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Studies On Natural Cross-Pollination In Pigeonpeas (*Cajanus cajan*)

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INTRODUCTION

Before starting a crop-improvement program, it is of prime importance to determine the mode of reproduction and the amount of natural cross-pollination for the particular area where the breeding program is to be conducted. The determination of the amount of natural cross-pollination is necessary in order to ascertain the proper breeding procedures, purity of varieties or stocks, and seed production of new varieties.

The pigeonpea, (*Cajanus cajan*) has been considered by Krauss (1)² normally to be a self-pollinated species. Wilsie (4) however, reported that crossing between adjacent rows of different varieties ranged from 13.98 to 15.86 percent with an average of 15 percent in a population of 24,883 plants; while Shaw (3) presented data to show that, in India, natural crossing takes place readily.

The extent of natural crossing occurring in pigeonpea grown in Puerto Rico was not known; therefore, this study was conducted in order to assess the rate of natural cross-pollination under our climatic conditions.

MATERIALS AND METHODS

Krauss (1,2) has shown that, in immature pod color, red or black blotching was dominant over green, and that red and purple flowers are dominant over pure yellow flowers. For this study both flower and immature pod colors were used as a basis for the determination of natural crossing.

Ten rows spaced 8 feet apart and approximately 40 feet long were planted in each of three plots. The two outside rows on each side of the plot and the two center rows were sown with a strain of pigeonpea breeding true for the dominant marker red flower, and a red-blotched pod. The other four rows were sown with a pigeonpea strain breeding true for the recessive pure yellow flower and green pod color. The plants were allowed to bloom and inter-pollinate freely, if they would.

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² Italic numbers in parentheses refer to Literature Cited, p. 3.

Plants were chosen at random from each row bearing the recessive marker genes, and selfed by covering unopened buds with finely woven nylon bags, to determine the efficiency of this method in preventing natural crossing, and to serve as a check on the open-pollinated material. At maturity, the plants with the recessive marker were harvested in each of the four rows in each plot and threshed individually.

The following season, the progenies from the recessive marker plants, selfed and open-pollinated plants, were grown in the field in progeny rows. Plants bearing red or red-veined yellow flowers and red- or black-blotched pods were scored as natural hybrids, while plants with pure yellow flowers and green pods were considered as self-fertilized, or fertilized by another member of the recessive strain.

TABLE 1.—Percentage of natural cross-pollination in progenies of open-pollinated pigeonpea plants

Plot No.	Plants with yellow flowers and green pods	Plants with red-veined flowers and blotched pods	Total plants	Natural hybrids
	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Percent</i>
1	1,470	87	1,557	5.59
2	1,848	107	1,955	5.47
3	1,701	115	1,816	6.33
Total	5,019	309	5,328	5.80

RESULTS AND DISCUSSION

The results for single-plant progenies for all progenies in the three plots are presented in table 1. The percentage of cross-pollination between strains grown in adjacent rows ranged from 5.47 to 6.33, with a mean of 5.80 percent for the whole population of 5,328 plants. No natural hybrid was observed in the progenies from plants covered with nylon bags.

It is evident from these data, that the extent of natural cross-pollination in this study was not considerable. However, for a species which is considered highly self-pollinated, and which involves inbreeding in its improvement systems, this percentage should not be underestimated. This is very important from the standpoint of maintaining the purity of varieties or stocks. Personal observations and reports from different research workers in commercial plantings of this crop show that contamination is considerable. This can result in a big hazard in a breeding or seed-production program if adequate measures are not taken.

As observed by Krauss (1), Wilsie (4), and by the author, upon examination of hundreds of unopened buds, it was found that the anther sacs de-

hised a day before the flower opened. A possible explanation for cross-pollination taking place under this circumstance could be the presence of minute insects like thrips occurring in the flowers before they open. The presence of *Frankliniella cephalica* and *F. insularis* species of thrip has been confirmed by the author during the hybridization season in a large number of buds. If fertilization has not taken place by the time the flower opens, some insect vectors like bees, which visit the flowers in large numbers, could also effect cross-pollination. The fact that no natural hybrid was observed in progenies from plants covered with nylon bags tends to support the hypothesis that the most probable pollen vectors for this crop are insects, and that purity of varieties or stocks can be maintained by this method.

SUMMARY

Results obtained in a study of natural crossing among strains of pigeonpea grown in adjacent rows show that cross-pollination ranges from 5.47 to 6.33 with an average of 5.80 percent in a population of 5,328 plants. Progenies from plants artificially selfed with nylon bags produced no natural hybrids.

The results obtained in this study indicate that, for the maintenance of pure varieties or stocks, and the seed production of new varieties, they should be grown under isolation, or with the flowerbuds covered with finely woven nylon bags, in order to prevent contamination.

RESUMEN

Se hizo un estudio para determinar el porcentaje de cruzamiento natural en el gandur. Se sembraron hileras adyacentes de dos variedades y se encontró que el porcentaje de cruzamiento fluctuó entre 5.47 y 6.33, con un promedio de 5.80, en una población de 5,328 plantas. En los descendientes de las plantas autofecundadas artificialmente cubriendo las flores con bolsas de nilón, no se encontró evidencia de cruzamiento natural.

Los resultados obtenidos en este estudio indican que para mantener la pureza de las variedades y para la producción de semilla de nuevas variedades, es necesario sembrar predios aislados o proteger las flores cubriéndolas con bolsas de nilón para evitar la contaminación de las mismas.

LITERATURE CITED

1. Krauss, F. G., The pigeonpea (*Cajanus indicus*) its improvement, culture, and utilization in Hawaii, *Hawaii Agr. Exp. Sta. Bull.* 64: 46 pp, 1932.
2. —, Improvement of the pigeonpea; genetic analysis of *Cajanus indicus* and the creation of new varieties through hybridization and selection, *J. Hered.* 18: 227-32, 1927.
3. Dhaw, F. J. F., The breeding of *Cicer* and *Cajanus*. *Bull. Imp. Bur. Plant Genet., Herbage plants* 7: 14-6, 1932.
4. Wilsie, C. P., Natural crossing in the pigeonpea. *J. Agr. Res.* 49: 923-7, 1934.