*****

- Genetics and Plant Breeding -

TWO CROSSES WITH THE "NEBULOSUS-MOTTLED" VARIETY CONTENDER
(Ane Ane, from the recessive character anebulosus)

R. Prakken
Department of Genetics
Agricultural University
Wageningen, The Netherlands

In 1964 Lamprecht tried to analyse "Die Vererbung eines neuen Typs von Marmorierung der Samen von Phaseolus vulgaris L." (1), based on the analysis of two crosses with the variety Contender. The seedcoat of Contender is "cloudy grayish brown mottled" (veined) on a cartridge buff background (Ane Ane, Fig. 9); it has a brown hilumring (the "hilumring factor" D is hypostatic in relation to the "shine factor" J, that produces a brown hilumring too), and it is shiny and afterdarkening. Genotype: (PP TT) c^uc^u (dd) JJ Ane Ane. It is known that in the c^uc^u-background type the modifying genes G (yellowbrown factor), B (gray-greenish brown factor) and V (violet factor) are almost without influence; the violet flower colour shows that it is VV. In 1968 Nakayama and Saito (2) also tried to analyse two Contender-crosses.

The articles of both authors, Lamprecht and Nakayama c.s., are extremely difficult to penetrate, mainly depending upon the fact that Lamprecht, and in agreement with him Nakayama too, wrongly considered the genes G and B (see above) as colour genes, each of which, together with the basic gene P, should produce a brown hilumring, leaving the remaining part of the seedcoat almost uncoloured. Prakken (3) extensively showed that G and B are not colour genes but merely modifying ones and therefore, together with P only, are of no influence on the (white) seedcoat colour. This misconception about the action of G and B, together with the intricacy of both articles and some difference in explanation between Lamprecht and Nakayama, with the result that, after my retirement in 1969, I studied the Contender-case myself. (In a personal correspondence of Jan.-Feb. 1970 Nakayama wrote that, with respect to the yellowbrown factor G, he had come to the same conclusion as the present author and that, with respect to B, he was not yet sure; he observed that, in the Contender-article, some clear B-colours did not show a brown hilumring.) My own two analyses are discussed below.

1. The cross between Contender and "La Gaude."

The variety Contender showed the usual violet flower and nebulosus-mottled seedcoat; genotype: (PP TT) c^uc^u (dd) JJ gg BB VV Ane Ane zz (for xx cf. below).

The variety "La Gaude" is mentioned in Annual Report of the B.I.C. 18, 1975, p. 61 (4). Its seedcoat is black striped on a cartridge buff background with strong nebulosus-mottling (Ane?), and it is shiny and afterdarkening (J). The flower is violet (V) while its standard shows sharply contrasting blackish violet veins (a character as far I know not analysed before), diverging from the narrow base to the periphery, giving, in the bud

stage, the flower a zebra-striped appearance (ZZ). If the new C-allele for black (non-red) stripes upon an unchangable background (like $c^u c^u$) preliminary is indicated as $C^{L.G.}$, the genotype of "La Gaude" is (also on the ground of other crosses):

(PP TT) $C^{LG}\ C^{LG}$ (DD) JJ gg BB VV Ane Ane ZZ.

The F_1 genotype therefore is (heterozygous loci double underlined):

(PP TT) $C^{LG}\ c^u$ (Dd) JJ gg BB VV Ane Ane Zz

Its seedcoat colour was the same as in the "La Gaude" line itself (black stripes/nebulosus-mottling/cartridge buff), the flower colour violet with a less conspicuous, zebra-veining in the standard.

The F_2-segregation actually was for $C^{L.G.}\text{-}c^u$ and for Z-z only, three small families, together 81 plants:

53 $C^{L.G.}$ (exp. 60.7) + 28 $c^u c^u$ (exp. 20.3).

The fine nebulosus-mottling in the seeds of F_2 usually was stronger than in Contender and not missing in any plant: Ane Ane. Between the black stripes of $C^{L.G.}\ C^{L.G.}$ - and $C^{L.G.}\ c^u$-plants no difference could be found. The accompanying colours, not to be discussed here, behaved as usual: linked with $C^{L.G.}\text{-}c^u$. Very striking was that all striped-seeded $C^{L.G.}$-plants more or less clearly showed the blackish violet zebra-like veins in the standard (Z.), but that in all $c^u c^u$-plants they were completely lacking; conclusion: Z is lying very near the complex locus C or may even belong to it. Further studies are concentrated upon this question.

2. The cross between Contender and Citroenboon.

The Contender-parent belonged to the same line as in cross 1, above.

The seeds of the Citroenboon-parent (flower pale lilac $V^{lae}V^{lae}$) are self-coloured dark pattern type (CC) (pale) greenish yellow (GG bb), without brown hilumring and non-afterdarkening. Genotype:

(PP TT) CC dd jj GG bb $V^{lae}V^{lae}$ ane ane(?) zz.

The F_1-genotype therefore is (segregating loci double underlined):

(PP TT) Cc^u (dd) Jj Gg Bb VV^{lae} Ane ane zz

Leaving out, at first, the segregation for G-g, B-b and Ane-ane, the F_2-plants showed 3 x 2 x 2 = 12 seedcoat types (Table 1).

The segregation for each of the three single gene pairs was:

Table 1. The 12 main seedcoat colour types in F_2 of Contender with Citroen; (dd) jj without brown hilumring and with a white background mottling ($C^{L.G.}c^u$) or completely white ($c^u c^u$).

dark pattern type, CC				heterox mottled type, Cc^u				background type, $c^u c^u$				total
J.V.	J.$V^{lae}V^{lae}$ jj V.	jj $V^{lae}V^{lae}$		J.V.	J.$V^{lae}V^{lae}$ jj V.	jj $V^{lae}V^{lae}$		J.V.	J.$V^{lae}V^{lae}$ jj V.	jj $V^{lae}V^{lae}$		
19	9	3	0	42	13	19	5	19	10	6 (W)	0 (W)	145
20.4	6.8	6.8	2.3	40.7	13.6	13.6	4.6	20.4	6.8	6.8	2.3 exp.	

for C-C^u: 31 CC + 79 Cc^u + 35 c^uc^u (exp. 36.25)
for J-j: 112 J. + 33 jj (exp. 36.25; without hilumring)
for V-V^{lae}: 108 V. + 37 $V^{lae}V^{lae}$ (exp. 36.25; pale lilac flower).

For all three therefore a good agreement with the 3:1 segregation, independent from each other.

As already known the gene pairs G-g, B-b (and V-V^{lae}) are (almost) without influence on the c^uc^u background type. In the dark pattern colour of Cc^u and CC each of the three has its own characteristic influence, more clearly however in the shiny J.-types than in the mat (dd)jj-types. The complete analysis for the three modifying gene pairs, G-g, B-b and VV^{lae} will therefore not be given here. It may only be pointed out that among the 112 J.-plants all seven expected colours were represented: 1. greenish yellow (= schamois), 2. yellowbrown, 3. gray greenish brown, 4. brown, 5. (dark blue violet, 6. (dark) brown violet and (by far the most frequent 7. and 8. black (gg B.V. + G.B.V.).

The influence of Ane is most clearly visible in the c^uc^uJ. background types. The 35 c^uc^u-plants (Table 1) appeared to consist of: 22 (dd) J. Ane. (more or less clear "nebulosus" upon cartridge buff) + 7 (dd) J. ane ane (purely cartridge buff) + 6 (dd) jj..... (purely whiteseeded; Ane not working), probably representing the ratio 9:3:4. In the selfcoloured dark pattern type CC (31 plants) the action of Ane-ane is not at all observable, nor is it in the white background mottling of the 24 (dd) jj Cc^u mottled seeded plants. In the cartridge buff background of the 55 dd J. Cc^u-plants, however, the action of Ane-ane can be observed: it appeared that (almost?) all B.-plants (with the gray-greenish brown factor) were Ane. and (almost?) all bb-plants ane ane, which is in agreement with Lamprecht's suggestion (1, p. 270) of a (rather strong) linkage between B and Ane.

The F_2-results as described above were in agreement with the results of 14 F_3-families, with 16-32 plants per family.

(Presence of the shine-factor J is usually called necessary for the action of Ane; but about an eventual action in D. jj nothing can be concluded, as in the two crosses of all three authors, Lamprecht, Nakayama and Prakken,

the one cross was dd JJ (Cont.) with ... JJ (all F_2-plants JJ) and
the other cross was dd JJ (Cont.) with dd jj (all F_2-plants dd)).

References

1. Lamprecht, H. 1964. Die Vererbung eines neuen Typs von Marmorierung der Samen von Phaseolus vulgaris L. Agri Hortique Genetica 22:256-271.

2. Nakayama, R. and K. Saito. 1968. Genetical studies on kidney beans (Phaseolus vulgaris). IX. Inheritance of a type of marbling on seed-coat in a variety Contender. Bull. Fac. Agric., Hirosaki Univ. 11:9-15.

3. Prakken, R. 1970. Inheritance of colour in Phaseolus vulgaris L. II. A critical review. Mededelingen Landbouwhogeschool, Wageningen, 70-23:1-38.

4. Prakken, R. 1975. A "forgotten group" of seedcoat colours in Phaseolus vulgaris L. Ann. Rep. of the B.I.C. 18:60-62

*****

CROSSES WITH SOME Phaseolus VARIETIES THAT ARE "CONSTANTLY PATTERNED WITH A DARK PATTERN COLOUR"

R. Prakken
Department of Genetics
Agricultural University
Wageningen, The Netherlands

In B.I.C. Annual Report 18, 1975, the present author wrote a note about A "forgotten group" of seedcoat colours in Phaseolus vulgaris L., viz. those varieties with a "constant pattern in the dark-pattern-colour of the ever-segregating-mottling" (6).

Since the beginning of the century two types of mottling have been distinguished, viz. a. ever-segregating-mottling and b. constant mottling.

a/ The ever-segregating type of mottling is in the colours from pale (greenish) yellow to black. It is usually "explained" by accepting that the heterozygote C-c (or c^u) is mottled:
and a darker colour (like that in the homozygous CC = dark pattern colour
a paler colour (like that in the homozygous cc = background colour).

An old alternative explanation is to ascribe the ever-segregating mottling to two genes, (almost) absolutely linked, Yz and yZ, or in more recent symbols Cm and cM, M locally suppressing the darker colour produced by C.

If the basic gene P and the colour gene J (shine factor) are present, the P. CC J. "dark pattern colours", caused by the action of the modifying genes G (yellow brown f.), B (gray-greenish brown f.) and V (violet f.) are usually sharply distinguishable:

1. P. CC J. gg bb vv = pale greenish yellow
2. " " " G. bb vv = yellow brown
3. " " " gg B. vv = gray-greenish brown
4. " " " G. B. vv = (coffee) brown
5. " " " gg bb V. = dark blue violet
6. " " " G. bb V. = dark brown violet
7. " " " gg B. V. = black
8. " " " G. B. V. = black

the corresponding paler "background colours" (cc) will not be discussed here.

b/ In the constant mottling (striping, etc. see Lamprecht (1)), the starting colour of the series 1-8 is not pale greenish yellow but (lilac) red. The red colour is usually ascribed to the multiple allelic series of R: R (selfcoloured red), $R^{m(a)}$ (red mottled), R^{st} (red striped) etc., see Lamprecht 1947 (1). In case of R^{st} and again in the presence of basic gene P and colour gene J, the colour series (of the stripes), caused by the modifying genes G, B, and V is: