Open Flower Segregants Selected from *Cajanus platycarpus* Crosses

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Pigeonpea (*Cajanus cajan* L. Millsp.) has a typical papilionaceous flower. The flower is irregular (zygomorphic) and is made up of five petals, a standard or vexillum, two wing petals, and two petals fused together to form a keel-like structure (Fig. 1a) that encloses the anthers and stigma. Although the structure is most suited for self pollination, in pigeonpea a certain amount of cross pollination does occur with insect visitations (Saxena et. al. 1990).

The natural outcrossing was in the past considered a negative trait due to its role in the contamination of cultivar purity. However of late a lot of importance is being given to this trait for its potential role in hybrid pigeonpea research and the development of cytoplasmic male sterile systems (CMS) (Tikka et al. 1997; Saxena and Kumar 2003; Mallikarjuna and Saxena 2005). In all the CMS systems, cross pollination is essential for seed set.

Cajanus platycarpus is a wild species placed in the tertiary gene pool of pigeonpea. ICRISAT has made progress in successfully crossing *C. platycarpus* with cultivated pigeonpea (Mallikarjuna 2003). In the segregating population from the cross *Cajanus platycarpus* × *C. cajan* ICPL 85010, significant variation in flower morphology was observed in F_1BC_3 progeny. Some of the flowers were found to be abnormally completely open (Fig. 1b). Such chasmogamous flowers (Lord 1981) encourage cross pollination as the pollinating agents have free access to pollen grains in the anthers and the stigma. The percentage of abnormal flowers on each plant ranged from 5 to 86%. In these open flowers, the stamens were separate (Fig. 1b & d) instead of forming a di-adelphous bundle as usually seen in pigeonpea (Fig. 1c). The filaments of each anther were separate from each other, giving a rubiaceous flower structure. The anthers in these open flowers did not dehisce even at anthesis (Fig. 1e). Hence the pollen grains remained enclosed in the anther sacs, not available for pollination/fertilization, and for all practical purposes was similar to a male sterile trait. Anther morphology in the F_1BC_3 plants was abnormal too and anthers were not placed close to the stigma as seen in cv ICPL 85010. Nondehiscent anthers and their placement away from the stigma are traits favoring cross pollination. Pollen fertility in the anthers was assessed based on acetocarmine pollen stainability studies. Pollen grains were stained in 2% acetocarmine, a DNA specific stain, and pollen grains which picked up a bright stain were counted as fertile grains. In pigeonpea, pollen stainability is a good indication of pollen fertility (Mallikarjuna, unpublished). In this study, pollen fertility ranged from 26 to 77% but in spite of high pollen fertility, none of the plants set seeds due to self pollination. Tripping the flowers did not release the pollen grains from the anthers, which meant that the anther walls were tough, unlike anthers in cultivated pigeonpea.

Forced self pollination did not set seeds in these hybrids, but seeds were obtained when pollinated with cultivated pigeonpea ICPL 85010. This showed that that there is no female sterility in these plants, but some sort of self incompatibility mechanism seemed to be operational. Open flowers coupled with self incompatibility are desirable traits for hybrid pigeonpea breeding.

In the interspecific cross *Cajanus cajan* T-21 × *C scarabaeoides*, some of the BC_1F_2 plants showed free stamens that were all sterile, although the anther appeared normal. Histological observation revealed early degeneration of pollen mother cells (Reddy and Faris 1981). In the present study, anthers were fertile but without the dehiscence of the anther wall, hence pollen was not released from the anthers.

Further experimentation is necessary to determine if the open flower mutants of pigeonpea can be effectively utilized for the development of exclusively cross pollinating pigeonpea, and thus for use in the hybrid breeding program, where self pollination is an undesirable feature.

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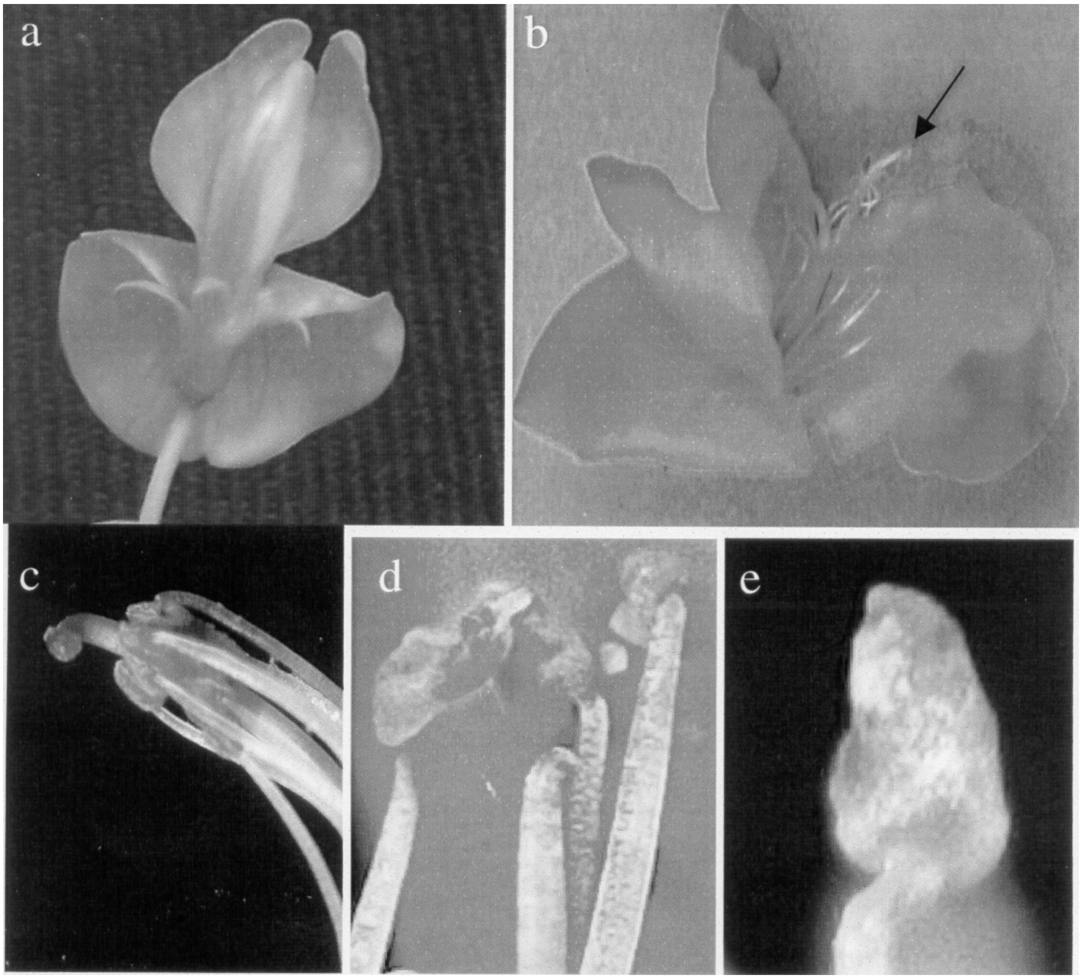

Figure 1. Open flower segregants from the cross *Cajanus platycarpus* × *C. cajan.*

a. Normal pigeonpea flower of pigeonpea cv ICPL 85010
b. Open flower (chasmogamous) from the cross *C. platycarpus* × *C. cajan*. Arrow points at the stigma.
c. Normal anthers of pigeonpea cv ICPL 85010.
d. Anthers from the cross *C. platycarpus* × *C. cajan* with abnormal morphology.
e. A close up of a nondehiscent anther from the cross *Cajanus platycarpus* × *C. cajan*.