A New Strain of Andean Potato Mottle Virus from Brazil

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ABSTRACT

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The host range of a virus causing severe mosaic and crinkle of potato plants in Santa Catarina, Brazil, was similar to that of Andean potato mottle virus (APMV). Comparative host range with two strains of APMV, serological studies, and other properties indicated that the virus from Brazil (APMV-B) is a different strain. This virus caused more severe symptoms in host plants, and symptoms in potato can be confused with those induced by other potato viruses.

Andean potato mottle virus (APMV), a member of the comovirus group, was first recognized in Peru (3), where it is widespread in potatoes. APMV has also been found in a germ plasm collection in Chile (2) and symptoms have been observed in potatoes in Bolivia and Colombia (L. F. Salazar, *unpublished*). The virus has been experimentally transmitted by *Diabrotica viridula* under glasshouse conditions (J. A. Abad and L. F. Salazar, *unpublished*). So far, this virus seems to be restricted to the Andean region of South America, where two serologically distinct strains have been identified (4). This paper reports its occurrence in Brazil (isolate B) and its relationship to strains H and C (type strain) of APMV.

MATERIALS AND METHODS

Virus isolation and maintenance. Isolate B was isolated from potato cultivar Delta plants grown in a seed field at Canoinhas, SC, Brazil, in April 1982. These plants showed severe mosaic and crinkle (Fig. 1). Some plants showed yellow blotching of the leaves. These plants constituted the second generation of tubers imported from Sweden. The virus was transmitted by sap inoculation and maintained in *Nicotiana clevelandii* or *N. glutinosa*. Strains C and H of APMV (3) obtained from the virus collection at the International Potato Center (CIP) were cultured in plants of *N. clevelandii*.

Virus purification. Strains B, C, and H were purified from systemically infected leaves of *N. clevelandii* following the procedure of Salazar and Harrison (4). Virus preparations were layered on 10–40% sucrose density gradients and centrifuged for 90 min at 20,000 rpm in a Beckman SW 25.1 rotor.

Serology. Antiserum to strain B was produced by injecting a rabbit intravenously with 2 mg of purified virus followed by three weekly intramuscular injections or 1, 2, and 2 mg of virus, respectively, in Freund's incomplete adjuvant. Antiserum (titer 1:512 to 1:1,024 in gel double-diffusion test) was collected 2 wk after the final injection. Double-diffusion serological tests were made in 0.7% agarose containing 0.85% NaCl. Antigen and antiserum samples were diluted with saline.

RESULTS

Comparative host range. Unlike strains C and H, strain B caused local chlorotic lesions and systemic mosaic on *Solanum villosum* (Fig. 2) and *Datura stramonium* (Table 1). Lesions were not produced consistently, so these hosts cannot be used as local lesion assay hosts. Strain B infected all hosts susceptible to strains C and H, although symptoms were usually more severe and occasionally killed infected plants of *Physalis floridana* (Fig. 3). Symptoms of APMV-B on potato cultivar Delta were similar to those found on naturally infected plants (Fig. 1).

General properties of strain B. Properties of APMV-B in *N. clevelandii* were determined by systemic infectivity in *N. clevelandii* or *P. floridana*. Infectivity was lost by heating for 10 min at 70–75 C or by dilution at 10^{-7}. Sap remained infective after incubation for 3 wk at room temperature or 6 wk at 4–8 C. In these properties, strain B is similar to the type strain (3).

Particle properties of strain B. Purified preparations of strain B contained isometric particles about 28 nm in diameter and some were penetrated by stain (1% uranyl acetate, pH 4.5). Centrifugations in sucrose density gradients showed three components (T, M, and B) with sedimentation coefficients similar to those of isolate C (53, 93, and 112S) (4). Polyacrylamide gel electrophoresis of purified preparations of isolate B also yielded two polypeptides with estimated molecular weights of 22,000 ± 400 and 40,000 ± 600 (three experiments), close to the values of 20,800 and 40,100 estimated for the type strain of APMV (3). Purified, unfractionated preparations of strain B also contained two nucleic acid species estimated by polyacrylamide gel electrophoresis to be of similar molecular weight to those of strain C (1.3 and 2×10^6) (4).

Serological relationships. When antiserum for strain C was compared in gel-diffusion serological tests against strains B and H, a single precipitin line that spurred over those of the heterologous strains was produced (Fig. 4). Similarly, an antiserum prepared to strain B produced spurs when compared with the other strains.

Intragel absorption of antiserum to

Table 1. Comparison of symptoms produced by three strains of Andean potato mottle virus on selected hosts

Species	Strain H	Strain C	Strain B
Nicotiana clevelandii	M[a]	M	MS, Ld
N. tabacum 'Samsun'	O	M	MS
N. benthamiana	M	M	MS, Ld
Solanum villosum	SS	–	LC, MS
Datura stramonium	O	M	LC, MS
Gomphrena globosa	SS	SS	SS
N. rustica	M	M	MS
Physalis floridana	M	M	MS, Ld, D
S. tuberosum 'Delta'	SS	–	MS

[a] Symptoms: M = mild mosaic, MS = severe mosaic, SS = susceptible without symptoms, LC = local chlorotic spots, Ld = leaf deformation, O = not infected, D = death of plants, and – = not tested.

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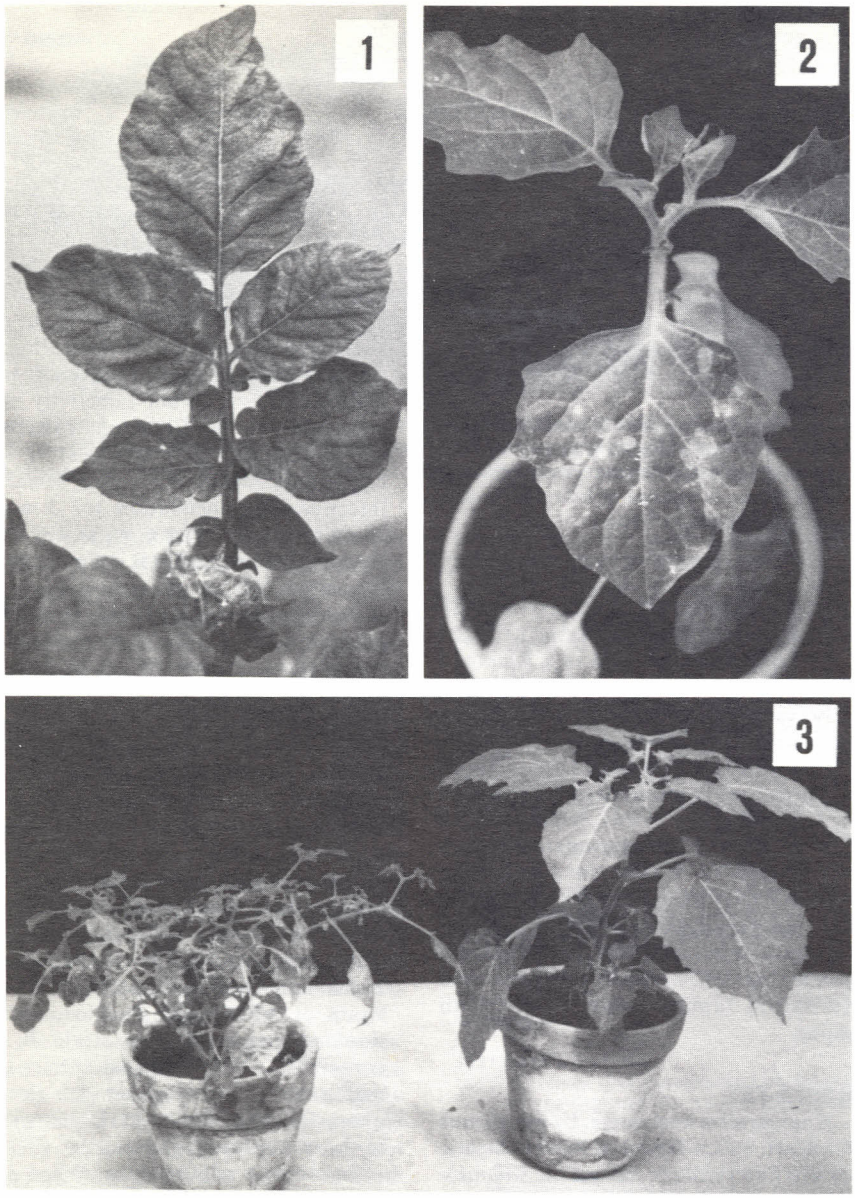

Figs. 1–3. Symptoms induced by Andean potato mottle virus strain B (APMV-B): **(1)** Severe mosaic and crinkle in potato cultivar Delta. **(2)** Local necrotic lesions in *Solanum villosum*. **(3)** (Left) Severe stunting, mosaic, and rugosity induced by APMV-B and (right) mild mosaic by APMV-C in *Physalis floridana*.

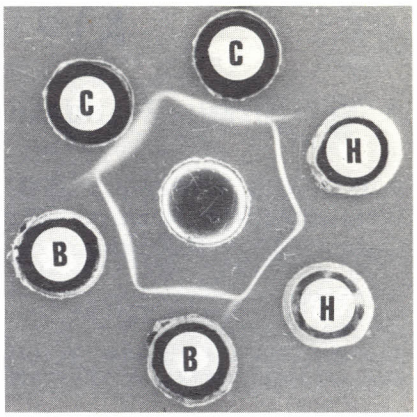

Fig. 4. Gel diffusion reaction between strains C, H, and B of Andean potato mottle virus. Central well was charged with antiserum to strain C (type strain) diluted 1:20.

strain B with a semipurified preparation of strain H removed all antibodies that reacted to H and a large proportion of those to C. Similarly, the precipitin line with strain B was reduced in intensity. These results provide evidence to consider strain B as a serologically related strain of APMV. Strain B failed to react with antisera to Andean potato latent, potato black ringspot, and tomato black ring viruses.

Attempts to determine incidence in seed and commercial potato fields. An extensive survey based on symptomatology and subsequent serological testing of samples was conducted in seed and commercial potato fields in Canoinhas and Tres Barras in the state of Santa Catarina and Contenda in the state of Paraná during April 1983. APMV-B was not detected in any of 106 potato and weed samples collected although plants with similar symptoms to that of the original infected Delta plants were tested. These results suggest that the symptoms described for APMV can be confused with those produced by other viruses in potato. In all fields visited, *Diabrotica* sp. was present as adults feeding on the foliage or larvae infesting the tubers.

DISCUSSION

Serological tests, comparative host range, and physical properties of the isolate reported in this paper provide strong evidence to consider this a new strain of APMV. In general, strain B seems more virulent than strains C and H (4). Symptoms consisting of mosaic and crinkle in cultivar Delta more closely resemble those caused by potato virus A or some strains of potato virus Y than the mottle symptoms reported for strains C and H (4). Our failure to find potato or weeds infected with APMV is intriguing. Because APMV is not known to occur in Europe, it seems unlikely that the original imported seed carried the virus. More likely, APMV-B occurs in other areas in Brazil or is restricted in the Canoinhas area to solanaceous weeds from which it occasionally infects potato. Indeed, a serological relationship has been demonstrated recently between APMV-B and a comovirus causing eggplant mosaic in Brazil (1). In any case, should this virus be present in Brazil, its particularly high degree of virulence makes it a threat to seed production. Fortunately, routine testing of APMV by serological means now included in the basic seed potato production service (SPSB-EMBRAPA) at Canoinhas reduces the possibility of developing severe outbreaks. As a precaution, studies on transmission of APMV-B by *Diabrotica* sp. should be intensified because this insect species is prevalent in the region where the virus was found.

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