DETAILED DOCUMENTATION OF THE OBSCURATUM PHENOMENON IN PISUM

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In a line of Pisum sativum (arvense) there appeared the phenomenon long known as obscuratum (1, 3-7, 9), showing a certain percentage of self-colored, violet-black seeds among a large majority of violet spotted ones (F, Fs, or F Fs). The character requires the presence of anthocyanin (A) for expression but it is not heritable. Although the phenomenon has often been observed and described, few data are available providing actual counts and percentages. Tables 1 and 2 give such data gathered in the experimental fields of Bonn in 1983 and 1984. Table 1 shows the numbers of seeds and the percentages of violet-black seeds in seven families derived from individual plants which themselves bore only spotted seeds.

Table 1. Percentages of violet-black and partly colored seeds of seven families of a line of Pisum arvense (1983).

Family no.	No. of seeds	Normally spotted	Self violet-black	Partly colored
1	1861	1789	63 (3.39%)	9 (0.48%)
2	970	947	23 (2.37%)	-
3	1661	1572	82 (4.94%)	7 (0.42%)
4	1560	1528	29 (1.86%)	3 (0.19%)
5	1592	1529	56 (3.52%)	7 (0.44%)
6	609	533	54 (8.87%)	2 (0.33%)
7	511	461	45 (8.81%)	5 (0.98%)

The violet-black seeds from these populations were selected and the 184 plants grown from them were investigated in the field in 1984 (Table 2).

Table 2. Percentages of violet-black and partly colored seeds. All the plants producing these seeds were grown from violet-black seeds.

No. of plants	Total no. seeds produced	No. violet-black seeds	No. partly colored seeds	Total no. in the latter two categories
184	13,110	97 (0.74%)	25 (0.19%)	122 (0.93%)

The 122 self-colored or partly colored seeds were distributed on 24 (13%) of the 184 plants; all 24 plants also bore spotted seeds. Three categories could be distinguished for the colored seeds: five plants bore only violet-black seeds, eight plants bore violet-black and partly colored seeds, and eleven plants had only partly colored seeds, so that the ratio of the first two categories to the last was nearly 1:1 (in four groups of plants we found the following ratios: 6:6 in 71 plants; 2:2 in 48 plants; 3:2 in 44 plants; and 2:1 in 21 plants).

Table 3 gives an example of the distribution per plant for each category (we usually counted from the first fertile node upwards).

Table 3. Examples of the distribution of the three categories of seed coat color phenotype on individual plants.

Plant no.	Pods with number of seeds (if not otherwise state, seed coat color is spotted; vb=violet-black; pc=partly colored.
1	4 (4 vb) - 4 (4 vb) - 6 - 2 - 2 - 6 - 3 - 2 - 5 - 4 - 5 - 1 - 6 - 5 - 5 - 5 - 4 - 5 - 4 - 5 - 5 - 6 - 6 - 2
2	2 - 4 - 5 (1 vb, 2 pc) - 2 - 6 - 5(4vb, lpc) - 5 (4 vb, 1 pc) - 6 - 7 - 4 - 3 - 5 - 4 - 1 - 4 - 5 - 4
3	2 - 5 - 4 - 6 - 4 - 4 - 5 - 5 - 3 - 6 - 6 - 6 - 4 (1 pc) - 7 - 4 - 4 - 3 - 6 - 5 - 5 - 5 - 4 - 5 - 3 - 1 - 4 - 3 - 3 - 2 - 4 - 6 - 6 - 5 (1 pc) 4

Sixteen plants grown from partly colored seeds were also investigated. They produced 1,448 seeds, 35 of which were violet-black and 6 partly colored (2.42% and 0.41%, respectively). The violet-black and partly colored seeds were distributed on 3 (19%) of the 16 plants. All three plants bore violet-black as well as partly colored seeds.

After having crossed the P. arvense line with long P. sativum lines (latter being derived from hybrids between mutant 489C and DGV), the F_2 was investigated for violet-black and partly colored seeds. The phenomenon of somatic instability had also appeared in the F1, but was not counted in larger numbers there. Table 4 gives the details for the three F2 families investigated, but since only A plants produce colored seeds, only their seeds are given in the table.

Table 4. Percentages of violet-black and partly colored seeds in three F_2 families of the cross P. arvense x P. sativum (1983).

Family no.	No. of seeds	Spotted and unspotted seeds	Violet-black	Partly colored
1	859	808	47 (5.47%)	4 (0.47%)
2	1389	1383	4 (0.29%)	2 (0.14%)
3	585	567	16 (2.74%)	2 (0.34%)
	2833	2758	67 (2.36%)	8 (0.28%)

From family No. 3 of Table 4 40 Light brown[1/] seeds were selected (details about segregations for seed coat colors of similar crosses, see Marx [8]). In the 30 F3 plants evaluated in 1984, exactly 1500 seeds were counted, none of which was violet-black or partly colored. The light brown seeds were generally very slightly spotted, but some of them did not show spotting. These F3 plants may have lost the gene (or element) which makes possible the instability to the degree described above. However, as already noted by Lamprecht (4), there may be a certain relationship between the percentage of violet-black seeds and the amount of insolation. In contrast to the sunny summer of 1983 in Central Europe, we had long periods of rain in 1984, which may explain the general differences in the percentages of violet-black seeds produced.

[1/] A discussion of the nomenclature concerning flower and seed coat color is beyone the scope of the present paper. The terms are only descriptively and tentatively used in their normal usage of everyday language.

Freeling (2), commenting on the work of McClintock and the question how insertion elements are recognized, writes (p. 281): "The most common way to recognize an insertion element is when the element lowers or obliterates the expression of a gene, but reverts frequently to the nonmutated phenotype. This genetic instability is usually recognized as variegated somatic tissue." He continues that in maize transposons "are known to reside in each of the eight genes necessary for complete anthocyanin (purple) pigmentation" and that transposons "were discovered at these genes simply because somatic instability is easily recognizable".

The question whether transposons are involved in the obscuratum phenomenon may be answered by future experimental work in molecular genetics.

1. Blixt, S. 1972. Agri Hort. Genet. 30:1-293.
2. Freeling, M. 1984. Ann. Rev. Plant Physiol. 35:277-298.
3. Fruwirth, C. 1909. Arch Rass. u. Ges. Biol. 6:433-469. (Quoted by Blixt, 1972).
4. Kajanus, B. 1913. Fuhlings Landw. Ztg. 62:153-160. (Quoted by Lamprecht, 1956.
5. Lamprecht, H. 1956. Agri Hort. Genet. 14:19-33.
6. Lamprecht, H. 1958. Agri Hort. Genet. 16:49-53.
7. Lamprecht, H. 1974. Monographie der Gattung Pisum.
8. Marx, G. A. 1984. PNL 16:43-45.
9. Rimpau, W. 1891. Landwirthschaftliche Jahrbucher 20:366-369. (Quoted by S. Blixt, 1972).

Acknowledgement: I thank Prof. Marx for providing references to the obscuratum.

Erratum

PNL 16, p. 41

1) There is a typographical error on line 2 of the last paragraph. It should read: "As no Fa plants with..." (Fa instead of fa).

2) Concerning the editor's comment in brackets (line 4, same paragraph) the author maintains he is sure that it was a non-fasciated plant.