IMMUNITY TO PEA SEEDBORNE MOSAIC VIRUS: A REASSESSMENT

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Immunity to pea seedborne mosaic virus (PSbMV) was reported to be conferred by a single recessive gene, designated sbm (2). However, infected susceptible plants show an array of symptom expression (4, 5), and plants initially identified as PSbMV-immune have sometimes proved to be susceptible just before plant maturity (Hampton, unpublished results). Some breeders attempting to develop disease-resistant pea cultivars have therefore begun to question whether PSbMV-immunity is indeed conferred by a single gene. These circumstances prompted us to re-examine the genetic control of immunity, Details of this study will be published separately, but here we wish to confirm previous analyses (1, 2) and to discuss how the results might be applied in breeding programs.

Four different USDA Plant Introduction (P.I.) accessions, three of which were recently reported to be immune to PSbMV (3), were used as parents in reciprocal crosses with a common susceptible line. The susceptible parent, WL-1255A[1/], was also homozygous recessive for wlo, the wax gene reported by Gritton and Hagedorn (1) to be linked with sbm. Susceptible marker parent WL-1183 reported by these workers, like WL-1255, also carried the edible-pod gene, p, which is linked with wlo on chromosome 6. One of our resistant parents, P.I. 193586, had been included in the investigation by Hagedorn and Gritton (2).

Our results clearly confirm those previously reported (1, 2), showing that resistance is conferred by a single gene pair, linked with wlo on chromosome 6 (Table 1). Our segregation ratios were determined after the plants were repeatedly inoculated with PSbMV and then rigorously examined for presence of disease symptoms. Moreover, all progenies remaining symptomless for 60 to 90 days after PSbMV-inoculations were assayed repeatedly on Chenopodium amaranticolor.

In view of the technical difficulties of screening for PSbMV-immunity by conventional methods and of the demonstrated potential for mistaking tolerance for immunity, it would seem desirable to consider the use of marker genes closely linked to sbm as preliminary indicators of susceptible or immune plants, in lieu of PSbMV-inoculation. Ideally, the marker gene used to identify resistant plants would be visible in the seedling stage and be at least horticulturally neutral, if not beneficial. Although the waxless (wlo) plants can be easily scored early in seedling development, they may be considered horticulturally undesirable because the waxless surfaces of the leaflets predispose the plant to damage by post-emergence applications of herbicides now commonly in use. Still, this problem ultimately may prove less serious than it presently seems. Newer herbicides such as trifluralin are applied as a pre-emergent treatment and it is not yet known whether pea plants with wax genes are adversely affected by herbicides applied in this manner. Nor is it known whether wlo or other wax mutants are horticulturally undesirable in their own right, i.e. in the absence of pesticides. Moreover, should the afila gene gain commercial acceptance, cultivars with wlo may not be injured by herbicides since wlo affects only the upper surface of the leaflets and since the leaflets in af plants are converted to tendrils. Thus, it may be unwise to dismiss wlo as deleterious without further evaluation.

1/ - Furnished by Dr. Blixt

Table 1. F_2 segregation of pea seedborne mosaic virus resistance (sbm) and reduced leaf wax (wlo).

Parent crossed with L-1255		Sbm/- Wlo/-	Sbm/- wlo/wlo	sbm/sbm Wlo/-	sbm/sbm wlo/wlo	Total N	Total P
PI 193586	Obs.	145	71	52	0	268	
	Exp.	134	67	67	0		
	X^2	0.90	0.24	3.36			4.50
PI 347485	Obs.	148	55	49	2	254	
	Exp.	127	63.5	63.5	0		
	X^2	3.47	1.14	3.31			7.92
PI 347494	Obs.	201	123	96	1	421	
	Exp.	210.5	105.2	105.2	0		
	X^2	0.43	3.01	0.80			4.24
PI 378158	Obs.	115	64	48	0	227	
	Exp.	113.5	56.7	56.7	0		
	X^2	0.02	0.94	1.33			2.29

Even if wlo should prove to be horticulturally undesirable, it still might serve effectively, though indirectly, in developing a group of breeding lines with resistance to PSbMV. In this approach a line carrying sbm and wlo in the coupling phase would serve as a parent in crosses with a range of susceptible breeding lines. Selection would then be practiced, as suggested before, on the basis of the presence or absence of wax, i.e. discarding all normal wax segregants and retaining waxless plants which also have horticultural merit on other grounds. After further selfing and selection, a selected number of wlo breeding lines would be tested by conventional means to confirm the presence of sbm; crossover plants (Sbm-wlo) would be discarded. This diverse group of breeding lines could then be used in a second round of crosses with a line(s) carrying resistance in the repulsion phase, i.e. sbm Wlo. Selections in this second round of crosses would again be practiced on the basis of the presence or absence of wax as well as on horticultural merit, but in this case the normal wax plants would be retained and the wlo segregants would be discarded because all the progeny would be homozygous for sbm.

The second closely linked gene, p, (for edible poddedness), has the disadvantage of being an adult plant character. Gene p could nonetheless be used in combination with sbm either alone or together with wlo, especially if the objective were to develop edible-podded cultivars.

It must be emphasized again that breeders who take advantage of the linkage wlo-p-sbm, either along the lines outlined above or in some other way, should take the necessary precaution of testing their material for immunity at crucial steps along the way.

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