A Destructive Blight of Spinacea oleracea Incited by a Strain of the Broad Bean Wilt Virus

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ABSTRACT

A destructive blight of spinach in western New York symptomatic of cucumber mosaic virus was ascertained to be incited by a strain of the broad bean wilt virus. Host range included 43 species in 14 families, none of which was in the Cucurbitaceae. A resistant selection made within Plant Introduction 103063 is also resistant to cucumber mosaic virus. Phytopathology 60:1405-1406.

In 1963, fall-planted spinach grown in the Eden area of western New York, near Lake Erie, was severely blighted and many plantings were abandoned. Sporadic outbreaks of this disease have occurred in subsequent years, and it was particularly severe in 1967. The disease syndrome in the field, a mottle that progressed to a severe chlorosis and culminated in necrosis of the growing point, was indistinguishable from that incited by cucumber mosaic virus (CMV).

CMV, however, appeared an unlikely incitant because CMV-resistant cultivars were as severely damaged as the susceptible cultivar, America, frequently grown in the area in 1963. Host range studies further ruled out CMV and indicated a similarity to a virus unidentified at the time, isolate PO, originally recovered in 1954 from streaked peas growing at Geneva, New York (1, 2). The host ranges of isolates PO and 63-51 (the type isolate from blighted spinach) were identical, and included 43 species in 14 families. Suscepts occurred in 10 of 11 species of Solanaceae, and in 18 of 32 species of Leguminoseae but none in Cucurbitaceae.

The primary source of inoculum for the spinach blight in 1963 was not ascertained. Transmission experiments with the pea aphid (*Acyrthosiphon pisum* Harris) and the peach aphid (*Myzus persicae* Sulzer) established the stylet-borne nature of the virus. The peach aphid was a much more efficient vector, and predominated the blighted spinach plantings. It is conjectured that susceptible tomato (*Lycopersicon esculentum* Mill.) and pepper (*Capsicum frutescens* L.), which are extensively grown throughout the season and overlap spinach plantings, served as virus reservoirs and enabled the peach aphid to vector the virus to the succulent young spinach. Weed hosts appeared to be a less likely virus reservoir, although some susceptible species grew in the vicinity.

The identity of the virus was not readily established. Symptoms in some suscepts resembled those of tobacco ringspot virus (TRSV) or alfalfa mosaic virus (AMV), but comparisons of the host ranges of isolates PO and 63-51 with TRSV and AMV did not indicate any relationships. PO and 63-51 incited a systemic mottle on *Celosia cristata* L. and *Iberis umbellata* L., neither of which was infected by TRSV or AMV. Cross-protection tests between PO or 63-51 and TRSV or AMV were negative. In serological tests, PO antiserum did not react with TRSV or AMV; nor did TRSV or AMV antisera react with PO or 63-51 antigens.

The first substantial clue to the identity of PO and 63-51 was found in a paper by Stubbs (4) describing the broad bean wilt virus (BBWV) in Australia. Symptoms of BBWV on pea and spinach were practically identical to those incited by PO, 63-51, and other spinach isolates from the Eden area. The slight discrepancies in the host range of New York isolates and that reported for the Australian BBWV probably resulted from genotypic differences in susceptibility among cultivars of a species. For example, Stubbs (4) reported that the three cultivars of *Phaseolus vulgaris* tested were not susceptible to BBWV; in this investigation, however, Red Kidney and a few other bean cultivars were susceptible to PO and 63-51, but most were resistant. The inheritance of this resistance is currently under investigation. Serological tests of PO, 63-51, and 67-254 (another spinach blight isolate collected in 1967) antigens with PO and BBWV antisera, the latter kindly supplied by R. H. Taylor, Victorian Plant Research Institute, Burnley, Australia, further suggested that the New York spinach blight virus is

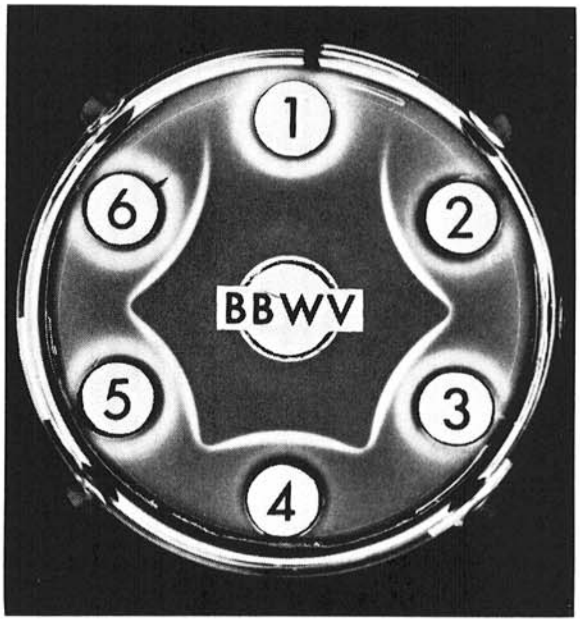

Fig. 1. Gel diffusion patterns of New York spinach virus antigens against antiserum of Australian broad bean wilt virus (BBWV). Pea sap in outer walls: 1, healthy; 2 and 5, 63-51; 3 and 6, PO; 4, 67-254. Similar patterns were obtained against antiserum from New York PO isolate.

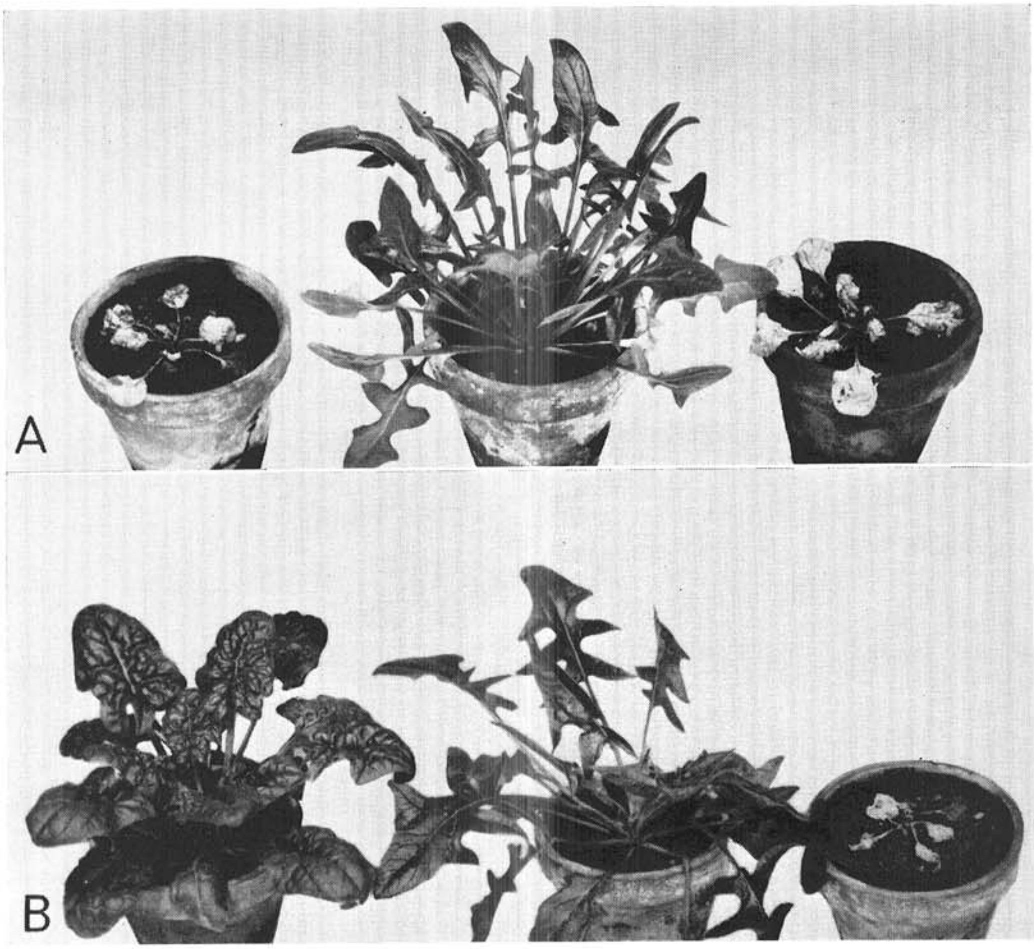

Fig. 2. Reaction of three spinach genotypes to **A)** New York 63-51, a strain of broad bean wilt virus (BBWV); and **B)** cucumber mosaic virus (CMV) at 25 C. Left, Virginia Savoy; center, S125; right, America.

a strain of BBWV (Fig. 1). Taylor et al. (5) reported similar serological relations of BBWV and PO antisera with BBWV antigens. Australian BBWV was not obtainable for direct comparison with the New York isolates of the virus.

A search for resistance to the New York strain of BBWV included commercial varieties and plant introductions, the latter principally from Asia and Europe. Resistance was found in a selection, S125, from P.I. 103063 received in this country in 1933 from Peking, China. S125 is also resistant to CMV (Fig. 2). Resistance to BBWV did not break down at the high temp of 28 C, but resistance to CMV did. It is noteworthy that P.I. 103063 was collected in a region near Manchuria where the original source of CMV resistance, P.I. 20026, was collected in 1906 (3). Either the original introduction was not resistant to BBWV, or resistance was lost in subsequent breeding programs. No other CMV-resistant line or variety tested was resistant to BBWV, including P.I. 178590 reported by Webb et al. (6) to be a new source of resistance to CMV. Studies on the inheritance of resistance to BBWV in spinach are in progress.

LITERATURE CITED

1. Kim, W. S., & D. W. Hagedorn. 1959. Streak-inciting viruses of canning pea. Phytopathology 49:656-664.
2. Schroeder, W. T., R. Provvidenti, & F. L. McEwen. 1960. An unusual virus isolated from *Pisum sativum* affected by streak. Phytopathology 50:654 (Abstr.).
3. Smith, L. B. 1920. Breeding mosaic resistant spinach and notes on malnutrition. Va. Truck Exp. Sta. Bull. 31 and 32:134-160.
4. Stubbs, L. L. 1947. A destructive vascular wilt virus disease of broad bean (*Vicia faba* L.) in Victoria. J. Dep. Agr., Victoria 46:323-332.
5. Taylor, R. H., P. R. Smith, C. Reinganum, & A. J. Gibbs. 1968. Purification and properties of broad bean wilt virus. Australian J. Biol. Sci. 21:929-935.
6. Webb, R. E., B. A. Perry, H. A. Jones, & D. M. McLean. 1960. A new source of resistance to spinach blight. Phytopathology 50:54-56.