Seed Transmission of Bean Common Mosaic Virus in Phasemy Bean

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Accepted for publication 12 May 1976.

ABSTRACT

PROVVIDENTI, R., and S. W. BRAVERMAN. 1976. Seed transmission of bean common mosaic virus in phasemy bean. Phytopathology 66:1274-1275.

Bean common mosaic virus (BCMV) was seed-transmitted in five of 26 accessions of phasemy bean (*Macroptilium lathyroides*). The rate of transmission ranged from 5 to 33%, with the higher percentage from progenies of plants derived from infected seeds. The virus was localized in the embryos but not in the testae. None of the 26 accessions was resistant to two isolates of BCMV from bean (*Phaseolus vulgaris*) and one from phasemy bean. However, resistance to BCMV was found in six accessions of a related species, *M. atropurpureum*, commonly known as siratro.

Bean common mosaic virus (BCMV) has been reported to be seed-borne in bean (*Phaseolus vulgaris* L.) (6), in case-knife and scarlet runner beans (*P. coccineus* L.) (1), in tepary bean (*P. acutifolius* Gray, var. *latifolius* Freeman) (4), and in mung bean [*Vigna radiata* (L.) Wilczek (synonym: *P. aureus* Roxb.)] (2). In a study to assess resistance to powdery mildew in phasemy bean [*Macroptilium lathyroides* (L.) Urb. (synonym: *P. lathyroides* L.)], five of 26 accessions of this species yielded seedlings with symptoms indicative of viral infection. This report presents evidence that BCMV also is seed-transmitted in *M. lathyroides*.

MATERIALS AND METHODS

Seeds of 25 accessions of phasemy bean were obtained from the U.S. Department of Agriculture's Western and Southern Regional Plant Introduction Stations (Pullman, Washington, and Experiment, Georgia, respectively), and those of one accession were derived from the seed collection of the Food and Agriculture Organization (FAO), Rome, Italy.

For virus identification, leaves of infected plants were triturated in 0.05 M potassium phosphate buffer, pH 7.0, and extracts were rubbed onto leaves of the following diagnostic species: *Chenopodium quinoa* Willd.; *Cucumis sativus* L. 'Marketer'; *Glycine max* (L.) Merr. 'Corsoy' and 'Harosoy'; *Macroptilium lathyroides* (L.) Urb. 'FAO 13382'; *Nicotiana tabacum* L. 'Havana 423'; *Phaseolus vulgaris* L. 'Black Turtle 1', 'Black Turtle 2', 'Bountiful', 'Great Northern 1140', 'Improved Tendergreen', 'Michelite 62', 'Puregold Wax', 'Red Mexican UI-34', 'Red Mexican UI-35', and 'Topcrop'; *Pisum sativum* L. 'Bonneville' and 'Ranger'; and *Vigna unguiculata* (L.) Walp. 'Early Ramshorn'. Crude extracts from infected phasemy bean leaves, degraded with 3.5% pyrrolidine, were used in gel double-diffusion tests [No. 2 Ionagar, 0.75% (w/v) dissolved in saline (0.85% w/v NaCl), containing 0.02% sodium azide] against an antiserum to BCMV prepared by Uyemoto et al. (8). To determine the presence and distribution of the virus, seeds from infected plants were soaked for 16 hours in distilled water and then dissected. Testae and embryos were surface-decontaminated with running water for 30 minutes and ground individually with potassium phosphate buffer (1:2, w/v). Extracts were rubbed onto leaves of bean cultivars VC-1822 and Black Turtle 2, which are local and systemic hosts of BCMV, respectively.

The reaction of phasemy bean lines to BCMV was assessed by inoculating six to 24 plants of each line with two recognized isolates of the virus, NY67-85 and NY68-95 (4), and also with isolate NY75-57 from phasemy bean P.I. 330592. Plants were mechanically inoculated when they had reached the three- to four-leaf stage, after examination for freedom from seed-borne infection. All experiments were conducted in an insect-free greenhouse maintained at 27 C.

RESULTS

Virus detection and identification.—Viral infection was detected in five of twenty (5/20) seedlings of P.I. 330345, in 1/20 of P.I. 330350, in 2/21 of P.I. 330353, in 1/20 of P.I. 330590, and in 9/110 of P.I. 330592. Although initial symptoms were discernible on the primary leaves of a few seedlings, prominent mottle, cupping, and distortion occurred usually on the first trifoliate leaves. Subsequent growth was stunted and leaves were small, mottled, and puckered. All 18 infected plants yielded virus isolates that caused chlorotic local lesions on *C. quinoa*, and systemic green mottle, leaf curling, and puckering on leaves of cultivars Black Turtle 2, Bountiful, and FAO 13382. The other bean cultivars, Black Turtle 1, Great Northern 1140, Improved Tendergreen, Michelite 62, Puregold Wax, Red Mexican UI-34, Red Mexican UI-35, and Topcrop did not develop

systemic infection. These cultivars have been used to differentiate strains of BCMV (3, 4, 7). The other hosts (cowpea, cucumber, pea, soybean, and tobacco) were not infected. In immunodiffusion tests, crude leaf extracts from the 18 infected plants reacted with a BCMV antiserum. The precipitate formed a continuous line, whereas no reaction was visible with sap of healthy plants of pyrrolidine controls. Leaf dip preparation of virus-infected phasemy bean plants, negatively stained with 2% (w/v) potassium phosphotungstate (pH 6.5), revealed a number of flexuous rods about 750 nm long. All these tests indicated that BCMV was the causal agent infecting seedlings of phasemy bean.

Seed transmission in experimentally infected plants.—To confirm seed transmission of BCMV in phasemy bean, healthy plants of P.I. 367856 were inoculated with the two isolates of the virus from bean, and one from phasemy bean. Seeds from infected plants were planted in pasteurized soil after 12 weeks of dormancy and kept in an insect-free greenhouse. Infection occurred in 7/79, 6/126, and 3/63 seedlings that had derived from plants infected with isolates NY67-85, NY68-95, and NY75-57, respectively. Seeds of a plant of P.I. 367856 infected with isolate NY75-57 were used for direct tests for the presence and distribution of the virus. The virus was recovered from 10 of 65 embryos, but not from any of the testae.

Rate of virus transmission in progenies of plants infected through seed.—In bulk seed of P.I. 330592, nine of 110 plants were virus-infected. When three of these infected plants were allowed to produce seeds, they yielded a higher proportion of virus-infected seedlings (29/108, 35/105, and 17/58). Prior to being planted, the seeds had been kept in storage for 6 months.

Reaction of phasemy bean lines to isolates of bean common mosaic virus.—All of the inoculated plants of the following 26 accessions were susceptible to three isolates of BCMV: P.I. 276183, P.I. 276185, P.I. 285102, P.I. 330344, and FAO 13382 (Australia); P.I. 292347 (Bolivia); P.I. 310293 and P.I. 330349 (Brazil); P.I. 330591 (Denmark); P.I. 316464 (Fiji); P.I. 280130, P.I. 330345, and P.I. 330590 (Guyana); P.I. 330353 (Hawaii); P.I. 330351, P.I. 330352, and P.I. 367856 (India); P.I. 286301 (Ivory Coast); P.I. 295335 and P.I. 330348 (Mexico); P.I. 276184 (Papua New Guinea); P.I. 330350 (The Philippines); P.I. 341219 (Puerto Rico); P.I. 330346 (Senegal); P.I. 330592 (Surinam); and P.I. 279600 (Taiwan). Plants of P.I. 315737 (Puerto Rico) were resistant to BCMV isolates, but foliage, flowers, and pods indicated that this line was not phasemy bean. Symptoms caused by isolate NY67-85 and NY68-95 (from bean) were essentially similar to those incited by isolate NY75-57 (from phasemy bean). Plants of P.I. 280130, P.I. 292347, P.I. 310293, P.I. 330349, and P.I. 330350 reacted with bright chlorotic vein banding followed often with a diffuse chlorosis, whereas those of P.I. 330348 and P.I. 341219 responded with necrotic local lesions, stem streak, apical necrosis, and premature death. All the other lines exhibited varying degrees of stunting, mosaic, and leaf distortion.

Resistance to bean common mosaic virus in Macroptilium atropurpureum.—Since all 26 accessions of *M. lathyroides* were susceptible to BCMV, an attempt was made to determine the reaction of a closely related species, *M. atropurpureum* (DC.) Urb. (synonym: *P. atropurpureus* DC.) commonly known as siratro. Twelve to 20 plants of P.I. 316463 and P.I. 318685 (Australia); P.I. 322577 (Brazil); P.I. 195793 and P.I. 312134 (Guatemala); and P.I. 307599 (Mexico) were inoculated with virus isolates NY67-85, NY68-95, and NY75-57. None of the plants was systemically infected by these BCMV isolates, but isolate NY67-85 and NY68-95 were recovered from symptomless inoculated leaves.

DISCUSSION

Although susceptibility in *M. lathyroides* to BCMV had been previously established (5), this is the first report of seed transmission in this species. No references were found in the literature concerning the incidence of BCMV in countries where phasemy bean is grown. However, we detected this virus in seeds collected in such diverse areas as Guyana, Hawaii, The Philippines, and Surinam. The adverse effect of BCMV infection in phasemy bean was established in our greenhouse tests. Plants of two accessions were so severely infected that they died prematurely. Other accessions reacted with varying degrees of stunting and mosaic, and many plants might have died under the stress of field conditions. Therefore, if seed lots containing BCMV-infected seed are used in an area where a vector of the virus is present, the initial infection from seed may create a threat to the entire crop.

Bean common mosaic virus can be controlled best by growing resistant cultivars to eliminate the main source of the virus, the infected seeds. None of the 26 accessions of *M. lathyroides* was resistant to BCMV. However, accessions of a related species, *M. atropurpureum,* are potential sources of BCMV resistance that might be incorporated in phasemy bean by interspecific crossing if that should prove feasible. In addition, the resistance to powdery mildew found in *M. lathyroides* could be transferred to *M. atropurpureum,* a susceptible species.

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