Maintenance of Genetic Purity in Pigeonpea Seed

In general pigeonpea predominantly produces selfed seed but usually there is some outcrossed seed produced on uncovered flowers (mean around 20% and range 0-99%) as a result of insect activity. This poses considerable problems in developing pure lines and in maintaining purity of released cultivars. It has been established that *Megachile* spp. (leaf cutter bee) is probably responsible for most of the cross-pollination; *Xylocopa* spp. (carpenter bee) and *Bombus* spp. (bumble bee) are also probably responsible.

A large number of factors determine the amount of outcrossing in pigeonpea. Some factors are the number of insect pollinators present in relation to number of flowers, the flowering habit of the varieties grown, the location of the field in relation to insect habitats, the distance between unlike varieties, barrier crops, and environmental factors such as wind direction and velocity. A wide range of outcrossing in different areas has been reported. The isolation distances required for the maintenance of the genetic purity of pigeonpea varieties must depend partly on the extent of outcrossing.

Two tests were recently conducted at ICRISAT Center, Patancheru, in an attempt to determine the effect of plot size and isolation distance on seed purity in pigeonpeas.

For the plot size study an experiment was planted in isolation during the 1979 rainy season. The determination of natural crossing was measured using green stem and dominant purple stem marker stocks. The difference between the two stocks is readily detected in seedlings and is simply inherited.

Plots with green and purple stem plants were alternated in three blocks, one with four, the second with six, and the third with eight rows per plot. The rows were 10 m long with a distance of 75 cm between rows and 25 cm between plants. The distance between the blocks was 10 m. At maturity each row in the green stem plant plots was harvested separately and the seed from each row planted in the field. The frequency of purple stem plants was estimated for each green stem plot and for each row within a plot to determine the percentage of natural outcrossing at different distance from the edge of the plot.

The percentage of cross-pollination in the different rows within each of the three plot sizes was similar. The average of the central two rows in the four-row plots, the central two and four rows in the six-row plots, and the central two, four, and six rows in the eight-row plots was similar to their respective overall means. The fact that crossing was not reduced in the innermost rows of the plots was both surprising and disappointing for it indicates that the practice of saving seed of test lines from yield trials does not, by and large, ensure the purity of a particular genotype in future trials. This trial needs to be repeated for at least one more year to generalize the observation.

The experiment to determine the isolation distance requirement for the maintenance of genetic purity was planted at ICRISAT Center on 22 July 1980. The green and purple stem marker stocks were again used in this study. The purple stem stock was planted in a centrally located octagonal block (3000 m^2) and small blocks of the green stem stock were planted at distances of 0 (300 m^2 block), 20, 50, and 100 m (150 m^2 blocks) from the purple stem central block in all four directions. The area around the blocks was kept fallow.

A marked reduction in percentages of outcrossing was observed with increased distance from the purple stem stock (Table 1). The percent outcrossing was generally more in

Table 1. Mean percent outcrossing measured in green stem blocks of pigeonpea in different directions and distances from a centrally located purple stem block in 1980 at ICRISAT Center.

Meters from purple block	Direction				Overall mean
	North	West	South	East	
0	18.0	14.9	12.7	15.6	15.1
20	7.1	6.6	8.0	9.7	7.4
50	2.2	3.0	3.7	7.1	4.1
100	1.7	2.8	4.4	4.8	3.0
Mean overall	7.3	6.8	7.2	9.3	
less 0 m	3.7	4.1	5.4	7.2	

the eastern blocks and to a lesser extent in southern blocks at all distances except 0 m. These results indicate that the wind direction, which was generally from the north-west at the time of flowering, probably influenced the movement of the insects and hence the amount of outcrossing. The level of outcrossing observed in this experiment may have been lower than expected because the material was planted late. However, the results from this study provide information useful in establishing isolation requirements for pigeonpea seed production under conditions similar to those found in this test.

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Test Plot Size in Pigeonpea

It is important for breeders and agronomists to know what plot size is adequate for conducting their trials. In pigeonpeas, information on plot size is scanty. Therefore, a preliminary investigation was carried out by harvesting individual rows from six-row plots in a replicated yield trial.

The experimental material consisted of the F_2 populations plus the parents from a diallel cross using seven medium-maturing, indeterminate, semispreading lines. The 28 entries were planted in a Vertisol during the 1976 rainy season in a randomized complete block design using four replications. The spacing between the 5-m-long rows was 150 cm and between plants, 30 cm. Five sets of plot sizes were formed by combining the yield of middle two, middle four, all six, random two and random four rows in each plot (including guard rows). An analysis of variance was carried out on each set and coefficients of variation (CVs) were used to compare the relative precision of the various plot sizes.

The populations did not differ in general appearance (plant height and plant type), and 50% flowering ranged from 103 to 120 days. This was because of the close similarly in the phenology of the parents. Using the standard middle four-row plots, yield of the F_2s ranged from 1280-1592 kg/ha with a mean of 1446 kg/ha. The highest yield of 1720 kg/ha was recorded for cultivar C 11.

To rule out the effect of plant stand on yield, plants per row were counted and differences were found to be nonsignificant.

Analysis of variance (Table 1) showed that,

Table 1. Analysis of variance for yield in various plot sizes drawn from six-row pigeonpea plots at ICRISAT Center in 1976.

Source	df	Mean squares				
		Middle 2-row plot	Middle 4-row plot	All 6-row plot	Random 4-row plot	Random 2-row plot
Replication	3	0.07	0.36	0.95	0.32	0.07
Genotypes	27	0.11*	0.34**	0.79**	0.38**	0.12*
Parents	6	0.24**	0.90**	2.15**	1.07**	0.36**
F_2	20	0.07	0.18	0.39	0.18	0.06
Parents vs F_2	1	0.02	0.16	0.65	0.16	0.06
Error	81	0.06	0.16	0.27	0.15	0.04
CV (%) - Overall		14.0	11.4	9.9	11.0	11.9
CV (%) - Parents only		18.6	13.7	11.1	12.2	15.1
CV (%) - F_2 only		13.3	10.5	9.2	10.4	10.4