Stunt of Beans Incited by Peanut Stunt Virus

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ABSTRACT

The main symptoms caused by peanut stunt virus (PSV) in beans are epinasty, crinkling, leaf distortion, mottling, and stunting of the plant. All commercial bean cultivars grown in North Carolina were found susceptible to the virus. Peanut stunt virus has a wide host range (22 genera) and was not transmitted by bean seed. Peanut stunt virus was inactivated between 55 and 60 C, and was infectious at a dilution of 1:1,000 but not 1:10,000. Expressed juice was infective after 24 but not 48 hours at room temperature. Flower production was reduced about 50% and pod production about 90% in the cultivars Harvester and Extender when inoculated with PSV in the greenhouse. Phytopathology 61:328-330.

Additional key words: Pole, snapbeans, dry beans, *Phaseolus vulgaris.*

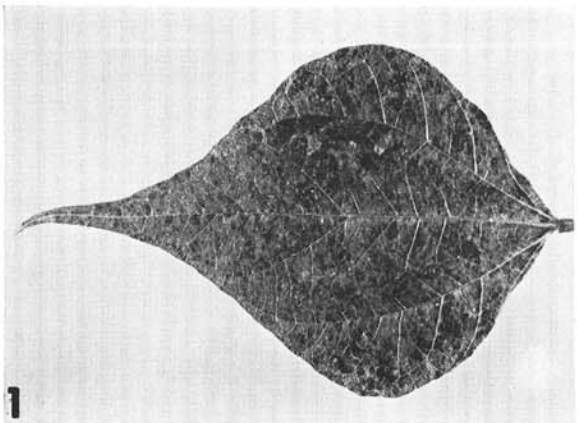
Stunt of beans (*Phaseolus vulgaris* L.), incited by the peanut stunt virus (PSV), was first identified in the Half Runner cultivar in western North Carolina in 1965 (1). Bean plants with stunt symptoms, however, had been observed in specimens submitted to the Plant Disease Clinic at N. C. State University for several years previously. In 1966, '67, and '68, stunt was found in several counties of North Carolina, mostly in home gardens. Zaumeyer & Goth (7) in 1967 studied the disease and concluded that it could cause severe damage to beans. In 1970, Echandi & Hebert (1) reported that stunt had appeared the previous summer in epiphytotic form in home gardens and commercial pole and snapbean plantations in North Carolina. A strain of PSV was collected in 1967 in a field of snapbeans in Washington (3). Host range, purification, and properties of this strain have been reported (4). This paper describes the disease in beans as well as some of the characteristics of the virus.

MATERALS AND METHODS.—Plants were grown in the greenhouse at Raleigh at 20-28 C in clay pots with a mixture of soil, sand, and peatmoss (1:1:1 v/v). Fifteen virus isolates were collected from commercial pole and snapbean plantations in western North Carolina and sap transmitted to Ramshorn blackeye peas (*Vigna sinensis* [Torner] Savi), *Nicotiana glutinosa* L., *Nicotiana tabacum* L., and return inoculations were made to beans. One isolate was used throughout this work and was maintained by mechanical transfers to young Ramshorn blackeye peas. Crude juice for inoculations was prepared by grinding infected plant tissue with 0.01 M potassium phosphate buffer pH 7.2 in a mortar and pestle and rubbed on Carborundum-dusted leaves with a cotton swab. After inoculation, leaves were rinsed with water and plants were placed on a greenhouse bench. Young plants of 19 bean cultivars and 33 other species were inoculated, usually when their primary leaves were well expanded. Symptoms were described on 3- to 6-week-old plants.

Crude juice from primary leaves of PSV-infected blackeye peas was used for studying the thermal inactivation point, dilution endpoint, and longevity in vitro. Results were based upon systemic infection in Ramshorn blackeye pea plants. The Ouchterlony double-diffusion test was conducted using 0.02% sodium azide as preservative in the agar. Antisera specific for cucumber mosaic virus (CMV), bean pod mottle (BPMV), alfalfa mosaic virus (AMV), tobacco mosaic virus (TMV), and PSV were used. Seed from naturally infected Dade bean plants from commercial plantations in the neighborhood of Hendersonville, N. C., were used for seed transmission tests.

RESULTS.—*Symptoms and host range.*—In the field, pole and snapbean plants infected when young were severely stunted with mottle and with crinkled and distorted leaves. Leaves that developed after infection became mottled, rugose, and cupped downward at the leaf margins. If any pods developed, they were small and distorted. Plants infected shortly before blooming continued to grow, but at a slower than normal rate, and later appeared stunted. Leaves developed after infection in pole cultivars Dade and Kentucky 191 were rugose, mottled, and crinkled, and with a strong downward cupping of the leaf margins. Necrosis of the growing tips or of branches was observed in some plants. Pods were scant; many were small, malformed, and with few small seeds.

All bean cultivars inoculated in the greenhouse were susceptible. Primary leaves showed epinasty 3-7 days after inoculation. Additional symptoms can be grouped in three categories: (i) leaf mottling, crinkling, distortion, and plant stunting (Fig. 1, 2); (ii) the same as (i) with veinal necrosis and/or necrotic spots in inoculated leaves; (iii) apical necrosis. Cultivars that belonged in the first category were Great Northern 1140, Unrivalled Wax, Topcrop, Stringless Black Valentine, Stringless Green Pod, Stringless Green Refugee, Sure Crop, Plentiful, and Extender. The cultivars that belong in the second category were Dade, White Half Runner, Great Northern 23, Pinto III, Michelite, Red Mexican, Tennessee Green Pod, and Bush Blue Lake 290. On Dade the primary veins of inoculated leaves showed brown discolorations in both leaf surfaces; reddish brown spots varying in size and shape, mostly angular, about 2-3 mm, were present in the interveinal spaces. Many of these spots were superficial, others were deep and sunken. The stem above and below the first node was also discolored brown. Inoculated leaves



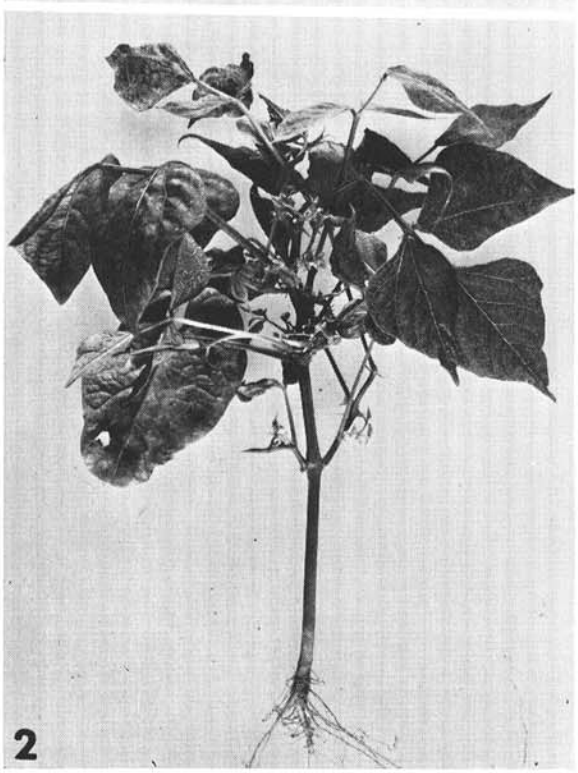


Fig. 1-2. **1)** Leaflet of bean (*Phaseolus vulgaris*) infected with peanut stunt virus. **2)** Bush bean plant (*Phaseolus vulgaris*) infected with peanut stunt virus.

of White Half Runner were dull, and true leaves were severely deformed and cupped downward. The cultivars included in the third category were Top Notch Golden Wax and Kentucky 191. All inoculated plants of Top Notch Golden Wax showed apical necrosis 2 weeks after inoculation, and died shortly thereafter. Two out of eight inoculated plants of Kentucky 191 showed apical necrosis; the rest appeared as those in (ii).

Of the other plant species inoculated with PSV, 27 were infected (Table 1). No infection occurred on *Stizolobium* sp., *Cajanus cajan* (L.) Millsp., *Zea mays* L., *Avena sativa* L., and *Gossypium hirsutum* L.

Physical properties.—The virus was inactivated between 55 and 60 C for 10 min, and lost its infectivity between 1:1,000 and 1:10,000 dilution. Unbuffered crude sap remained infective after 24 but not 48 hr at ca. 25 C.

Serology.—The Ouchterlony double-diffusion test gave a positive reaction between PSV antiserum and the fifteen PSV isolates from western North Carolina. A strong reaction was obtained with PSV antiserum and crude sap from diseased young leaves of bean and cowpea. No reactions were observed between PSV and antisera for CMV, BPMV, AMV, or TMV.

Though some of the isolates varied sufficiently by host reaction to differentiate them, there was no evidence of spur formation by the precipitin bands in the agar.

Transmission.—Hebert (2) found that PSV is transmitted by 3 species of aphids. He suggested that white clover (*Trifolium repens* L.) acts as the principal overwintering host. Since 10 of 15 samples of white clover collected in 1969 and 1970 in the vicinity of bean fields affected by stunt reacted positively to PSV antiserum, this indicates that white clover may be a source of primary inoculum for beans in North Carolina. No infection was observed in greenhouse plants grown from 2,000 seed harvested from a field of Dade that had 100% infection. Troutman et al. (6), however, reported a low percentage of transmission of the virus in peanuts.

Effect of PSV on the production of flowers and pods.—The effect of PSV on the production of flowers and pods in cultivars Harvester and Extender was studied in the greenhouse. Five plants of each cultivar were inoculated, and five healthy plants were maintained as controls. Flowering occurred 35 days after planting. Healthy plants bore 180 flowers and set 77 pods, whereas infected plants bore 94 flowers and set only 7 pods. The average numbers of flowers and pods of healthy and infected plants are shown in Fig. 3.

Discussion.—Stunt of beans is prevalent in western North Carolina, and at present is the most important virus disease of pole and snapbeans in the state. Symptoms of stunt can be easily confused with common bean

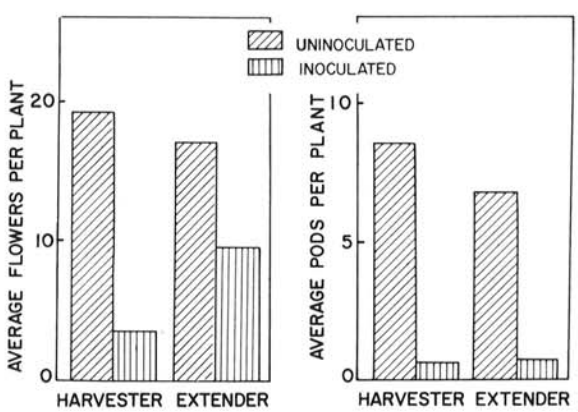


Fig. 3. Average flowers and pods per plant of the bean (*Phaseolus vulgaris*) cultivars Harvester and Extender noninoculated and inoculated with peanut stunt virus.

TABLE 1. Host range and symptoms of peanut stunt virus

Plant species	Symptoms[a]
Arachis hypogaea L. 'North Carolina No. 2'	SM, St
Canavalia ensiformis (L.) DC.	SM, St
Capsicum annuum L. 'Hungarian Wax'	SM, St
Cassia occidentalis L.	LL
Chenopodium amaranticolor Coste & Reyn.	LL
C. quinoa Willd.	LL
Crotalaria spectabilis Roth.	SM, St
Cucumis sativus L. 'National Pickling'	LL, SM
Cyamopsis tetragonoloba (L.) Taub.	LL
Datura stramonium L.	SM
Dolichos lablab L.	LL
Gomphrena globosa L. 'Globe Amaranth'	SM
Lespedeza striata (Thunb.) H. & A.	SM, St
Lupinus angustifolius L.	SM, St
Lycopersicon esculentum Mill. 'Bonny Best'	SM
Nicotiana glutinosa L.	SM, St
N. tabacum L. 'Turkish'	SM, St
Phaseolus vulgaris L. (many cultivars)	LL, SM, St
Pisum sativum L. 'Alaska'	SM, St
Sesbania exaltata (Raf.) Cory	SM, St
Tetragonia expansa Murr.	LL
Trifolium incarnatum L.	SM, St
T. pratense L.	SM, St
T. repens L.	SM, St
Vicia sativa L.	SM, St
V. villosa Roth.	SM, St
Vigna sesquipedalis (L.) Fruwirth	LL, SM, St
V. sinensis (Torner) Savi	LL, SM, St

[a] SM = Systemic mottle or mosaic; St = stunting of plant; and LL = local lesions.

virus diseases such as yellow bean mosaic and pod mottle, and because of its wide variation in symptoms it is sometimes difficult to recognize in the field.

The fact that all tested commercial pole and snap-bean cultivars grown in North Carolina were found to be susceptible indicates that it will be difficult to find resistance to stunt in common bean cultivars. The PSV has an extensive host range, as indicated in Table 1 and previous reports (2, 4, 5). White clover is the most widely distributed perennial host; however, other widely cultivated species such as Lespedeza (*L. striata*), crimson clover (*T. incarnatum*), and red clover (*T. pratense*) are susceptible and could serve as reservoirs of the virus. Although a representative group of bean isolates of PSV was obtained from different locations in the western part of the state, no serological differences were observed that would indicate the presence of PSV serotypes.

The severe reduction in yield observed in bean plants inoculated and grown in the greenhouse substantiate the field observations reported by Echandi & Hebert (1) regarding yield reduction in commercial bean plantations.

LITERATURE CITED

1. ECHANDI, E., & T. T. HEBERT. 1970. An epiphytotic of stunt in beans incited by the peanut stunt virus in North Carolina. Plant Dis. Reptr. 54:183-184.
2. HEBERT, T. T. 1967. Epidemiology of the peanut stunt virus in North Carolina. Phytopathology 57:461 (Abstr.).
3. MINK, G. I., T. T. HEBERT, & M. J. SILBERNAGEL. 1967. A strain of peanut stunt virus isolated from beans in Washington. Phytopathology 57:1400.
4. MINK, G. I., M. J. SILBERNAGEL, & K. N. SAKSENA. 1969. Host range, purification, and properties of the western strain of peanut stunt virus. Phytopathology 59:1625-1631.
5. TROUTMAN, J. L. 1966. Stunt, a newly recognized virus disease of peanuts. Phytopathology 56:587 (Abstr.).
6. TROUTMAN, J. L., W. K. BAILEY, & C. A. THOMAS. 1967. Seed transmission of peanut stunt virus. Phytopathology 57:1280-1281.
7. ZAUMEYER, W. J., & R. W. GOTH. 1967. Beans and other leguminous hosts of peanut stunt virus. Phytopathology 57:837 (Abstr.).