CROSS FERTILIZATION IN PEAS UNDER DIFFERENT ECOLOGICAL CONDITIONS (II)

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The work on natural cross fertilization in peas, studied by growing control lines with green cotyledons among a great majority of plants with yellow cotyledons (1,2), has been extended. WL 6040 was tested again in 1984 in two ecologically different locations (Tables 1 and 2).

Table 1. Percent of cross fertilizations on Location I (WL 6040).

Control group	Plants in each group (No.)	Plants with cross fertilization(s) (No.)	(%)	Seeds of each control group (No.)	Yellow seeds (No.)	(%)
1	10	3	30	637	3	0.4
2	16	3	19	696	7	1.0
3	18	5	28	869	8	0.9
4	16	11	69	796	22	2.8
5	14	8	57	696	13	1.9
6	15	5	33	732	9	1.2
7	20	8	40	1046	13	1.2
8	21	11	52	935	33	3.5
9	18	4	22	585	10	1.7
10	19	9	47	796	21	2.6
Totals/ means	167	67	40.1	7786	139	1.79

For location I the percentage of contaminated plants was about 10% higher in 1984 than in 1983 (cf. PNL 16, p. 38) and for contaminated seeds the difference was a bit more than a half percent above the value of 1983. The values for location II were, however, very similar in the two years (% of plants with cross fertilizations 1983: 30.4 and 1984: 29.87; % of yellow seeds 1983: 1.92 and 1984: 1.73).

Table 2. Percent of cross fertilizations on Location II (WL 6040).

Control group	Plants in each group (No.)	Plants with cross fertilization(s) (No.)	(%)	Seeds of each control group (No.)	Yellow seeds (No.)	(%)
1	13	1	8	288	1	0.3
2	12	4	33	338	5	1.5
3	15	2	13	414	2	0.5
4	17	1	6	400	2	0.5
5	19	9	47	549	14	2.6
6	14	5	36	399	9	2.3
7	11	4	36	246	6	2.4
8	20	8	40	696	14	2.0
9	17	7	41	500	12	2.4
10	16	5	31	508	10	2.0
Totals/ means	154	46	29.87	4338	75	1.73

Table 3. Percent of cross fertilizations on Location I (WL 145).

Control group	Plants in each group (No.)	Plants with cross fertilization(s) (No.)	(%)	Seeds of each control group (No.)	Yellow seeds (No.)	(%)
1	8	3	38	651	5	0.8
2	8	3	38	329	6	1.8
3	14	7	50	646	20	3.1
4	4	-	-	189	-	-
5	11	2	18	503	7	1.4
6	13	4	31	647	7	1.1
7	11	6	55	384	10	2.6
8	6	2	33	218	6	2.8
9	19	-	-	682	-	-
10	15	-	-	742	-	-
Totals/ means	109	27	24.77	4991	61	1.22

Table 4. Percent of cross fertilizations on Location II (WL 145).

Control group	Plants in each group (No.)	Plants with cross fertilization(s) (No.)	(%)	Seeds of each control group (No.)	Yellow seeds (No.)	(%)
1	16	6	38	784	11	1.4
2	3	1	33	41	2	4.8
3	7	-	-	258	-	-
4	4	1	25	191	1	0.5
5	2	-	-	31	-	-
6	4	-	-	92	-	-
7	4	2	50	155	2	1.3
8	3	-	-	108	-	-
9	6	5	83	289	17	5.9
10	8	5	63	266	32	12.0
11	6	1	17	236	6	2.5
Totals/ means	63	21	33.33	2451	71	2.897

Since Location II seems to have a richer insect fauna than Location I, the higher percentage of contaminated plants found at Location I this year was quite unexpected. Since no insecticide was sprayed on Location II in 1984, this perhaps should have allowed a further increase in the percentages of contaminated plants and seeds. It did not. Yet, because the field was not sprayed, seed production was greatly reduced as a result of a high incidence of disease, particularly viral disease. This explains the difference in the average seed production per plant between the two fields (46.6 seeds per plant on Location I vs. 28.2 seeds per plant on Location II).

Cross fertilization rates were also determined using WL 145 (long, late, non-fasciated, green cotyledons). Table 3 shows the results for Location I and Table 4 for Location II.

Usually 20 seeds were sown for each control group in both fields, so the loss of plants was especially high in this line. The difference between the average seed production per plant (45.8 seeds per plant on Location I and 38.9 on Location II) was not as great as in the case of WL 6040. The percentage of contaminated plants and seeds was greater in Location II than Location I but the high values on Location II were mainly due to the surprisingly high rates of cross fertilizations of control groups 9 and 10 and for which there is no satisfactory explanation. Having watched (and filmed) the different kinds of bumble bees and a solitary bee species for many hours, I noted that these bees do not seem to have the refined information systems that the honey bee has for communicating the most productive parts of a field. Moreover, bumble bee behavior is often rather erratic: leaving a red pea flower, turning to different plant species of the meadow nearby, returning to the pea field, flying from white to red flowers and vice versa, sometimes crossing the entire field and beginning its activity anew at the most distant part of the field, etc.

Besides the two lines mentioned, WL 118 (medium height, as early as DGV NF 15-1, non-fasciated, green cotyledons) also was investigated. The control group, consisting of 36 plants, had two contaminated plants (=5.6%) and produced 1682 seeds, two of which had yellow cotyledons (=0.12%).

Moreover, a few recombinants were selected, resulting from cross fertilizations between WL 6040 and probably DGV. They were in most respects similar to DGV (height, non-fasciation, flowering and ripening times, etc.) except, of course, for the green cotyledons (Table 5).

Table 5. Percent of cross fertilizations on Location I (recombinant between WL 6040 and probably DGV, details in text).

Control group	Plants in each group (No.)	Plants with cross fertilization(s) (No.)	(%)	Seeds of each control group (No.)	Yellow seeds (No.)	(%)
1	10	3	33	279	8	2.9
2	14	7	50	494	20	4.04
Total/ means	24	10	41.7	773	28	3.62

The final group investigated derived from a cross fertilization between WL 6040 and probably again DGV, having green cotyledons but which was still normally segregating in fasciated and non-fasciated plants. Of the six non-fasciated plants, four were contaminated; all six plants together produced 214 seeds, 14 of which had yellow cotyledons. All four fasciated plants were contaminated; the four plants together produced 131 seeds, nine of which had yellow cotyledons (6.5 and 6.9% respectively for the non-fasciated and fasciated plants).

To make sure again that no mistakes had been made in determining the cross fertilizations, 21 F2 families were studied (566 plants). Since the M2 of R 650 A (3) contained several plants with the dominant alleles Fa and/or Af (some of them with anthocyanin pigmentation) and since we had several other similar cases among another M2, such plants were chosen to determine whether any seeds of other lines might have been mixed up with the M_2 seeds. All 21 families segregated. Among the anthocyanin-producing plants we were able to ascertain the pollen source as P. arvense from the color of the seed coats. These also segregated for cotyledon color.

The real values for the cross fertilizations were in fact generally slightly higher than given in the tables because doubtful cases were systematically eliminated. On investigating such doubtful cases, we found that some of them had really been the products of cross fertilizations.

Since the initiation of this study we have found at least:

969 plants with green cotyledons
620 plants for segregations
858 plants - M2 of R 650 A (plus other M_2's not evaluated for
2447 this problem.

Moreover, at least 37,474 seeds have been investigated (segregations for yellow and green seeds not included).

1. Loennig, W. E. 1983. PNL 15:40.
2. Loennig, W. E. 1984. PNL 16:38-40.
3. Loennig, W. E. 1984. PNL 16:42.