

LOCUS IDENTITY TEST FOR 11 CURLED MUTANT LINES IN *PISUM SATIVUM* L.

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Abstract

Identity/allelism tests for 11 curled mutant lines of pea revealed that line 5142 and 5954 are mutations in the locus curl representative line 5855, while rest lines for the time being have been considered to be the mutations in the locus curl < a representative line 5846.

Introduction

Phenotypically the curled mutation in pea is characterized due to strong upward as well as downward curling of leaflets and stipules (Fig. 1). The first reported case of probable curled mutation in pea was spontaneous appeared in the cross between Blacky X Screw ball in the F₃ generation (Kellenberger, 1952). A second spontaneous event was found by Gelin *et al.*, (1959). Blixt (1958) for the first time induced curled mutation by nitrogen treatment of the seeds of cultivar Weitor and maintained as line 5142. Subsequently Blixt also obtained eight curled mutations with ethyl methane sulphonate of the variety Weitor, Parvus and of line 1197 of D.G. Well, from 1968 through 1976 and accessioned as lines 5831, 5944, 5960, 5972, 5985, 5986 and 5988 in Weibullsholm collections.

Sidorova (1981) obtained four curled mutants, K76, K330, K611 and K627 by treating seeds of cv. Torsdag with ethyl methane sulphonate as well as gamma rays, and of cv. Parvus with nitroso methyl urea (NMU). Her identity test crosses between K76, K330, K611 and K627 have resulted allelic mutation, while origin test crosses have shown that line K76 was semidominant and the rest three were recessive. Sidorova (1981) proposed gene symbols curl for K76, and curl < a for K330, K611, and K627. At Weibullsholm K76 is represented by line 5855 and K330, K611 and K627 by line 5846. In the present work 11 curled mutant lines showing considerable variations in the degree of curling were investigated for allelism.

Materials and Methods

Identity/allelism test crosses are crosses between the morphologically identical to similar mutants (Arain, 1985). The following curled mutant lines were used for identity (IDX) and origin (ORX) test crosses.



Fig. 1. Left: Cultivar Torsdag. Right: Mutant with curled leaves and stipules.

1. Line 5142 obtained by Blixt (1958) through nitrogen (N) treatment of the seeds of cultivar Weitor.
2. Lines 5944, 5954, 5960, 5972 induced by Blixt with ethyl methane sulphonate (EMS) treatments of the seeds of cv. Parvus.
3. Line 5831 obtained by Blixt with ethyl methane sulphonate of cv. Weitor.
4. Lines 5985, 5986 and 5988 also by Blixt with EMS treatments of line 1197 of D.G. Well.
5. Line 5846 representative line for curl $< a$ of Sidorova mutants K330, K611 and K627 of cv. Torsdag.
6. Line 5855 representative line for curl of Sidorova's mutant K76 of cv. Torsdag.
7. Line 2157 of cv. Torsdag, line 1263 of cv. Weitor and line 1107 of cv. Parvus respectively were used for origin test crosses.

Crossing and evaluation work was carried out at Weibullsholm Plant Breeding Institute at Landskrona, Sweden.

Results and Discussion

Results from origin test crosses are presented in Table 1. Lines 5142, 5831, 5855, 5954 and 5960 observed to have F₁ plants phenotypically normal, which would indicate recessivity of the mutants. Origin cross no. 4993 for lines 1263 x 5831 have shown segregation in chlorotica mutant as well and following F₂ segregations were found 448 normal, 168 curled, 130 chlorotica and 92 curled chlorotica. The chlorotica segregated undisturbed in 3:1 with Chisquare 0.95, while the curled have shown marked deficit of normals with corrected chisquare for linkage 15.4, indicating linkage.

For Sidorova's mutants, line 5846 curl < a and line 5855 curl, origin crosses were performed by Sidorova and as a rule not to be repeated. In spite her mutants were crossed with the origin lines used at Weibullsholm to investigate, if back ground genotype influenced the expression of curl. For the same reason Weibullsholm mutants were also crossed with line 2157 of cv. Torsdag used by Sidorova. Such crosses are presented in Table 2. Cross No. 6315 and 6316 have indicated certain influence of the back ground genotype on the expression of the phenotype of curl. Origin cross results are lacking for lines 5972, 5985, 5986 and 5988.

The results of identity crosses between the two curl alleles of Sidorova and the curl mutants of Weibullsholm collections are given in Table 3. The cross curl < a x curl (line 5846 and 5855) both the mutants originated from cv. Torsdag have shown F₂ segregation in two distinguishable phenotypes. As the F₁ Phenotype was curled and the genetic back ground should be the same which indicates that the phenotypic expressions of curl < a is different from curl. It may be mentioned that line 5142 and line 5954 resulted in curled F₁ when crossed to curl < a and curl as well as with one another. These mutants are therefore undoubtedly in the curl-locus.

Table 1. Showing origin test crosses (ORX) of curled lines of Pea.

| Cross No. | Parents origin x mutant | F1-phenotype | F2-segr. Norm:mutant | Chisqr for 3:1 |
|------------|----------------------------|--------------|-------------------------|-------------------|
| 4963,5331 | 1263 x 5142 | Normal | 1802:539 | 4.822 |
| 4993 | 1263 x 5831 | Normal | 578:260 | 15.937 |
| 5333 | 2157 x 5855 | Normal | 506:143 | 2.969 |
| 4934, 5334 | 1107 x 5944 | Normal | 494:164 | 0.398 |
| 4940,5335 | 1107 x 5954 | Normal | 3175:943 | 9.800 |
| 4941,5336 | 1107 x 5960 | Normal | 994:280 | 6.051 |

1) segregated chlorotica as well.

Table 2. Additional origin test crosses of curled representative lines with Weibullsholm parents of Pea.

| Cross No. | Parents origin x mutant | F1-phenotype | F2-segr. Norm:mutant | Chisqr for 3:1 |
|-------------------|----------------------------|--------------|-------------------------|-------------------|
| 5332 | 2157 x 5142 | Normal | 1191:365 | 1.975 |
| 6315 | 1107 x 5846 | Normal | 821:276 | 0.020 |
| 6320 | 1263 x 5846 | Normal | 573:191 | 0.000 |
| 6315 ¹ | 1107 x 5855 | Normal | 517:165 | 0.196 |
| 6316 ¹ | 1263 x 5855 | Normal | 1588:463 | 6.498 |

1) In this cross two slightly different mutant phenotypes could be distinguished, one resembling line 5855 and the other line 5954, which is a mutant from line 1107. This indicates a certain influence of background genotype on mutant phenotype. Line 1107 and 1263 are genetically related.

Results presented in Table 3 shows that two phenotypes can be distinguished in crosses with curl < a but not with curl. It seems probably that line 5142 and 5954 are mutations in allele curl.

The mutants of line 5960, 5985 and 5988 seems to form a group fo their own. The F₂ segregations in crosses with curl < a are curled and with curl more normal. Notes on the observation list indicates a weak curling being present on large frequency of plants, however for the moment may it suffice to accept them as mutants of the curl locus, different from 5142 and 5954, possibly curl < a.

Table 3. Showing identity test crosses and F₂-segregation of different curled mutant lines of Pea.

| Cross No. | Parents SD | F ₁ - pheno- type | Nor. | Par. 1 | Par. 2 | P1 + P2 | Chisqr for segr. |
|-----------|--------------------------------|------------------------------------|------|-----------|-----------|------------|---|
| 5351 | 5846 x 5855 Curl < a x Curl | Curled | 3 | 319 | 293 | — | 1.105 for 1:1 |
| 5342 | Curl < a x 5142 | Curled | 25 | 799 | 609 | — | 25.639 for 1:1 |
| 5343 | Curl x 5142 | Curled | — | — | — | 891 | — |
| 5353 | Curl < a x 5954 | Curled | — | 866 | 956 | — | 4.446 for 1:1 |
| 6314,5360 | Curl x 5954 | Curled | 58 | — | — | 1375 | — |
| 4804,5345 | 5142 x 5954 | Curled | — | — | — | 1500 | — |
| 5354 | Curl < a x 5960 | Curled | 8 | 503 | 347 | — | 28.63 for 1:1 |
| 5361 | Curl x 5960 | ?Normal | ?874 | 276 | — | — | 0.562 for 3:1 |
| 5356 | Curl < a x 5985 | Curled | — | 519 | 1503 | — | 0.445 for 3:1 |
| 5363 | Curl x 5985 | ?Normal | ?514 | 176 | — | — | 0.069 for 3:1 |
| 5357 | Curl < a x 5988 | Curled | — | — | — | 100 | — |
| 5364 | Curl x 5988 | ?Normal | 294 | 116 | 92 | — | 1.119 for 9:4:3 |
| 5346 | 5142 x 5960 | ?Normal | 1457 | — | 415 | — | 8.003 for 3:1 |
| 5348 | 5142 x 5985 | Normal | 359 | — | 121 | — | 0.011 for 3:1 |
| 5349 | 5142 x 5988 | Normal | 1128 | — | 351 | — | 1.302 for 3:1 |
| 5373 | 5960 x 5985 | Curled | — | — | — | 30 | — |
| 5374 | 5960 x 5988 | Curled | — | — | — | 318 | — |
| 6317 | Curl < a x 5831 | Normal | 1094 | 243 | 385 | — | 40.491 for 9:3:4 |
| 6312 | Curl x 5831 | Normal | 150 | 68 | 62 | 55 | 63.140 for 9:3:3:1 8.138 for linkage |
| 6322 | 5142 x 5831 | Normal | — | — | — | — | — |
| 6325 | 5954 x 5831 | Normal | 763 | 281 | 262 | — | 8.459 for 9:4:3 |
| 6326 | 5960 x 5831 | Normal | 298 | — | 147 | — | 21.031 for 9:7 |
| 6318,5352 | Curl < a x 5944 | Normal | 1799 | 503 | 200 | — | 15.556 for 3:1 287.670 for 9:4:3 |
| 6313,5359 | Curl x 5944 | Normal | 1138 | 398 | — | — | 12.975 for 3:1 |
| 6323,5344 | 5142 x 5944 | Normal | 1868 | 663 | — | — | 0.680 for 3:1 1.895 for 3:1 |

(Table 3 Cont'd.)

| Cross No. | Parents | F1- pheno- type | Nor. | Par. 1 | Par. 2 | P1 + P2 | Chisqr for segr. |
|-----------|-----------------|-----------------------|------|-----------|-----------|------------|---------------------|
| 5366,6327 | 5954 x 5944 | Normal | 1017 | 377 | — | — | 2.996 for 3:1 |
| 6328,5367 | 5960 x 5944 | Normal | 673 | 195 | — | — | 2.973 for 3:1 |
| 5369 | 5985 x 5944 | Normal | 748 | 234 | — | — | 0.658 for 3:1 |
| 5370 | 5988 x 5944 | Normal | 232 | 63 | — | — | 2.183 for 3:1 |
| 5355 | Curl < a x 5972 | Normal | 501 | 126 | — | — | 8.166 for 3:1 |
| 5362 | Curl x 5972 | Normal | 549 | 189 | — | — | 0.015 for 3:1 |
| 5347 | 5142 x 5972 | Normal | 487 | 142 | — | — | 1.910 for 3:1 |
| 5372 | 5960 x 5972 | Normal | 325 | 74 | — | — | 9.021 for 3:1 |
| 5358 | Curl < a x 5986 | Normal | 900 | 336 | — | — | 3.145 for 3:1 |
| 5365 | Curl x 5986 | Normal | 549 | 231 | 189 | — | 0.798 for 9:4:3 |
| 5350 | 5142 x 5986 | Normal | 1156 | 383 | — | — | 0.013 for 3:1 |
| 5375 | 5960 x 5986 | Normal | 155 | 32 | — | — | 6.394 for 3:1 |
| 6324 | 5831 x 5944 | Normal | 510 | 138 | — | — | 4.741 for 3:1 |
| 5368 | 5972 x 5944 | Normal | 339 | — | 119 | — | 0.186 for 3:1 |
| 5371 | 5986 x 5944 | Normal | 118 | — | 40 | — | 0.000 for 3:1 |

1) Many plants pseudo-curl.

Kat. 1 76

Kat. 1 330

Kolla med

Curl < a

Curl

Sidorova!!

5846

5855

?5960

5142?

?5985

5954?

?5988

a) pseudo-curl, leaflets folded + - inwards or downwards?

b) line 5831 phenotypically + - normal

c) line 5954 leaflets curled + - downwards

d) line 5855 leaflets curled + - upwards

e) line 5960 + - = line 5142 = line 5855

f) line 5985 leaflet margins rolled in

g) Line 5986 weak curled, lower leaves normal, top constantly curled.

h) Line 5944 ej curled - svar curled - normal.

i) Line 5831 pseudo-curl.

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