TWO NEW ANTHOCYANIN GENES IN THE D SEGMENT OF CHROMOSOME 1

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Routine observations in 1987 of various Wiatrowo accessions revealed two characters connected with the appearance of anthocyanin pigmentation in pea plants which have not previously been described. In the first case, anthocyanin dots were found on the upper surface of the leaves in line Wt702 (P. sativum ssp. tibetanicum) (Fig. 1). Line Wt702 was crossed with testerlines to investigate the mode of inheritance of the new character and to find linkages. In 1989, plants of the F_2 generation of following crosses were analyzed in the field: cross 713 - Wt702 x Wt11238, cross 714 - Wt702 x Wt10345, cross 715 - Wt702 x Wt11288, cross 716 - Wt702 x Wt11744, and cross 717 -Wt702 x Wt15860.

Anthocyanin dots were inherited as a monogenic dominant character, in accord with the ratio 3 (dots present): 1 (dots absent) (Table 1). However, expression of the trait was not uniform, i.e. there were plants with stronger (like the parent) and weaker intensity of dotting. Therefore, accepting monohybrid inheritance it is possible that heterozygotes show an intermediate intensity of dotting or that expression of the trait may be influenced by the genetic background. The name "anthocyanin dots" for the character and symbol And for the gene is proposed.

Dihybrid segregation was investigated involving the following markers: A D i k wb s st b M n fa v cp te gp wlo Pl r tl. There was no significant evidence of linkage between And and most of the markers but a significant ($P < 0.001$) joint segregation chi-squared was found for the pair And - D with a recombination fraction of 13.3% (Table 1). These results indicate that the And locus is on chromosome 1 in the D region.

Table 1. Phenotypic distribution in an F_2 population segregating for anthocyanin dots from cross Wt702 (And) x Wt11238 (testerline).

Monohybrid segregation

D	d	Total	Chi-sq. (3:1)
100	24	124	2.10
And	and		
102	41	143	1.03

Dihybrid segregation of D - And (coupling)

D And	D and	d And	d and	Total	Joint chi-sq	Recomb. fract.	SE
87	13	4	20	124	49.0	13.3	3.3

In the second trait investigated, two lines, Wt10225 and Wt423 (P. syriacum), were found in which the seedlings were characterized by the presence of anthocyanin pigment in the stem and leaves. Plots with plants displaying this trait, referred to here as "anthocyanin seedlings", were clearly distinguishable in the field from plots where the plants were of the normal green phenotype and the difference was visible from some distance.

Nozzolillo (2-4) described a similar character named red stemmed plants. The red stemmed plants were selected from line PI356980, which normally produces green plants, and monogenic dominant inheritance was observed. Red stemmed and green stemmed plants were associated with the $\underline{D}^{w}$. and $\underline{D}^{co}$ alleles, respectively, in a segregating population (1). Marx and Nozzolillo (1) stated that $\underline{D}^{w}$ was associated with red stems and $\underline{D}^{co}$ was associated with green steins but it was not explained whether this association was due to pleiotropy or to tight linkage of separate genes.

At Wiatrowo, line Wt10225 (anthocyanin seedlings) was crossed with the following testerlines: Wt11238 (cross 719), Wt11288 (cross 720), Wt11143 (cross 721), Wt10345 (cross 722), Wt15860 (cross 723), and Wt11744 (cross 724). In these crosses anthocyanin seedling segregated as a monogenic trait and the symbol Ans is proposed. Similarly to And, expression of the character was not uniform, i.e. the intensity of anthocyanin pigmentation was variable and it is not clear whether allele And is dominant or partially dominant.

The analysis of dihybrid segregations revealed strong linkage between Ans and D with a recombination fraction of 6% (Table 2). Thus the D segment on chromosome 1 appears to contain several loci concerned with anthocyanin synthesis. Alleiism tests should be conducted to determine if the "red stemmed plants" described by Nozzolillo are controlled by the gene symbolised as And. This test could also reveal whether the association between red stems and allele $\underline{D}^{w}$ is due to pleiotropy or linkage.

Table 2. Phenotypic distribution in an F_2 population segregating for anthocyanin seedlings from cross Wt10225 (Ans) x Wt11238 (testerline)

Monohybrid segregation

Ans	ans	Total	Chi-sq. (3:1)
104	40	144	0.59
D	d		
105	33	138	0.09

Dihybrid segregation of Ans - D (coupling)

Ans D	Ans d	ans D	ans d	Total	Joint chi-sq.	Recomb. fract.	S.E.
97	2	8	31	138	92.3	6.0	2.1

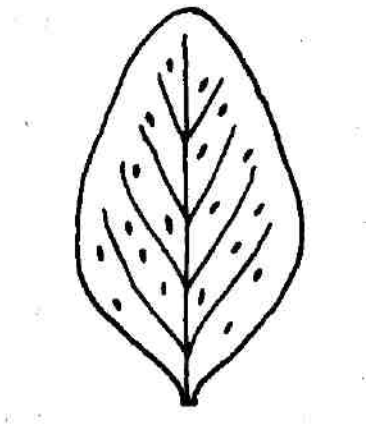

Fig. 1. Typical pattern of anthocyanin dots on a leaflet of line Wt702.

1. Marx, G.A. and C. Nozzolillo. 1979. PNL 11:25-27
2. Nozzolillo, C. 1977. PNL 9:42-45.
3. Nozzolillo, C. 1978. PNL 10:63.
4. Nozzolillo, C. 1979. PNL 11:23.