Oca Strain of Arracacha Virus B from Potato in Peru

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ABSTRACT

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Identity of the oca strain of arracacha virus B, isolated from naturally infected potato in central Peru, was confirmed by symptomatology in indicator hosts, properties in sap, particle morphology, and serologic reactions. The virus was transmitted through potato tubers to progeny plants, but infection was symptomless.

During a survey in 1978 to identify viruses commonly causing bright yellow leaf markings (calico) in potato plants growing in the Huasahuasi Valley in the Andean highlands of central Peru, I collected 28 leaf samples from affected plants of several different cultivars. Each was tested with a range of antisera to viruses commonly found in potato fields in the region and by sap inoculation to *Chenopodium amaranticolor* Coste & Reyn., *C. quinoa* Willd., *Nicotiana bigelovii* Wats., and *N. debneyi* Domin. Andean potato mottle, potato mop-top (PMTV), and the Andean potato calico strain of tobacco ringspot, three viruses frequently associated with yellow leaf symptoms in the Andes (1,3,6,10), were detected in 13, 5, and 4 samples, respectively. Some of these samples also contained potato virus X and/or potato virus S. The latter virus was detected alone in one sample, but four were apparently healthy. One sample (cultivar unknown) that was infected with PMTV contained an additional virus coded as 6A. This virus resembled arracacha virus B (AVB) (8,9), not previously reported from potato, in that it caused systemic necrosis in *C. murale* L. and had isometric particles about 26 nm in diameter. This paper reports tests to establish the identity of the 6A virus.

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MATERIALS AND METHODS

Virus 6A was separated from PMTV by using infected apical leaves of *C. murale*, which PMTV does not invade systemically (4), as inoculum. The virus was cultured in *C. quinoa* and *Tetragonia expansa* Murr., and *C. murale* was used as the test plant. Healthy tubers of the potato cultivars used were supplied by the Department of Agriculture for Scotland. The procedures used for growing and inoculating plants, electron microscopy, serology, and determination of stability in sap were as described previously (7,9). The oca (AVB-O) and type (AVB-T) strains of AVB were maintained in *C. quinoa*; these viruses and antisera to each came from previous work (8,9). Plants were kept under strict quarantine conditions.

RESULTS

The following plants were inoculated with sap from *C. quinoa* infected with 6A: *T. expansa* (Aizoaceae); *Gomphrena globosa* L. (Amaranthaceae); *C. amaranticolor*, *C. murale*, and *C. quinoa* (Chenopodiaceae); *Cucumis sativus* L. (Cucurbitaceae); *Lycopersicon esculentum* Mill. (cv. Moneymaker), *N. bigelovii, N. clevelandii* Gray, *N. glutinosa* L., *N. rustica* L., *N. tabacum* L. (cvs. Samsun, White Burley, and Xanthi), *Petunia hybrida* Vilm., and *Physalis floridana* Rydb. (Solanaceae). Apical leaves were tested for infection by back inoculation to *C. murale*. All of these hosts responded to inoculation in the same way they responded to AVB-O (8), with the exception that *C. quinoa* developed a systemic mild mosaic and *N. rustica* was infected symptomlessly.

In *C. quinoa* sap, 6A was infectious after dilution to 10^{-3} but not to 10^{-4} and after heating for 10 min at 65 C but not at

70 C. Infectivity was retained in sap for at least 6 days at 20 C.

In gel diffusion tests, *C. quinoa* sap containing 6A reacted with antiserum to AVB-O by giving a strong, single precipitin line, but it gave only a weak line in reaction with antiserum to AVB-T. When *C. quinoa* saps containing 6A and AVB-T were placed in wells adjacent to each other and to wells containing twofold dilutions of AVB-T antiserum, a pronounced spur developed at the intersections between the precipitin lines. By contrast, when AVB-O antiserum and AVB-O were substituted for the AVB-T antiserum and AVB-T, precipitin lines fused without any spur formation, which indicated serologic identity between AVB-O and 6A. No precipitin lines developed in any instance against healthy *C. quinoa* sap, which was included as a control in all tests.

When healthy plants of potato cultivars Desiree, Maris Piper, Pentland Crown, Pentland Dell, and Record were inoculated mechanically with 6A, symptomless infection developed in inoculated leaves of each (detected by inoculation to *C. murale*), but without systemic infection. Systemic but symptomless infection did develop, however, when healthy scions of Cara, Desiree, Maris Piper, Pentland Crown, and Pentland Dell were top-grafted onto tomato plants infected with 6A. Three cuttings from infected scions were rooted from each of Desiree, Maris Piper, and Pentland Dell, and the tubers that formed were harvested, sprouted, and planted. Apical leaves of the plants produced were tested for infection by inoculation to *C. murale*. Although all plants were symptomless, the virus was detected in 3 of 4, 9 of 10, and 8 of 8 plants of Desiree, Maris Piper, and Pentland Dell, respectively, a transmission rate through tubers of 90%.

DISCUSSION

The 6A virus closely resembled AVB-O in symptomatology in indicator hosts and potato plants, properties in sap, and particle size and shape (8), and tests using AVB-O antiserum indicated serologic identity. AVB-O was originally isolated from the same locality as 6A, the Huasahuasi Valley, but from a different crop (8).

AVB-O may be predominantly a virus of other plants in the Andes (eg, oca), which only occasionally spreads to potato. It could, however, be widespread in the potato crop but previously undetected because *C. murale* is rarely used in routine tests for potato viruses. In limited glasshouse tests, the virus was transmitted through tubers of systemically infected plants to progeny plants. The virus did not cause symptoms in the potato cultivars tested, but it may cause bright yellow (or other) symptoms at high altitudes in the Andes, where temperatures fluctuate widely during the day and the nights are cold (2,5,10).

Further work is needed on the economic importance and mode of spread of AVB-O in potatoes in the Andean region. Meanwhile, quarantine authorities in countries outside South America may consider using *C. murale* to test for AVB-O during their routine checks on potato material imported from the Andes. Potato botanical seed should also be tested, because AVB-O is readily seed-transmitted in potato (R. A. C. Jones, *unpublished*).

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