase and inherited as a single block of genes or single unit of recombination and segregated jointly in simple mendelion pattern in the ratio of 3:1. No recombinant types were observed for these traits. Hence, this linkage bloc is designated as **EDgRDt** in Vamban-1 and it respective allelic linkage block in Gulbarga-1 a **edgrdt**. That these genes act as basic genes whic determine the genetic system of the plants a dominant and recessive in the segregating F population.

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BREEDING FOR IMPROVED PLANT TYPE IN PIGEONPEA

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ABSTRACT

An attempt was made to breed for improved plant type in pigeonpea by crossing two contrasting parents *viz*., Vamban-1 and Gulbarga-1. The F2 population clearly segregated into four distinct classes of phenotypes (plant types) in the ratio of 50 intermediate erect tall:14 compact dwarf in the early segregants and 15 tall spreading: 1 compact bushy in the late segregants indicating that the plant type in pigeonpea was controlled by interaction of two pairs of non-allelic linkage blocks designated as DTcLS1 and TALs2 and their respective allelic blocks as dtcls1 and tals2.

KEY WORDS : Pigeonpea, plant type, interaction, linkage blocks

A long desired goal in pulse breeding has been to obtain suitable plant types with less vegetative growth, improved harvest index and reduced maturity duration. The plants with these characters not only enable us to raise more plants per unit area but also to fit in different cropping systems. These tall erect, compact and early maturing plants are most desirable. The same goal is achieved in this trial.

MATERIALS AND METHODS

An attempt was made at the National Pulses Research Centre, Vamban to breed for improved plant type in pigeonpea *ie.* early, compact erect tall genotypes with improved harvest index. For this purpose, both direct and reciprocal crosses were effected between two contrasting varieties *viz*., Vamban 1 and Gulbarga-1. Vamban-1 is an early maturing (100 days) compact dwarf genotype with terminal cluster flowering whereas Gulbarga-1 is a late maturing (150 days) tall spreading genotype with axilary flowering pattern. The crosses were effected during March 1994. Out of 263 flowers crossed, 112 crossed pods with 174 well filled seeds were obtained and the hybrids were studied during *rabi* 1994. High yielding true hybrid plants from both cross combinations were identified, taged and forwarded to F2 generation as single plant progenies and the segregating F2 populations were studied during Summer 1995. Observations were made on the following morphological characters at appropriate time of expression. The characters studied were plant type, flowering pattern and leaflet size. The segregation and independence or linkage of characters were studied using the chi-square test and goodness of fit as suggested by Panse and Sukhatme (1957). The experimental results obtained are discussed below:

RESULTS AND DISCUSSION

The interaction of genes during crossing sometimes gives rise to entirely new traits and

Table 1. Joint segregation of characters in F2 population

Duration	Plant type	Flowering pattern	Leaflet size	Observed	Expected	X^2 value	Genetic ratio
Early	Compact erect tall	Axilary cluster	Small	272	271.88	0.00005	50:14
Early	Compact erect dwarf	Terminal cluster	Large	76	76.12	0.00019	
		Total		384	384	0.00024	
Late	Tall spreading	No flowering	Medium	108	107.81	0.0003	15:1
Late	Compact bushy	Terminal axilary	Little	7	7.19	0.0050	
		Total		115	115	0.0053	

characters which often serve as clearly defined feature rendering the hybrid organism distinct from the parental forms. Cases are known where three or more genes interact to give unusual segregation ratios (Guzhov, 1989). This was vividly demonstrated in this experiment. There was no reciprocal difference among the hybrids for the characters studied. A total of 463 F2 plants was studied for plant type, flowering pattern and leaflet size and the F2 population clearly segregated into four distinct classes of phenotypes with various character combinations:

1. early, compact erect tall plants with axilary cluster flowering and small leaflets (new plant type-I).
2. early compact dwarf plants with terminal cluster flowering (like Vamban-1) and large leaflets.
3. Tall spreading late plants (like Gulbarga-1) with medium leaflets and no flowering.
4. late compact bushy plants with terminal axilary flowering and little leaflets (new plant type-II). The segregation of individual characters are discussed here.

Plant type

The two parents are contrasting in their plant type. Vamban-1 is a compact erect dwarf with short primaries without secondary branches whereas Gulbarga-1 is a tall spreading genotype with long primaries with secondary branches. The F1 hybrids were new in their plant type and are intermediate erect talls with long spreading primary branches without secondary branches indicating that the genes controlling plant type are complementary in nature. The F2 population segregated into 272 early compact erect tall plant with long primaries, 76 early compact erect dwarfs with shrot primaries, 108 late tall spreading and 7 late intermediate tall busy plants with primary secondary and teriary branches. The expected genetic ratio is 50:14 in the early segregants and 15:1 in the late segregants, indicating that the plant type was controlled by three pairs of genes in early segregants and two pairs of genes in late segregants (Table 1).

Flowering pattern

The two parents are contrasting in flowering pattern. Vamban-1 is with terminal cluster flowering pattern whereas Gulbarga-1 is with axilary flowering pattern. The F1 hybrids were with axilary cluster flowering pattern indicating that the genes controlling this characters are complementary in nature. The F2 population segregated into 272 axilary cluster, 76 terminal cluster in early segregants and 108 no flowering and 7 terminal axilary in late segregants and the expected genetic ratio is 50:14 in the early segregants and 15:1 in the late segregants indicating that this character was controlled by three pairs of genes in early segregants and two pairs of genes in late segregants (Table 1).

Leaflet size

Both the parents are medium in leaflet size. The F1 hybrids were small in leaflet size indicating that the genes controlling leaflet size are complementary in nature. The F2 population

Table 2. Description of new plant types

Characters	Type-I	Type-II
Plant type	Intermediate to tall, erect, compact with long primary branches	Intermediate compact bushy with primary, Secondary and tertiary branches
Duration	Early	Late
Leafsize and colour	Small, dark green	Little, light green
Flowering pattern	Axilary cluster	Terminal axilary
Fertility	Fully fertile, high yielding with more number of pods with well filled seeds per plant with 100% viability.	Reduced fertility with few pods and very few inviable seeds.
Proportion in the F2	0.587	0.015

segregated into 272 small and 76 large in early segregants and 108 medium and 7 little in the late segregants and the expected genetic ratio is 50 small: 14 large in the early segregants and 15 medium: 1 little in the late segregants indicating that the leaflet size was controlled by three pairs of genes in early segregants and two pairs of genes in the late segregants. All the dominant genes produce large leaflet size and all the recessive genes produce little leaflets indicating that dominant and recessive alleles are additive in action in positive and negative directions respectively.

The joint segregation (Table 1) and test of independence or linkage of characters clearly brought out the fact that the characters such as plant type, flowering pattern and leaflet size are not independent and are controlled by three pairs of non-allelic interacting genes exhibiting full dominance and are linked together in coupling phase in two different chromosomes (non-homologous) and inherited as a linkage block or single unit of recombination and segregated jointly in the ratio of 50:14 in the early segregants and 15:1 in the late segregants indicating that the action of genes controlling plant type flowering pattern and leaflet size in **Dominant-Inhibitory** in early segregants and **Duplicate-Recessive** in the late segregants. The new plant types observed with various character combinations are not due to gene recombination or independent assortment of characters and are mainly due to the joint segregation and interaction of linkage blocks.

These linkage blocks produced new plant types with new character combination in heterozygous condition and in homozygous recessive state. These non-allelic linkage blocks are designated as DTCLs1 and TALs2 and their respective allelic linkage blocks as dtcls1 and tals2. The interaction of these linkage blocks determines the architecture of the plant with various character combination in the segregating F2 progenies.

New plant types

As a result of segregation and interaction of linkage blocks two types of new contrasting plant types were observed and are described in Table 2. Among the two types Type-I is heterotic, economical and useful in breeeding programme to maximise the yield potential whreas the Type-II is of academic interest useful in genetic experiments as a homozygous recessive genetic stock.

Type-I

The duration of the segregants varied from 80 to 110 days and the height of the plants varied from 66 to 133 cm with an average height of 100.9 1.6 cm. The co-efficient of variation was 16.5%. The number of pods per plant varied from 58 to 298 with an average of 121.4 3.6. The co-efficient of variation was 30.8%. The plant height and number of pods per plant are moderately correlated and the strength of correlation r = 0.46. It is possible to select and develop high yielding intermidiate tall, erect compact, early genotypes with wide range of variations ie. with a duration of 80- 110 days, 66 to 133 cm height and 58 to 298 pods per plant by crossing Vamban-1 as a non-allelic dwarfing gene source with tall spreading genotypes.

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