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First Report of Natural Outcrossing in Pigeonpea from China

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Natural outcrossing in pigeonpea (*Cajanus cajan*) is primarily responsible for the deterioration of purity of cultivars and genetic stocks. Several insects are responsible for transferring pollen from one plant to another within and across the fields. The major pollinating insects identified are *Apis mellifera*, *A. dorsata*, *Megachile lanata*, *Ceratina binghami*, and *Xylocop* spp. The populations of these pollinating insects and local environmental factors that assist in their movement determine the extent of natural outcrossing at a particular location. Natural outcrossing in pigeonpea has been reported from India, Kenya, Australia, Hawaii (USA), and Sri Lanka (Saxena et al. 1990, 1994).

Pigeonpea was introduced into China in the 6th century from India and since then it was cultivated sporadically in the southern provinces. In the 1950s, Chinese scientists in Yunnan province identified pigeonpea as a favorable host for lac insect (*Kerria lacca*) because it was found to have useful traits such as easy establishment, fast growth, and high yield of quality lac. Recently, under the crop diversification program in China several other uses of pigeonpea have emerged, e.g., for soil conservation; and as fodder, feed, and fresh vegetable (Saxena 2000). Specific cultivars for precise purposes have been developed from breeding materials received from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, India. To sustain pigeonpea productivity it has now become mandatory to maintain the genetic purity of these cultivars. Therefore, an experiment was conducted to determine the extent of natural outcrossing in China.

Pigeonpea variety ICPL 87091 with a distinct recessive trait of ‘determinate growth habit’ was selected for this study. The experiment was conducted in 1999 at Nanning in Guangxi province in China. Due to lack of experimental facilities 20 single-row plots of ICPL 87091 were sown in a field planted with breeding materials having dominant genetic marker of indeterminate growth habit and matching flowering time. These plots, measuring 5 m in length, were scattered at different places in the field. At least 10 pollinator rows on either side of each ICPL 87091 plot were ensured. The inter- and intra-row spacing was 100 cm and 50 cm respectively. Only two insecticide sprays were done at early flowering stage to control the pod borer *Maruca vitrata*. From each plot five individual plants were randomly harvested. The progenies of 66 selections with sufficient quantity of open-pollinated seed were sown in the subsequent rainy season. Since indeterminate growth habit is dominant over determinate growth habit, counts were recorded in each plant-progeny row for the self (determinate) and hybrid (indeterminate) plants. The frequency of natural outcrossing in each row was estimated as percentage of the observed number of hybrid plants.

In spite of two insecticide sprays a lot of insect activity was observed during flowering stage in the entire field. Also, several insect species were active but their identification was not feasible. However, among these, honeybees (*Apis* spp) were predominant. The data from the single plant progenies of ICPL 87091 revealed a large plant-to-plant variation (Fig. 1) for natural outcrossing in the preceding generation with a mean of 24.6%. In two progenies no outcrossed hybrid plant was recorded while in four progenies more than 40% hybrid plants were observed. In one progeny 60% natural outcrossing was

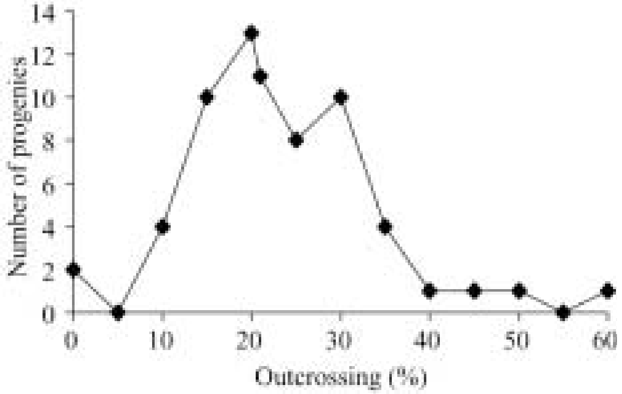

Figure 1. Frequency distribution of natural outcrossing in the open-pollinated progenies of pigeonpea ICPL 87091.

recorded. Of the 66 progenies evaluated, 52 exhibited 15–30% natural outcrossing. The inter-plant variation for natural outcrossing observed at Nanning may be due to variation in plant growth or shading from neighboring tall plants due to which the pollinating insects were relatively less active on such plants and the insects preferred to land on the well grown tall plants.

The results show that as in other countries, in China too the active pollinating insects are present in large numbers and they are a potential danger to the maintenance of genetic purity in pigeonpea. Since pigeonpea is being promoted in a range of environments, the extent of natural outcrossing is likely to vary from place to place. Therefore, it is advisable to determine the extent of natural outcrossing in the representative locations before undertaking the seed production of more than one genotype in one locality. For small-scale pure seed production in the breeding programs the use of mosquito nets is recommended while for large-scale seed production the plots should be isolated at a safe isolation distance. Since in a particular environment the population of pollinating insects and other physical factors are important, effective isolation distances for major pigeonpea-growing areas need to be estimated. Pending such study, the sowings in isolated blocks separated by at least 200 m, as recommended by the Food and Agriculture Organization of the United Nations (Ariyanayagam 1976) should be used. Besides seed production, there are two other contrasting implications of natural outcrossing in pigeonpea breeding. On one hand, it is detrimental to pedigree breeding that involves evaluation and selection of pure genotypes. On the other hand, the phenomenon of natural outcrossing can be used for the genetic improvement of breeding populations (Khan 1973) and hybrid breeding (Saxena et al. 1996). At ICRISAT a considerable progress has been made in hybrid breeding and the world's first commercial hybrid was released in 1991 (Saxena et al. 1996). Since pigeonpea research program in China is evolving the information on the extent of natural outcrossing is essential to develop both long- and short-term research and development strategies.

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