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Occurrence and Genetics of a Natural Mutant of Chickpea Having Twin Flower Peduncles and Polycarpy

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The occurrence of a natural mutant in chickpea (*Cicer arietinum* L.) accession ICC 5003 (K 850) is reported. The mutant is unique in having twin polycarpellary flowers per peduncle, in contrast to the single monocarpellary flowers of the parent genotype. A morphological description of the new genotype is presented. The twin flower peduncles, polycarpy, and other associated features of the mutant are the pleiotropic expression of one recessive gene, *tpc*.

There have been many reports of mutations that have provided new variability for the genetic improvement of crop plants.[2] While we were studying the range of morphological variability in the world collection of chickpea (*Cicer arietinum* L.) germ plasma during the post-rainy season of 1979-1980, a plant from cv. K 850 was identified that had twin flowers per peduncle and two pods joined at their bases on one pedicel (Figure 1B).[3] In subsequent generations the progeny bred true, indicating that the original plant was conditioned by a natural mutation. In this report, the characterization data, expression of associated morphological features, genetics, and possible utilization of the putative new mutant are presented.

Materials and Methods

Our experiments were conducted at the ICRISAT Center from 1980 to 1984 to record the morphology of the mutant, evaluate its agronomic usefulness, and study its genetics. Plants were grown at 60 × 10-cm spacing in the post-rainy season (November-February) on Vertisols. We measured leaf and vexillum area and other characters (Table 1). Pod set was estimated as the percentage of pods compared with the total number of flowers produced. We recorded mutant floral structures from a total of 200 flowers plucked from 20 plants. The mutant was crossed with two genotypes: cultivar K 850 (parent) and ICC 10301. Cultivar K 850 was bred more than a decade ago at the Government Agricultural College, Kanpur, India, from a cross between "Banda Local" and "Etah Bold" germ plasm collections (Figure 1A). The genotype ICC 10301 is a commercially released cultivar in Mexico. It has a simple leaf, i.e., one that is not differentiated into leaflets and rachis, in contrast to the usual unipinnate leaves of chick-peas. F_1 and F_2 populations were raised in order to score the normal and mutant features (twin flowers per peduncle and polycarpy) and to study the mutant's inheritance. The procedure of Pundir and Singh[4] was followed for meiotic analysis and pollen stainability; stained pollen grains were counted as fertile.

Results and Discussion

The progeny of the new mutant bred true in subsequent generations. This mutant dif-

Table 1. Differentiating features of the chickpea mutant and cultivar K 850

Feature	Mutant	K 850
Leaf area (cm^2)	8.11 (7.2-9.1)	6.02 (4.8-7.9)
Flower vexillum size (cm^2)	0.69	0.51
Carpels per flower	1.3	1
Flowers per peduncle	1-2	1
Peduncles with two flowers (%)	40 (32-45)	0
Plant canopy height (cm)	46.0 (43.0-50.0)	43.0 (40.0-45.0)
Pod shape	Obovoid	Rhomboid or ellipsoid
Pod set (%)	8.6 (7.5-9.4)	43.2 (38.5-46.4)
100-seed mass (g)	35.5 (34.6-37.3)	30.2 (29.0-31.0)

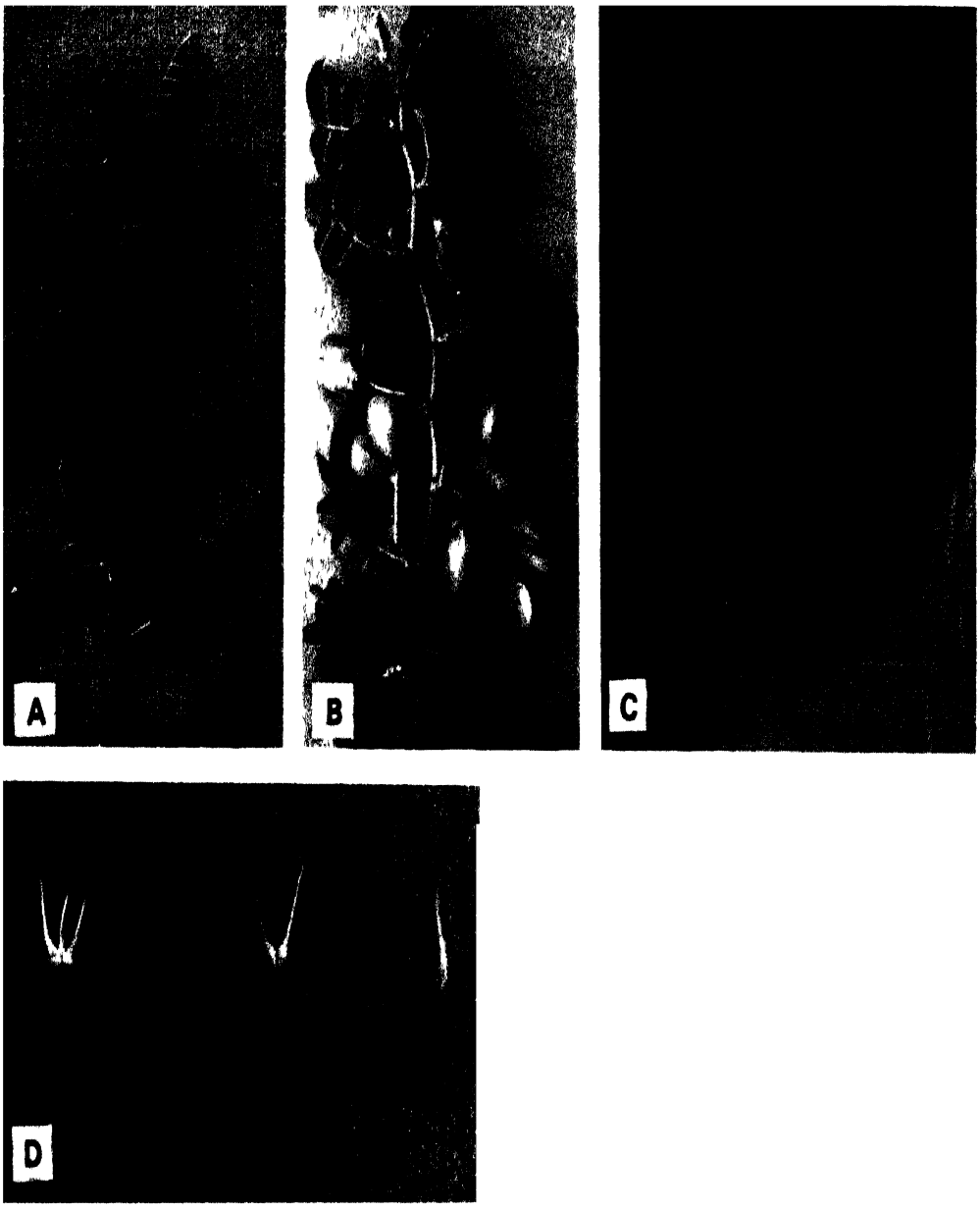

Figure 1. (A) Branch of parent genotype K 850 (B) Branch of mutant genotype (C) Metaphase I stage of pollen mother cell of mutant (D) Triple , double , and single carpeled flowers from the mutant genotype (E) Mutant pod set

Table 2. Floral features of the K 850 chickpea mutant

Feature	Flowers (%)
Gynoecium	
1 carpel (normal)	54 0
2 carpels	41 0
3 carpels	5 0
Androecium	
(9) + 1 stamens (normal)	95 0
(9) + 1 + 1 stamens	2 5
10 free stamens	2 0
11 free stamens	0 5
Calyx	
5 sepals (normal)	82 5
6 sepals	12 0
7 sepals	4 5
8 sepals	0 5
9 sepals	0 5
Corolla	
5 petals (normal)	89 8
6 petals	10 2

fers from the parent cultivar, K 850, in that it has twin polycarpellary flowers per peduncle compared with single monocarpellary flowers in the parent The occurrence of polycarpy in chickpea was reported earlier[1,5] in segregating material involving chick-pea genotype NP 82 as a common parent In those crosses, the flowers were sterile and abnormal. The genotype described here is a natural mutant whose flowers produce normal-appearing and fertile pollen grains, but with low pod set (Table 1), indicating some disturbance in its reproductive cycle, the reasons for which should be investigated However, the final pod number is near normal because more flowers per plant are produced. The single flowers occasionally

Table 3. Genetics of the chickpea mutant feature

Cross	F_1	F_2 segregation ratio: Class	No plants	Expected ratio		
CC 10301 × mutant	Normal	Normal	12	3 1	0	–
		Mutant type	4			
K 850 × mutant	Normal	Normal	271	3 1	0 001	0 98-0 95
		Mutant type	90			

produce two or three pods joined at their bases (Figure 1, D and E).

The mutant differs from the K 850 parent in that it has different phyllotaxy in the early growth stage: larger leaves and vexilla, higher seed mass, and a different pod shape (Table 1). It is similar to K 850 in regard to stomatal size, days to flowering, pollen stainability, and size and number of seeds per pod Meiotic studies indicated that the mutant is diploid with a normal meiotic cycle (Figure 1C)

The normal floral botany of chickpea is fairly consistent with a single monocarpellary flower on each peduncle, five sepals, five petals, and (9) + 1 stamens. In contrast, the expression of the mutant and other changes in floral parts revealed that the twin-flowers-per-peduncle trait is expressed in all the plants (although only 40% of the peduncles of a plant had two flowers). Forty-six percent of the flowers produced two or three carpels, and 3% of the flowers had 11 or 12 stamens. There was considerable change in sepal number, with 17.5% having between six and nine sepals per flower. A change in petal number was noticed only in about 10% of the flowers, which had six petals (Table 2).

F_1 plants of the two crosses were normal The F_2 plants segregated in a 3 1 (normal mutant) ratio, indicating that the mutant feature is expressed by one recessive gene (Table 3). The mutant features did not segregate in progenies of the cross, indicating that these are pleiotropic effects of a single gene We propose naming the mutant "K 850 polycarpy" and assigning the gene symbol *tpc* to the mutant feature

The mutant is unique and has the potential to increase chickpea pod numbers per plant, even though the pod set is low. An increase in pod number might be obtained by transferring this trait to a suitable genetic background or by agronomic manipulation

Seeds of the mutant genotype can be obtained from the Genetic Resources Unit, ICRISAT, Patancheru, India.

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