Indian J. Genet., **61**(3): 279-280 (2001)

Short Communication

First report of wind pollination in pigeonpea

R. Vijaya Kumar and K. B. Saxena

Genetic Resources and Enhancement Division, International Crops Research Institute for the Semi-Arid Tropics, Patancheru 502 324

(Received: February 2001; Accepted: June 2001)

The cleistogamous flowers of pigeonpea (*Cajanus cajan* (L.) Millsp.) predominantly favour self-pollination but, unlike other legumes, it is not a rule and a considerable extent of natural cross-pollination has been reported [1]. Howard *et al.* [2] were the first to report 14% natural out-crossing in pigeonpea at Pusa Agricultural Research Institute in Bihar. It was followed by a number of similar reports with up to 70% natural out-crossing. A variety of insects are attracted towards the large bright coloured pigeonpea flowers and the natural out-crossing has been reported to take place as a result of their frequent visitation from one flower to another within and across the fields. The known major pollinating vectors are *Megachile lanita, Apis florea* and *Apis mellifera* [3, 4]. Onim [5] reported that each insect visit lasts betweeen 15-55 seconds and they trip the unopen floral buds and thereby introduce foreign pollen on the stigmatic surface to affect the cross-fertilization. Williams [6] counted between 5500 and 107333 pollen grains on the body of a single pollinating insect of which pigeonpea pollen accounted for 98-100%.

So far over 20 research papers on natural out-crossing in pigeonpea have been published from Kenya, Uganda, Hawaii, Puerto Rico, Trinidad, Sri Lanka, Australia and several locations in India [1] and in each case only insects have been identified as a sole cross-pollinating agents. At ICRISAT, an extensive research is being carried out in pigeonpea to exploit the phenomenon of out-crossing in breeding commercial hybrid cultivars. To achieve this both genetic as well as cytoplasmic male-sterility systems have been developed [7] and during the experiments conducted in an insect-proof green house some pod formation was observed on the male-sterile plants. It was presumed that these pods were formed by the pollen of the neighbouring fertile plants which was transferred with the help of wind blowing from the air-coolers installed inside the green house to control the temperature and humidity. Since wind pollination is never reported in pigeonpea this experiment was conducted to examine the incidence of pollen transfer through wind.

The experiment was initiated in the last week of July, 1999 in an insect proof bay of an even-span detached green house, with roof ventilators, measuring 575 × 875 cm. It is fitted with four side discharge evaporative air coolers. A common water circulation-3-phase 5 hp pump, operating @ 2870-2900 rpm, supplies water to woodwool pads of four evaporative coolers, provided in one experimental bay. Each cooler is fitted with a blower wheel and 2-speed motor operating @ 1425 rpm at high speed and 920 rpm at lower speed. The free air delivery of the coolers is 8330 m^3/hr at high and 2980 m^3/hr at low speed. The air velocity at 50 cm away from register is 700 m/min at high and 480 m/min at low speed. These coolers maintained temperature between 28-32^o C and relative humidity between 50-60% inside the bay of the green house throughout the experiment duration. The experimental materials consisted of two male-sterile lines and their fertile maintainers. These include one genetic male-sterile (GMS) line and a cytoplasmic male-sterile line (CMS). ICPL 85010 was the common maintainer. The experimental materials were grown in 10" × 10" plastic pots filled with sterilized Alfisol mixture (4 parts of Alfisol : 2 parts of farm yard manure : 1 part sand). In each pot six seeds were sown, but the expected plant population could not be obtained due to low germination. In the GMS line roguing of fertile segregants was done at flowering and only four male-sterile plants were retained in three pots. In CMS line, 21 male-sterile plants germinated in six pots. The fertile maintainer ICPL 85010 was grown in 10 pots and each with 4-6 plants. The pots of the maintainer plants were kept at a distance of 0.5 m from the air coolers while the pots with male-sterile plants were placed 3 m away from the pollen source. For control one branch of each

male-sterile plant was protected from any air-borne pollen by covering it with a small muslin cloth bag. One month after flowering each male-sterile plant was carefully observed for pod set.

The plant population in each pot varied from 1-6 plants and since pigeonpea is a plastic crop, the fewer plants in a pot grew larger while more plants in a pot grew relatively smaller due to competition and this produced more or less similar biomass in each pot. The selfed branches of the male-sterile plants did not produce any pod while pod setting was observed in the unbagged open branches. In GMS plants the total pod count due to wind pollination from four plants was 13 with an average of 3.25 pods/plant. The CMS plants produced a total of 105 pods with an average of 5.00 pods/plant. The present observations revealed that wind not only can carry pigeonpea pollen grains but can affect cross-pollination also.

The anthers and stigma of pigeonpea are enclosed within keel and to affect self-fertilization under normal environmental conditions the pollen dehiscence in male-fertile flowers commences a day before the petals unfold [8]. The reproductive parts of pigeonpea flowers are partially exposed two days after opening of flower when the keel petal starts withering. At this point of time, some quantity of pollen still remains in the anther lobes which can be blown by wind. Our unpublished studies showed that stigma of pigeonpea remains receptive up to three days after its flower opening. The availability of pollen and receptivity of stigma after withering of keel petal provide opportunity for cross-pollination through wind. Under normal field conditions where insects are mainly responsible for cross-pollination, the pod set on the male-sterile plants is usually very high and infact they produce pods similar to those of fertile plants [9]. On the contrary, the pod set through wind pollination even under continuous high wind velocity is very low. Considering the field situation where wind velocity during the cropping season is comparatively very low, it appears that wind pollination in pigeonpea is not likely to adversely affect any variety maintenance program. The isolation specification presently recommended, keeping in view insect aided cross-pollination, is sufficient enough to maintain the genetic purity of cultivars.

Acknowledgements

The authors acknowledge the support of Dr. R. C. Sachan, Senior Manager, Farm and Engineering Services Program and Mr. S. C. Gupta, Engineer, Controlled Environment Research Facility for providing technical information about green house.

References

1. **Saxena, K. B., Singh L. and Gupta M. D.** 1990. Variation for natural out-crossing in pigeonpea. Euphytica, **46**: 143-148.
2. **Howard A., Howard G. L. C. and Khan A. R.** 1919. Studies in the pollination of Indian crops. I. Memoirs, Department of Agriculture. India (Botanical series), **10**: 195-200.
3. **Pathak G. N.** 1970. Red gram. *In*: Pulse Crops of India. Indian Council of Agricultural Research pp. 14-53.
4. **Brar H. S., Jhajj H. S. and Gatoria G. S.** 1992. Abundance and activity of the bee visits to pigeonpea [*Cajanus cajan* (L.) Millsp.] and role of *Apis mellifera* (L.) in its pollination. Indian Bee Journal, **54**: 76-80.
5. **Onim J. F. M.** 1981. Pigeonpea improvement research in Kenya. *In*: Proc. International Workshop on Pigeonpeas, 15-19 Dec. 1980, ICRISAT Center, Vol 1, Patancheru, A.P. 502 324, India., p. 427-436.
6. **Williams I. H.** 1977. Behaviour of insects foraging on pigeonpea (*Cajanus cajan* (L.) Millsp.) in India. Tropical Agriculture (Trinidad), **54**: 353-363.
7. **Saxena K. B.** 2000. Pigeonpea. *In*: Plant Breeding : Theory and Techniques. S. K. Gupta (ed). Agrobios, Jodhpur, India p. 82-112.
8. **van der Maesen L. J. G.** 1986. *Cajanus* D. C. and *Atylosia* W. & A. (Leguminosae). Agricultural University of Wageningen Papers: 85-4 (1985). Agricultural University Wageningen, the Netherlands, pp. 225.
9. **Saxena K. B., Chauhan Y. S. Singh L., Kumar R. V. and Johansen C.** 1996. Research and Development of Hybrid Pigeonpea. Research Bulletin No. 19, International Crops Research Institute for the Semi-Arid Tropics, Patancheru 502 324, Andhra Pradesh, India pp. 16.