MATERNAL TRANSMISSION OF MUTATED PLASTIDS IN THE JAPANESE MORNING GLORY

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(WITH TWO FIGURES)

Chlorophyll variegation, which is commonly found in the Japanese morning glory (*Pharbitis nil*), is transmitted as a simple recessive to the self-green condition. The whitish patches appear somewhat irregularly on the respective leaves of variegated individuals, so that the variegation is regarded as a pattern character. The allelomorphs, normal (self-green) and variegated, are quite constant and no cases of mutations either from normal to variegated or its reverse have come under our notice.

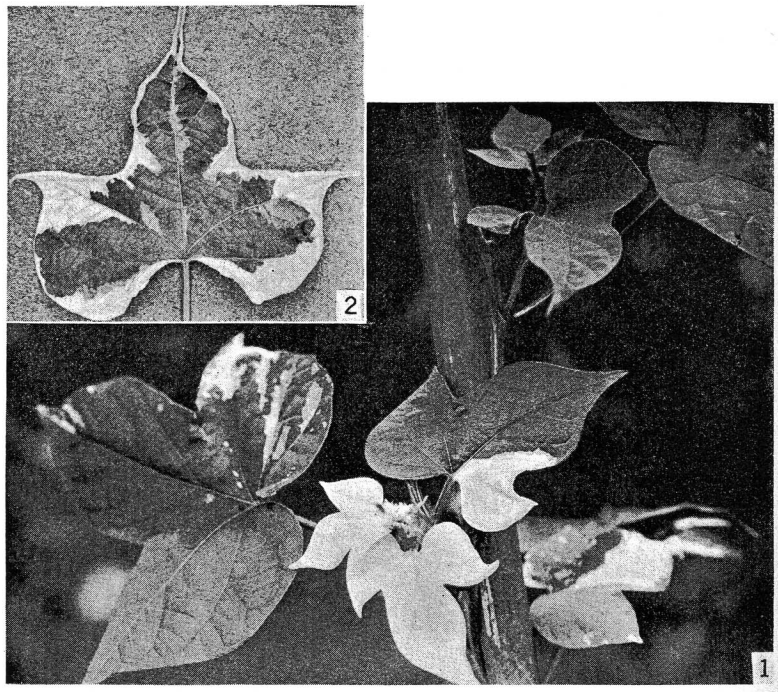
In 1928 three unexpected variants with variegated leaves incidentally occurred in the hybrid progeny of different crosses, their sister plants being invariably self-green. The variegation of these plants differed in color, namely:

1. White; variegation in white.
2. Creamish; at first cream in color and creamish white in the extended leaves.
3. Yellowish; variegated with yellowish color, a little more intense in the young leaves.

The white-variegated variant puts out at times green and white branches (fig. 1) and also chimerical bud variations with periclinal white-over-green tissues. The results obtained from selfing the flowers of these branches are collected in table I.

The albinotic seedlings had short hypocotyls with small cotyledons and perished about two weeks after germination. The green individuals thus segregated bred true to type for generations, while the variegated ones gave rise to three forms in various proportions according to the amount of variegation of the mother plants or of the branches from which the seeds were collected. The slightly variegated branches or individuals gave mostly green seedlings, whereas the highly variegated ones produced mostly albinotic seed-

lings. The variegated segregates were at all events few in proportion compared with the green and white segregates. The chimerical branches shown in table I were of green "cores" with white "skins" (fig. 2); as expected, they produced only albinotic seedlings.



FIGS. 1, 2.—Fig. 1, white-variegated plant, with green (upper right) and white (lower left) branchlets. Fig. 2, chimerical leaf with green core covered with white skin, taken from progeny of the original variegated. The crumpling of the leaf is due to the gene crumpled-1.

At the same time the original variegated plant was crossed with a self-green strain in reciprocal ways, the results being given in table II.

Table II shows that the case is evidently non-Mendelian owing to plastid inheritance. Five green plants obtained by cross green ♀ ×variegated ♂ were selfed and they bred true to type in the subsequent generation, as expected. In experimenting with the other variegated mutants, the same procedure was followed, when it was

found that both creamish and yellowish plastids were inherited maternally out of Mendelian rule. Up to the present a considerable number of cases of plastid inheritance have been studied, and recently DE HAAN (1) made a collection of available data to that date, to which he added his own criticisms.

The origin of the variegation in these variants of the Japanese morning glory is due to sporadic occurrences of plastid mutations.

TABLE I

OFFSPRING OF WHITE-VARIEGATED VARIANT, SHOWN SEPARATELY ACCORDING TO TYPES OF BRANCHES

CHARACTER OF BRANCH	GREEN	VARIEGATED	ALBINOTIC	TOTAL
Green	69	.....	.....	69
Variegated	168	10	38	216
White	.....	.....	28	28
Chimerical	.....	.....	15	15

TABLE II

OUT-BREEDING DATA OF WHITE-VARIEGATED VARIANT

CROSS	GREEN	VARIEGATED	ALBINOTIC	TOTAL
Green×white	66	.....	.....	66
White×green	.....	.....	24	24
Green×variegated	48	.....	.....	48
Variegated×green	25	3	19	47

Let us suppose that one of the green plastids, contained in an embryonic cell of the original white-variegated plant (variegation had appeared already at the seedling stage), had mutated to a white one and had a chance to propagate in a cell or cells of the growing point of the seedling. This is one of the most likely explanations to account for the origin of the variant. For the other two cases of variegation, similar mutations would take place, but from green to creamish or yellowish and possibly at different times of somatogenesis (variegation appeared later when the plant began to take on a luxuriant growth). In these cases the plastid mutations were sporadic in their occurrence (not mutable) and the mutated plastids never reverted to their prototype so far as we could observe. Prior to this, IMAI

(2) observed plastid mutations in this plant and wrote: "I have met with two or three cases, in which the variegated leaves or branches were produced on self-green plants, in my own culture. The appearance of variegation on the self-coloured leaves was due not to a factor mutation, but to a plastid mutation, their transmission, therefore, being non-Mendelian." In another publication (3) he gave a short note on the occurrence of the three forms of plastid mutations which we are investigating at present. In Asagao-Sô, a classical monograph of the Japanese morning glory published in 1817, we find two colored pictures of different specimens, each showing a mosaic of green and variegated colorations of leaves (2, figs. 6 and 7). Although, as pointed out by IMAI, the colors are somewhat exaggerated, the depiction of such mosaics is no doubt explained by the fidelity of the earlier authors to facts in their drawings and descriptions. Two possible explanations may be suggested to account for the origin of the mosaic specimens; namely, gene mutations occurring vegetatively from green to variegated, or plastid mutations from green to white. As the chances for the former seem more remote than the latter in this plant, we are inclined to accept the latter view also in these classical cases.

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