A CHLOROPHYLL MUTANT WITH TWO SITES OF EXPRESSION

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In 1977 one F_2 population among several from the same cross contained some abnormal plants with variegated or mottled leaves. Other plants in the same population showed evidence of another, possibly different, disorder marked by a diffuse paling of the leaves due to a reduction in chlorophyll, principally in the central portion of the leaflets (Fig. 1). The affected leaves were rarely, if ever, totally devoid of chlorophyll and not all leaves were affected, so most mutant plants survived and produced seeds.

All surviving F2 plants were progeny tested. The F3 progenies were variously composed of seedlings that were normal, those with variegation and those with the reduction in chlorophyll. Reduced fertility was common. Selection was practiced in these F3 progenies and eventually lines were developed which exhibited the chlorophyll condition without the variegation. The selection process also led to improved fertility. It also became apparent during the selection process (through Fg) that the expression of the chlorophyll disorder varied considerably. Field-grown plants and those grown in silica sand expressed symptoms early in the seedling stage and often a reduction in chlorophyll was evident on all leaves produced thereafter. In one instance, however, greenhouse-grown plants showed chlorosis of a single leaf borne at the 5-6 node stage of development. Occasionally some inbred plants derived from mutant plants failed to produce symptoms at all. Later in the course of inbreeding and selection it was noted that affected plants expressed -a second more consistent and characteristic symptom: the pods exhibited irregular yellow stripes along the adaxial suture (Fig. 2).

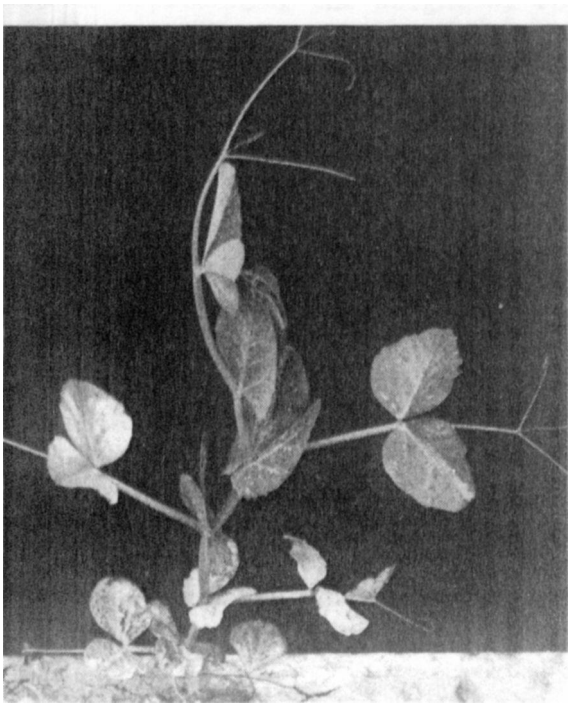

Fig. 1. Phenotypic expression on leaves of plants carrying a newly isolated chlorophyll mutant.

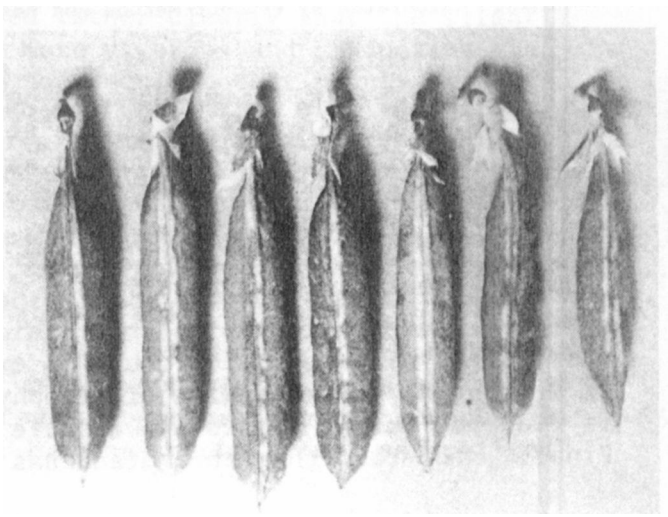

Fig. 2. Phenotypic expression on pods of plants carrying same mutant shown in Fig. **1** (color photo converted to black and white.

Once the lines had been selected for near normal fertility and consistent mutant expression, they were used in exploratory crosses with other lines in an attempt to localize the mutant. Table 1 presents the segregation of the mutant in **F2**'s in which no linkage was noted. There was a decided deficiency of mutant plants in these populations. Twenty-one normal green segregants from this **F2** population were progeny tested. Twelve progenies segregated, giving a collective ratio of 201 normal : 48 chlorotic. Again, a deficiency of mutants was evident. This was not the case, however, in another population in which the chlorophyll mutant showed linkage with wa on chromosome **2,** the single gene segregation ratios for the marker and mutant alike being very close to 3:1 (first pop., Table 2). The calculated percent recombination in the repulsion phase cross was 18**.7+/-**6. The two CrO plants recovered from that **F2** were then grown in **F3** and used as parents in coupling phase crosses. The results (second pop., Table **2)** verified the linkage between the chlorophyll mutant and wa, but once again there was a significant deficiency of mutant plants. The marker gene, wa, also showed a deficiency.

Table 1. Segregation in F_2 for normal green and chlorotic plants.

Population	Number		
	Normal	Chlorotic	Total
B279-236-254	333	68	401
$X^2_{[3:1]}$ = 13.8***			

Table 2. Joint segregation for an unnamed chlorophyll mutant and wa in F_2 of two crosses, one in repulsion and the other in coupling.

	Phase	Wa Chlor	Wa chlor	wa Chlor	wa chlor	Total	Chi-square Wa-wa	Chi-square Chlor-chlor	% Recomb.
B279-219-235	R	115	57	53	2	227	NS	NS	18.7±6
B280-769-792	C	462	29	39	84	614	8.08**	14.96***	13.2±2 1/

1/ Linkage calculated by Product Method and not adjusted for disturbances in single gene ratios.

Table 2. Joint segregation for an unnamed chlorophyll mutant and wa in F, **of** two crosses, one in repulsion and the other in coupling.

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-^Linkage calculated by Product Method and not adjusted for disturbances in single gene ratios.

Naming of this mutant will be deferred until Dr. Blixt compares the phenotype with other chlorophyll mutants in his collection and completely excludes the possibility that the mutant has not been previously isolated. Overall, this mutant has a number of virtues from a genetic and physiological point of view. The mutant shows rather clear-cut expression in the seedling stage so it has value as a seedling marker. Mutant expression occurs during ontogeny and expression is separated with respect to time, space, and tissue. Also, mutant expression is subject to considerable environmental variation, suggesting that phenotypic expression could be experimentally manipulated in the process of seeking an understanding of its physiologic basis. Although chlorophyll is reduced, mutant plants are capable of surviving and producing seeds. Finally, the fact that the mutant has been localized adds to its value.