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PISUM-CROSSES IX: THE NEW FLOWER COLOUR "CERISE"

by

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1. INTRODUCTION

In Pisum-crosses VIII (9) a gene *Aw* was described which together with *A* is basic for anthocyanin production in the flower. *A A aw aw* is phaenotypically white, although sometimes an extremely faint very light rose colour can be observed, probably especially in a very sunny season. After the war the original *A A aw aw* white line was lost and I obtained two lines in its place, the identity of which was unknown, however. In order to test this identity, the two lines were crossed and the present paper deals with the results which were quite unexpected.

Already by visual examination it turned out that one line was most probably identical with the old one, but the other one was clearly distinct by always showing clear spots of colouration on the wings, corresponding to H C C (= "Horticultural Colour Chart") China rose 024/2. The colour was named "light".

In a comparatively small F_2-generation, grown in 1948, difficulties in classification were met with, since some colours appeared which were uncertain or unknown. In order to get more knowledge of them, F_3-lines of all colour types were grown which were bred true in F_4. Also, a new cross between the original lines was made in 1949 and the F_2 of this cross has given clear results. They led to the existence of a new gene, called *Ce*, which in recessive condition is responsible for either the original colour "light" or a new colour "cerise", depending on other genes being dominant or recessive.

2. EXPERIMENTAL RESULTS

The two lines "light" and "white" gave a purple flowering F_1 and in the F_2 besides the expected parental and F_1 colours the known colour "crimson" and a hitherto unknown colour were found. The latter corresponds as a whole to very light phlox purple, Phlox purple H C C 632/3, with wings of China rose H C C 024/1. It fits the popular name "cerise" which on account of its conveniency was adopted. The high costs of reproduction prevent me from adding a coloured plate to this publication, but seed samples of all the types are available for those who are interested in them.

Once pure lines of the different colour types were available, the F_2-classification according to these types did not yield any difficulties. It may be remarked that the leaf axil colour of the white parent is light, of the light parent dark, while all F_2 types besides white were dark.

The F_2 was composed of 4 groups, derived from 4 F_1-plants. Since they approximately had the same segregation, it will do to mention the total figures for the whole F_2. These are:

purple	270
crimson	49
cerise	44
light	55
white	130

The derivation of some monogenic ratios from the above figures helps to clear up the situation. First of all we find coloured (purple + crimson + cerise + light) : white = 418: 130, expectation (411): (137). The well known gene *A* cannot be responsible for this segregation, since all whites in the present case had coloured leaf axils which never occurs when *A* is absent. Hence *Aw* must be the gene in question.

Among the coloured types we find:

(purple + crimson) : (cerise + light) = 319 : 99
(purple + cerise) : (crimson + light) = 314 : 104
expected according to 3 : 1 (314) : (104)

These results can be explained by assuming a new gene, *Ce*, as responsible for the former segregation, the known gene *Cr* [FEDOTOV (1, 2), identical with *Ap* of DE HAAN (3)] determining the latter.

The total formulae then are:

Aw Aw Ce Ce Cr Cr = purple (F_1).
Aw Aw Ce Ce cr cr = crimson (new combination)
Aw Aw ce ce Cr Cr = cerise (new combination)
Aw Aw ce ce cr cr = light (parent)
aw aw Ce Ce Cr Cr = white (parent)

In these formulae *Aw* is basic gene for colour production. It is unjustified to ascribe specific actions to *Ce* and *Cr* since they mutually influence each other.

Comparing the F_2-figures with the above formulae it is at once clear that *Ce* and *Cr* are linked. Applying the method as described before (8, p. 448) we find:

Ce–Cr	270 : 49 : 44 : 55	325 : 93
	(240) : (79) : (74) : (25)	(265) : (153)
		c = 6.0

The crossing-over percentage approximates 26.5%.

There is no reason for assuming linkage between *Aw–Ce* and *Aw–Cr*, but the only evidence in this case are the monofactorial segregations for *Ce* and *Cr*.

A fourth gene, segregating in the present cross, is a factor for stem length. The light parent is comparatively tall, the white parent small. A clear cut 3 : 1 segregation occurred in F_2, actual figures being 405 tall: 143 small, expectation (411) : (137). The gene in question might be *Le*, but this is not proven.

The relations between this length gene and *Aw*, *Ce* and *Cr* did not point to linkage, although both for *Ce–Le*(?) and *Cr–Le*(?) the deviations from independent segregation are fairly large. The data at hand are insufficient for a further discussion.

3. DISCUSSION

The above mentioned formulae are incomplete, since other genes are known whose presence is necessary for producing purple. The oldest known genes in question are *A* and *B* (for literature see 7, p. 360). In my material *A* must have been present in all plants, since no uncoloured leaf axils occurred. Also, *B* must have been present, since no rose and crimson rose have segregated. The same holds true for TEDIN's

Ar (5), (6), since no violet and crimson violet have segregated. Hence to all formulae *AA BB Ar Ar* must be added and doubtlessly more genes, of which I do not know the effect from personal observation. It may be remarked that in my material a somewhat darker and a somewhat lighter crimson were found, just as a somewhat darker and a somewhat lighter cerise. The distinction was not clear at all, however, and although much can be said in favour of modification due to light and age, the possibility of modifying genes cannot, for the moment, be completely excluded.

It is interesting to follow DE HAAN's discussion (3, p. 332) on the origin of the different flower colours. The probably oldest known pea had purple flowers. We now know that purple is the effect of a whole series of dominant genes. From purple, colours like rose and crimson arose by simple mutations, while the crossing of these mutants gave rise to a new colour, namely crimson rose. TEDIN's light purple is different, however, since his original type already differed in two genes from purple and crossing originated a new recombination which only differed in one gene from purple.

My case of cerise is analogous. The original "light" differs in both *ce* and *cr* from purple and hence must have arisen by two mutations. The new colour cerise which is different from purple in only one gene was obtained as a segregate after crossing. The mutations may have been purple → crimson → light, or purple → cerise → light. If my limited knowledge that cerise is a really new colour which has not occurred as an original type, is generally true, the latter possibility must be excluded, so that "light" has arisen as a mutation from crimson. Of course, this is mere hypothesis, attractive as it may be.

The linkage between *Ce* and *Cr* means that *Gp* — green or yellow pod colour — must belong to the same group, since *Cr* and *Gp* are clearly linked (10). Further evidence is lacking for the moment, however, just as with regard to *Cp*, *Fs* and *Ast* which according to LAMPRECHT (4) all belong to his chromsoome V.

4. SUMMARY

1. A new gene, *Ce*, is described which is necessary for the production of purple and crimson. *ce ce Cr Cr* represents the new colour "cerise", while *ce ce cr cr* stands for "light", in all cases assuming the presence of *A*, *Aw*, *B* and *Ar*.

2. *Ce* and *Cr* are linked with a crossing-over of approximately 26.5%.

3. It is supposed that "light" has arisen from crimson which in its turn arose from purple by mutation.

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