Maintenance of Genetic Purity in
Pigeonpea Seed

In general pigeonpea predominantly produces
selfed seed but usually there is some out
crossed seed produced on uncovered flowers
(mean around 20% and range 0-99%) as a
result of insect activity. This poses consid­
erable problems in developing pure lines
and in maintaining purity of released culti­
vares. It has been established that
Megaakvle spp. (leaf cutter bee) is pro­
bably responsible for most of the cross-
pollination; Xylooaopa spp. (carpenter bee)
and Bombus spp. (Bumble bee) are also pro­
bably responsible.

A large number of factors determine the
amount of outcrossing in pigeonpea. Some
factors are the number of insect pollina­
tors present in relation to number of
flowers, the flowering habit of the varie­
ties 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 mainte­
nance 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 respec­
tive 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 particu­
lar 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 m²)
and small blocks of the green stem stock
were planted at distances of 0 (300 m² block),
20, 50, and 100 m (150 m² 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 out­
crossing was observed with increased distance
from the purple stem stock (Table 1). The
percent outcrossing was generally more in

<table>
<thead>
<tr>
<th>Meters from purple block</th>
<th>North</th>
<th>West</th>
<th>South</th>
<th>East</th>
<th>Overall mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>18.0</td>
<td>14.9</td>
<td>12.7</td>
<td>15.6</td>
<td>15.1</td>
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<tr>
<td>20</td>
<td>7.1</td>
<td>6.6</td>
<td>8.0</td>
<td>9.7</td>
<td>7.4</td>
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<td>50</td>
<td>2.2</td>
<td>3.0</td>
<td>3.7</td>
<td>7.1</td>
<td>4.1</td>
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<tr>
<td>100</td>
<td>1.7</td>
<td>2.8</td>
<td>4.4</td>
<td>4.8</td>
<td>3.0</td>
</tr>
</tbody>
</table>

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.
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 F2 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 similarity in the phenology of the parents. Using the standard middle four-row plots, yield of the F2s ranged from 1280-1592 kg/ha with a mean of 1446 kg/ha. The highest yield of 1720 kg/ha was recorded for cultivar C11.

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>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Middle 2-row plot</th>
<th>Middle 4-row plot</th>
<th>All 6-row plot</th>
<th>Random 4-row plot</th>
<th>Random 2-row plot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replication</td>
<td>3</td>
<td>0.07</td>
<td>0.36</td>
<td>0.95</td>
<td>0.32</td>
<td>0.07</td>
</tr>
<tr>
<td>Genotypes</td>
<td>27</td>
<td>0.11**</td>
<td>0.34**</td>
<td>0.79**</td>
<td>0.38**</td>
<td>0.12*</td>
</tr>
<tr>
<td>Parents</td>
<td>6</td>
<td>0.24**</td>
<td>0.90**</td>
<td>2.15**</td>
<td>1.07**</td>
<td>0.36**</td>
</tr>
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<td>F2</td>
<td>20</td>
<td>0.07</td>
<td>0.18</td>
<td>0.39</td>
<td>0.18</td>
<td>0.06</td>
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<tr>
<td>Parents vs F2</td>
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<td>0.02</td>
<td>0.16</td>
<td>0.65</td>
<td>0.16</td>
<td>0.06</td>
</tr>
<tr>
<td>Error</td>
<td>81</td>
<td>0.06</td>
<td>0.16</td>
<td>0.27</td>
<td>0.15</td>
<td>0.04</td>
</tr>
</tbody>
</table>

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 (%) - F2 only     | 13.3 | 10.5 | 9.2 | 10.4 | 10.4 |

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