

SELF-INCOMPATIBILITY IN *ESCHSCHOLZIA CALIFORNICA*

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In reporting their studies of *Papaver rhoeas*, Lawrence *et al.* (1978) discussed a degree of uncertainty that must apply to descriptions of gametophytic incompatibility systems with single-locus control. This follows the discovery (Lundqvist *et al.*, 1973; Østerbye, 1975) of a system with at least three loci in *Ranunculus acris*, a member of the *Ranunculaceae*. Referring to evidence that the order *Papaverales* is derived from the order *Ranunculales*, Lawrence *et al.* (1978) suggested that control of self-incompatibility and site of inhibition of pollen growth should be studied in other members of the *Papaveraceae*. They have overlooked the demonstration of gametophytic control in *Papaver nudicaule*, the Iceland poppy (Fabergé, 1942).

In *Eschscholzia*, another genus of the *Papaveraceae*, the California poppy *E. californica* Cham. has generally shown a high level of self-sterility. Beatty (1936) found that inhibition of pollen tube growth in this species occurred in the stigma. The orthodox site of inhibition for the one-locus gametophytic (*Nicotiana*) system which the present results support is the style, but *Papaver* species have no style. Beatty's result supports the prediction of Lawrence *et al.* (1978) that stigmatic inhibition in poppies is likely to turn out to be a familial, rather than a generic characteristic. However, Brewbaker (1957) reported that the site of inhibition in *Papaver nudicaule* is the ovary.

Two California poppy plants of a cultivated strain were grown together in apparent isolation from other plants; neither set seed when the other was not flowering. Reciprocal crosses were made without emasculation. Germination of the seed was high, 10 plants of each of the reciprocal crosses were potted, and the 20 plants were kept in separate glasshouse cells. All plants began flowering within 4 days, 8 weeks after sowing. Crosses were made over two successive summers, but two plants died before many crosses had been made. Six plants were crossed with the surviving parent plant, and all six crosses were successful.

The results obtained by intercrossing 18 plants are shown in fig. 1. As in figs. 6 and 7 of Lawrence *et al.* (1978) the plants fall into four groups, arbitrarily labelled from A to D. Chi-square for the test of equality of the group sizes (7, 4, 4, 3) is the same as for the (6, 6, 3, 3) of fig. 7 (*loc. cit.*), a non-significant 2.00 with 3 degrees of freedom. Crosses between plants within each group were unsuccessful. Crosses between plants placed in different groups were generally successful; all those attempted twice were successful at least once, but five of those attempted once only did not succeed. Several crosses were made successfully in both directions, and there was no evidence of reciprocal differences in compatibility. The six plants crossed with one of the parents, nos. 1, 4, 8, 10, 18 and 19, covered all four compatibility groups.

The simplest interpretation is that the two parent plants differed in both *S*-alleles at a single incompatibility locus. The parental genotypes being S_1S_2

and S_3S_4 , the four groups of plants established are, in unknown order, S_1S_3 , S_1S_4 , S_2S_3 and S_2S_4 , and all the plants would be compatible with both parents.

Of the 18 plants that flowered for several months in the glasshouses, four produced several small pods in the cooler months without hand-crossing, with a small number of viable seeds assumed to be selfs. The maximum was 25 seeds per pod compared with the normal 100 or more produced by crossing, and most of the pods had less than five seeds (see legend to fig. 1).

Group	♀	5	7	10	15	16	19	20	1	11	12	17	2	6	14	18	3	4	8
A	5	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-
	7	- (1)	-	-	-	-	-	-	+	+	+	-	-	+	+	+	-	-	+
	10	-	-	-	-	-	-	-	+	+	+	-	+	+	+	-	-	-	+
	15	-	-	-	-	-	-	-	+	+	+	+	+	+	+	-	-	-	+
	16	-	-	-	-	-	-	-	+	+	+	+	+	+	+	-	-	-	+
	19	-	-	-	-	-	-	(2)	-	-	-	-	-	-	-	-	-	-	+
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	
B	1	-	+	-	-	-	-	+	-	-	-	-	-	+	+	-	-	-	-
	11	-	+	+	+	-	-	+	-	-	-	-	-	+	+	-	-	-	+
	12	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	+
	17	-	+	+	+	+	-	+	-	-	-	-	-	+	-	-	-	-	+
C	2	-	+	+	+	-	-	-	+	+	-	+	-	-	-	-	-	-	+
	6	-	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	+
	14	-	-	-	+	+	-	-	+	+	-	-	-	-	-	-	-	-	+
	18	-	+	-	-	-	-	-	+	+	+	+	-	-	-	(3)	-	-	+
D	3	-	+	+	+	+	+	+	+	+	+	+	-	+	+	-	-	-	-
	4	-	+	+	+	+	+	+	+	+	+	+	-	+	+	-	-	-	(4)
	8	-	+	+	+	+	+	+	+	+	+	+	-	+	+	-	-	-	-

FIG. 1.—The crosses attempted. Entries in the top and left-hand margins of the table are plant numbers; in the table a + indicates a successful cross, a - an unsuccessful cross. Production of seed by presumed self-fertilisation: (1) plant 7 had 3 pods, with 5, 7, and 25 seeds, (2) 10 pods gave a total of 34 seeds, (3) 1 pod, 1 seed, (4) 1 pod, 2 seeds.

The results do not prove that only one locus is significant in the control of self-incompatibility in *E. californica* (cf. Lawrence *et al.*, 1978), but they are fully consistent with this interpretation. The partial break-down of self-sterility shown by a few plants at low temperatures was presumably genetically influenced, but neither this nor the occurrence in other material of completely self-fertile plants has been studied further.

Darwin (1876) and earlier workers he quoted, and Douwes (1943), reported fairly high levels of self-fertility in their stocks of *E. californica*, whereas Stout (1920) and Beatty (1936) found most of their plants were self-sterile. Darwin also established an effect of temperature, as one of the strains used in his study of inbreeding had come to him from Brazil, where it had been completely self-sterile.

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