Research Reports

Breeding/Genetics

Self-incompatibility in Chickpea

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Chickpea (*Cicer arietinum* L.) is the most important food legume crop in India. As it has cleistogamous floral morphology, the phenomenon of self-incompatibility is not commonly known, since the flower opens up only after fertilization. However, self-incompatibility has been observed in segregating generations of some crosses involving parents from diverse sources, particularly in the brachytic mutants (Dahiya et al. 1990) (Fig. 1). These plants occurred more frequently in the F_2 generation of biparental mating of a cross (H 82-5 × E 100 ym) × Bhim. These plants were morphologically normal with normal but empty pods despite having viable pollen (84.21%). They produced normal pods and seeds with 78.34% viability when artificially pollinated with pollen from other plants of the same generation of the same cross or from other genotypes. Reciprocally, when pollen from these plants was used to artificially pollinate plants from parental lines or other genotypes the podsetting was normal with viable seeds. Therefore it is postulated that seeds failed to develop in these plants as result of a prezygotic phenomenon of self-incompatibility where genes for self-incompatibility might have either restricted pollen germination or prevented the growth of the pollen tube within the incompatible pistil. The development of pod wall without seeds might have resulted from the physiological stimulation caused by self-pollination in this self-incompatibility system activating the expansion of the ovary into the pod. To determine the role of various factors involved in the self-incompatibility system of chickpea, a detailed biochemical and cytomorphological study will be undertaken during the next season.

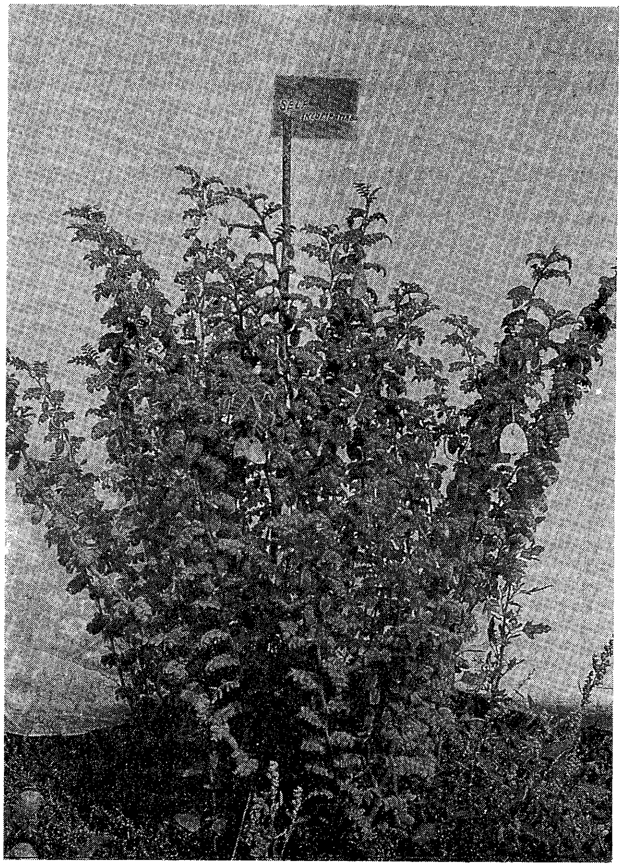

Figure 1. Plant with self-incompatibility phenomenon in crosses with brachytic mutant parent.

Reference

Dahiya, B.S., Lather, V.S., and **Kumar, R.** 1990. A brachytic mutant of chickpea. International Chickpea Newsletter 22:42.

Interspecific Hybridization in *Cicer*

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The wild relatives of crop plants can be utilized to broaden the genetic base of cultivated species and as donors of desirable traits. In the genus *Cicer, C. reticulatum* and *C. echinospermum* are of special significance because of their morphological similarity with the cultivated chickpea. The compatibility of *C. reticulatum* with chickpea has been observed at ICRISAT and elsewhere. Ladizinsky and Adler (1976) reported that the crossability of *C. echinospermum* with cultivated chickpea was low and the resulting hybrids were highly sterile. Nevertheless, this species has a seed size almost similar to chickpea, and was known to possess resistance

Figure 1. Parental line, ICC 11879 (*Cicer arietinum*), No. 204 (*C. echinospermum*), and their F_1 hybrid.

to bruchids, leaf miner, and fusarium wilt, and also moderate resistance to cold and ascochyta blight (Singh et al. 1991). Therefore, there is renewed interest in utilizing this species in chickpea improvement. ICARDA has reported successful crosses between chickpea (ILC 482) and *C. echinospermum* (ILWC 35) and a large seed set on F_1 hybrids (ICARDA 1990). However, supporting data on crossability, meiotic behavior of F_1 plants, pollen fertility, and pod-set, etc., are not shown. Gaur and Slinkard (1990) studied isozymes in the F_2 progenies of *C. arietinum* x *C. echinospermum*, but they also did not indicate the level of compatibility between these species. This paper presents data on the degree of crossability between *C. arietinum* and *C. echinospermum* by using conventional methods of crossing.

In 1991, two chickpea lines, ICC 11879 of Turkish origin (=ILC 482; with white flowers used in crosses at ICARDA) and GR 4 (a line with fewer leaflets, developed at ICRISAT), were crossed with *C. echinospermum* (No. 204; used by Ladizinsky and Adler 1976) in both directions. As is a usual practice in chickpea, emasculation and pollinations were made simultaneously, between 0900 to 1600 h. The seeds from crosses and parents were sown side by side in Nov 1991. Genuine F_1 plants were identified based on marker traits (white flower and few leaflets as recessive traits) and growth habit of the parents.The F_1 plants within the two crosses were almost similar. There were 13 true F_1 plants in a cross between ICC 11879 (♀) × No. 204 (♂) (62 pollinations were made) and 5 F_1 plants between GR 4 (♀) × No. 204 (♂), 24 cross pollinations were made), indicating 26.5 and 20.8% crossability in the two crosses. There was only one cross, seed obtained from the cross of *C. echinospermum* × ICC 11879 (36 pollinations made), which incidentally did not germinate. Hence, there is a need to attempt further crosses with *C. echinospermum* as the female parent, in order to understand the relationship between the species better.

The F_1 plants grew normally (Figure 1). Pollen from the parents and F_1s were stained with 2% acetocarmine and scored for fully and partly stained pollen grains. Fully stained pollen is, in general, fertile. Pollen fertility was 95% for the parental species and 53.8 and 51.8% for the two F_1 progenies (Table 1).

Table 1. Distinguishing traits of *Cicer* parental lines and F_1 hybrids of *Cicer arietinum* and *C. echinospermum*, ICRISAT Center, India, postrainy season 1991/92.

	C. arietinum		*C. echinospermum*	F_1	
Traits	ICC 11879	GR 4	No. 204	11879 x No. 204	GR 4 x No. 204
Growth habit	Semi-erect	Semi-erect	Prostrate	Semi-spreading	Semi-spreading
Leaf[1]	Normal	Few leaflets	Normal	Normal	Normal
Days to flowering	62	64	64	62	63
Flower color	White	Pink	Pink	Pink	Pink
Pollen stainability (%)	98	98	96	54	52
Pod-set (%)	60	62	75	31	20
100-seed mass (g)	30	17	15	28	15
Seed coat color	Beige	Yellow	Dark brown	Dark brown	Yellow
Seed coat reticulation	Absent	Absent	Heavy	Almost absent	Absent

1. Normal = 11-15 leaflets; Few leaflets = 5-7 leaflets.

We counted the number of flower-producing nodes and the number of pods set on normally developed branches and found considerable reduction in percentage of pod-set in the F_1 plants, i.e., 20% and 31% compared to 75% in *C. echinospermum* and 60% in ICC 11879. Flower buds were collected to study the meiotic behavior of the F_1 plants.

The present data on compatibility of the two species are different from that reported by Ladizinsky and Adler (1976). One of the reasons might be the difference in the chickpea genotypes used in the crosses. The present data indicated a very low percentage of pod-set in the F_1 progenies (see Figure 1) in contrast to the heavy pod-set reported at ICARDA (ICARDA 1990). This variation is probably due to the fact that the F_1 plants had low pod-set and therefore grew for a relatively longer time and ultimately produced more pods.

The meiotic behavior of F_1 plants and segregational pattern in F_2 progenies will be examined. The recombinant material, which is being developed, shall be evaluated for usefulness in the breeding program.

References

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Cell Biology

Effect of *Fusarium oxysporum* f. sp *ciceri* Culture Filtrate on Callus Growth of Different Genotypes of *Cicer arietinum* L.

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The genotypes of *Cicer arietinum* L. (chickpea) included in the study show different degrees of tolerance to *Fusarium oxysporum* f.sp *ciceri* (FOC) infection in the field. WR 315 is wilt resistant and JG 62 is wilt susceptible, while C 235 and H 75-35 are late wilters. These contrasting genotypes were compared for their *in vitro* resistance to FOC culture filtrate (CF). The CF of this pathogen and the calli of the different genotypes of chickpea were developed as described in this Newsletter.

It is now established that different genotypes behave differently under *in vitro* conditions. Thus the variation among the cultures growing on the medium supplemented with CF arises from the combined effect of tissue culture and *F. oxysporum* f. sp *ciceri* CF on different genotypes. In order to estimate the effect of CF alone, we must first have a clear idea of the effect of the tissue-culture system on different genotypes.

C_1 (B5+1.5 mg L^{-1} BAP+1.0 mg L^{-1} NAA) medium without CF was used for study of genotypic response to the tissue-culture system. This medium was supplemented with different concentrations of 14-day old FOC-CF (0, 0.25, 0.5, 1, 2, 3% v/v) to study the CF effect. Twenty pieces of 8-month old friable callus 2-3 mm in size (ca 25 mg) were inoculated in each petriplate. These were incubated under continuous light of 4000 lux intensity at 25±1°C.

Effect of tissue culture system. Callus growth rates were determined by recording increase in fresh mass at 5, 10, 15, 20, 20, 30, 40, and 60-day intervals according to the following equation.

$$\% \text{ increase in mass} = \frac{\text{Final mass - initial mass}}{\text{initial mass}} \times 100$$

Figure 1 shows a considerable variation in the increase in fresh mass. The maximum increase was observed in JG 62 followed by H 75-35, WR 315, and C 235.