Effect of Seed Size and Condition on Transmission of Pea Seed-borne Mosaic Virus

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The cooperation of the Green Giant Company and statistical treatment of the data by S. M. Saad are gratefully acknowledged.

Approved for publication by the Director of the Research Division of the College of Agricultural and Life Sciences, University of Wisconsin.

ABSTRACT

A technique to demonstrate seed transmission of the pea seed-borne mosaic virus (PSbMV) is described. There was no significant difference in percentage seed transmission of the virus between seeds sized in the range 12/64 through 19/64. There was a highly significant difference between seed transmission of the virus by seeds with seed coats showing growth cracks and seeds with intact seed coats. The former transmitted at a 33% rate; the latter, 4%. Presence of the virus did not reduce seed germinability. Phytopathology 60:1148-1149.

Additional key words: Pisum sativum, plant growth chamber, quartz sand, select environmental ditions.

A pea seed-borne mosaic virus (PSbMV) somewhat similar to one described by Inouye (2) in Japan in 1967 was found in the United States in 1968 in Washington and Wisconsin. The virus was transmitted through seed harvested from infected pea plants in Wisconsin to at least 10% of the developing seedlings. Because the virus can be readily transmitted by the pea aphid, *Acyrthosiphon pisum* (Harris), and the peach aphid, *Myzus persicae* (Sulzer) (2, 3), seed transmission, as a means of introducing primary inoculum, becomes especially significant. Seed producers need techniques to determine the presence or absence of PSbMV in their seed lots. The research reported here is an initial effort to help in the development of these techniques.

MATERIALS AND METHODS.—A procedure was developed to demonstrate seed transmission of the virus in peas (*Pisum sativum* L.). Pea seed harvested from field-grown Perfection-type peas in Wisconsin, many of which showed severe disease symptoms, were planted in white silica sand in a plant growth chamber at 21-22 C and a 12-hr photoperiod. Seedlings were watered with Hoagland's Solution C (1) every 3rd day and with tap water each intervening day. Initial readings on germinated and infected seedlings were recorded 14 to 16 days after planting. Following the first reading, the temp was raised to 28-31 C, and subsequent readings were taken at 7 and 14 days thereafter. These environmental conditions provided for max germination and optimum disease expression.

Infected seedlings were characterized by stunting and a downward curling of the leaves. To check on the presence of virus in plants exhibiting these symptoms, individual plants were selected at random and triturated with a mortar and pestle in 2 ml distilled water, and the mixture was rubbed onto Carborundum-dusted leaves of the highly susceptible pea cultivar, Dark Skinned Perfection. Results were read after 2 weeks.

To study the relationship of seed size to seed transmission of PSbMV, seeds collected in 1968 from pea plants in a Wisconsin field plot showing severe damage due to the disease were sized, using seven metal sieves graduated into 1/64 of an inch. Peas in each sieve size group contained various percentages of seeds that showed growth cracks in the seed coat (Fig. 1). (Close examination of this photograph will show that these growth cracks in the testa have been largely "healed"; mechanical cracks occurring at harvest or in processing do not heal.) To determine if these growth cracks were associated with seed transmission of the virus, seeds showing this symptom were removed from those with intact seed coats and planted separately. At least 40 seeds were used in each of the treatments. Seeds were grown as described above. Two complete trials were made. Data were statistically analyzed using Duncan's multiple range test.

RESULTS.—Initial seed transmission experiments, using seeds without consideration of seed coat condition, showed that all seed size groups contained a similar percentage of seed capable of transmitting the virus, about 10%. Since results of the two trials were similar, they were combined and summarized in Table 1.

Germination of seeds with intact seed coats was excellent. Even when virus transmission percentages of 7 and 8 were obtained, germination was 100%.

TABLE 1. The relationship of seed coat condition and seed size in peas to seed transmission of the pea seed-borne mosaic virus[a]

	Seed coat condition			
	Growth cracks		Intact	
Seed size	% Germination	% Virus transmission	% Germination	% Virus transmission
12 R[b]	82a[c]	25[d]	94[d]	6[d]
12 O	88ab	24	99	1
13	89ab	34	90	1
16	93b	40	97	4
17	94b	37	100	3
18	96b	29	100	7
19	96b	39	100	8
Avg	91	33	97	4

[a] Data are averages of two trials.

[b] Seed sized 12 was seed which passed through 12/64 inch holes in a metal sieve. R = round holes; O = oval holes. 13/64-19/64 inch openings were oval holes.

[c] Any two means followed by the same letter do not differ significantly (.05) from each other according to Duncan's multiple range test of significance.

[d] No significant difference among the treatments based on Duncan's multiple range test.

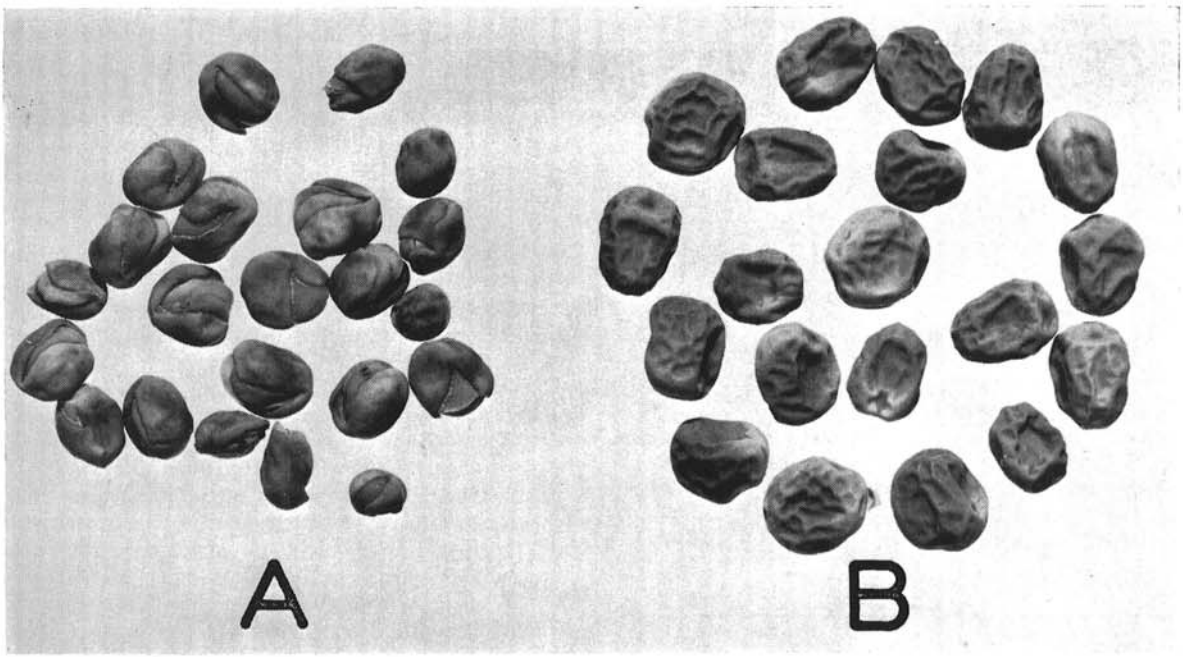

Fig. 1. Perfection-type pea seed. **A)** Growth cracking of the seed coat associated with high percentages of seed transmission of the pea seed-borne mosaic virus; **B)** normal pea seeds.

Germination of seed with growth cracks in the seed coat was also very good, except that small seeds which passed through a $^{1}\%_{64}$ round-hole sieve did not germinate as well.

A significantly greater percentage of seed showing growth cracks of the seed coat transmitted PSbMV (33%) than did those with intact seed coats (4%). Seed size had no significant effect on seed transmission, however.

Discussion.—The striking positive relationship between high rates of PSbMV transmission by pea seed and seed showing growth cracks of the seed coat provides a useful clue in determining whether or not a given lot of pea seed may be carrying PSbMV. Routine attempts to evaluate the percentage of pea seeds carrying PSbMV might well start with seeds showing growth cracks. It should be pointed out, however, that some virus-free pea seed lots have long been known to contain various percentages of seeds with growth cracks in the seed coat. Conversely, the authors observed in 1969 that certain pea seed lots were capable of transmitting PSbMV without growth cracks of the seed coat being visible.

A given lot of pea seed known to transmit PSbMV at a 10% rate was "improved" (transmission reduced to 4%) by removing seeds showing growth cracks of the seed coat. Even if this were possible on a commercial scale, a 4% transmission rate might prove to be too high, as the virus appears to be readily transmitted in the field. Thus, secondary spread from 4% of the plants could cause serious loss.

The use of white silica sand as a germination and seedling growing medium, and a plant growth chamber to provide uniform growing conditions, may well have worthwhile advantages. Developing symptoms could then be reliably attributed to PSbMV and not to other causes. Even so, it is important to spot check interpretation of the symptoms by inoculation to a known host plant such as Dark Skinned Perfection peas.

LITERATURE CITED

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