Distribution of Bean Pod Mottle Virus in Soybeans in North Carolina

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ABSTRACT

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In a survey of commercial soybean (*Glycine max*) fields in 21 counties in eastern North Carolina, bean pod mottle virus was more prevalent in the mideastern counties than in southeastern and northeastern counties. In the mideastern area, 37% of the fields had greater than 50% of plants infected, and 30% of the total crop surveyed was virus-infected. No evidence of significant pathogenic variation was obtained among 40 isolates when tested on four soybean and 18 common bean cultivars.

Since bean pod mottle virus (BPMV) was found in 1955 infecting soybeans (*Glycine max* (L.) Merr.) in North Carolina (7), the disease has commonly been observed in the eastern part of the state. BPMV is transmitted by the bean leaf beetle (*Cerotoma trifurcata* Forst.), which is very common in many soybean fields in eastern North Carolina (6). Windham and Ross (9) found that infection of Forrest soybeans with BPMV in the V2-3 stage caused 11–13% yield reductions. In certain years, the disease has seemed very prevalent; however, no surveys have been made to determine its distribution or incidence and whether other virus diseases with symptoms similar to BPMV may also be present.

In 1983, a survey of soybean fields in eastern North Carolina was conducted. The distribution and incidence of BPMV and the reactions of various hosts to the isolates of BPMV collected in the survey are reported.

MATERIALS AND METHODS

Virus collection. From two to seven soybean fields in each of 21 counties (total of 56 fields) were randomly visited. Data were recorded on the plant growth stage and the estimated percentage of plants with symptoms similar to those caused by BPMV, namely well-defined chlorotic areas in young leaves and rugosity of older leaves. Leaf samples were collected from two such plants in each of 40 fields; no BPMV-infected plants were diagnosed in 16 fields, and samples were not taken from these fields. Fields with estimated infection under 5% were surveyed more extensively than those with higher disease incidences. The survey was made in three trips, between 17 August and 2 September, in mideastern, northeastern, and southeastern counties. Leaf samples were kept on ice during the survey to preserve virus infectivity.

Virus identification. Double-diffusion serology tests were conducted using leaf sap at one concentration from each field sample and from leaves known to be infected with BPMV. Sap from plants free of BPMV was also included. Leaves from each sample were ground in 0.05 M phosphate buffer, pH 7, plus normal saline. The sap was placed in wells 5 mm apart cut into 0.5% agarose plates surrounding a well containing BPMV antiserum prepared to purified BPMV according to Bancroft (1). One antiserum concentration was used for all tests. The agarose medium contained 0.1% sodium azide and 0.75% sodium chloride. From each field, one sample that gave a positive serological reaction to BPMV antiserum was used to inoculate soybean cultivar Ransom. The isolates were maintained in Ransom plants to provide inocula for subsequent pathogenicity studies conducted on 18 common bean (*Phaseolus vulgaris* L.) cultivars, three soybean cultivars (Davis, Semmes, and Centennial) and one breeding line (1024), and cowpea (*Vigna unguiculata* (L.) Walp. subsp. *unguiculata* 'Blackeye').

For inoculation, leaves were dusted with 600-mesh Carborundum, then rubbed with cheesecloth pads soaked in plant sap produced from grinding 1 g of the infected Ransom leaf tissue with 10 ml of 0.05 M phosphate buffer, pH 7. Eighteen-day-old soybean plants of the three cultivars and line were inoculated on 28 November, and notes were taken on symptom development three times at weekly intervals starting 2 wk after inoculation. Common bean plants were inoculated on their primary leaves, and symptoms were recorded at three weekly intervals.

RESULTS

At least one leaf collection from each field sampled produced in serology tests a precipitin line that coalesced with that produced by known BPMV; evidence of spurs was lacking. Five of the 80 samples failed to react with BPMV antiserum; the field diagnoses were therefore correct in 94% of the samples. BPMV was found more frequently in the six mideastern counties than in the eight northeastern and seven southeastern counties surveyed (Fig. 1). The average estimated sizes (range) of fields surveyed in the northeastern, mideastern, and southeastern counties were 12 (3–35), 13 (2–60), and 19 (4–45) acres, respectively. Both incidence of infection and percentage of fields with infected plants were the highest in the mideastern area; 30% of the total crop was infected and 37% of these fields had greater than 50% of the plants infected. In two fields, all plants appeared infected. In the northeastern area, only one field (apparently 100% infected) had greater than 15% of the plants infected. The southeastern area had no fields that contained more than 20% infected plants.

The reactions of the common bean cultivars (Table 1) gave no clear evidence of pathogenic variation among isolates. Symptom expression sometimes varied between isolates on some bean cultivars; however, these differences appeared related either to differences in virus concentration in the inoculum (as indicated by numbers of local lesions on certain cultivars) or to differences in greenhouse temperatures after inoculation. Some cultivars developed local lesions during the week after inoculation, when average daily greenhouse temperatures (daily high + daily low ÷2) were near 30 C, whereas no lesions developed

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when temperatures were 25 C or less.

Each soybean cultivar reacted similarly to all isolates; however, Forrest and Centennial manifested more severe symptoms than Davis and line 1024. One isolate produced more severe symptoms than the others on the soybean cultivars and also infected cowpea. Aphids (*Myzus persicae* (Sulzer)) were used to transmit from the soybeans a virus that reacted positively with peanut mottle virus antiserum in microprecipitin tests. No infection of cowpeas was observed with any isolates of BPMV.

DISCUSSION

Results of this survey show that BPMV commonly infects soybean in eastern North Carolina; in only one sample was another virus (peanut mottle) detected.

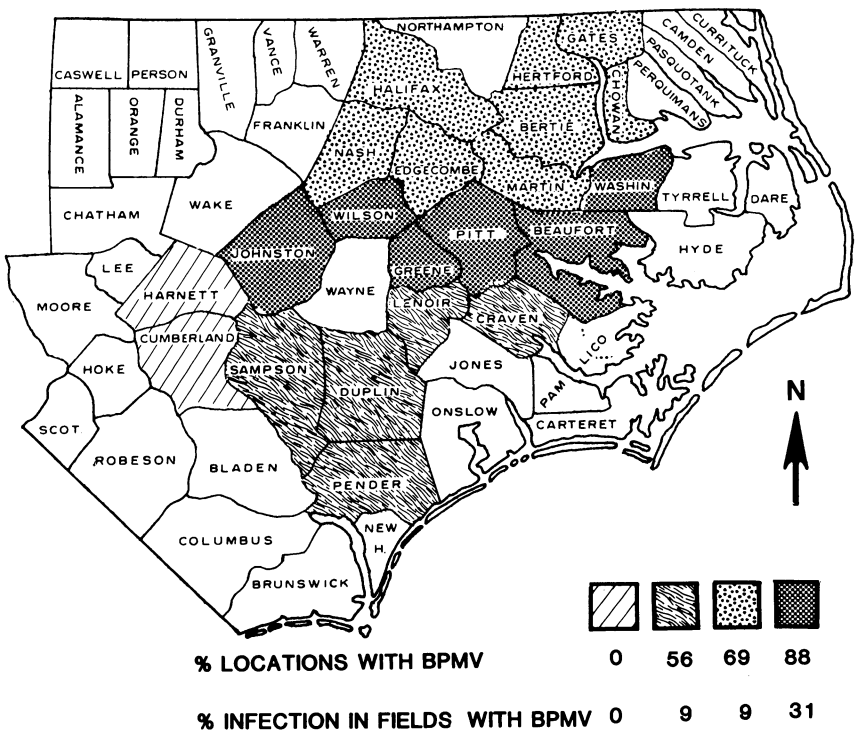

Fig. 1. Distribution and incidence of bean pod mottle virus in commercial soybean fields in eastern North Carolina in 1983. Unshaded areas are counties not surveyed.

Table 1. Reactions of common bean cultivars to bean pod mottle virus collected from eastern North Carolina

Common bean cultivars	Systemic mosaic	Symptoms on inoculated leaf: Superficial local lesions	Subepidermal local lesions	Veinal necrosis	Chlorotic local lesions
Blue Lake Bush	−	−	−	−	−
Blue Lake Pole	−	+(−)[a]	−	−	−
Bountiful Bush	−	+	−	+	+
Cherokee Wax[b]	−	−	−	−	−
Contender[b]	−	−	−	−	−(+)
Dwarf Horticulture Bush Shell[c,d]	+	−	−	−	+(−)
Genuine Cornfield Pole	−	+	+	+	−
Harvester	−	+	−	−	−
Kentucky Wonder Bush[c]	−	+	+	+	+
Kentucky Wonder Bush White	−	+	+	+	−
Pinto[c]	−	+	+	+(−)	−
Roma	+	−	−	−	−
Tenderette	−	−	−	−	−
Tendergreen[b]	−	−	−	−	−
Tenn. Green Pod	+	+	−	−	−
Top Crop	−	−	−	−	−
Wade[b]	−	−	−	−	−
White Half Runner	−	+	−	−	−

[a] Predominant symptom not in parentheses.
[b] Results differed from those of Skotland (6).
[c] Results similar to those of Skotland (6).
[d] Also had systemic chlorotic spots.

The presence of a band of counties through the midsection of the eastern part of the state where virus-infected plants were found with greater frequency than in the northern or southern areas may relate to such factors as vector activity and virus source.

Both population densities and activity of the principal vector, *C. trifurcata*, are probably major factors affecting virus dispersal within fields. Boiteau et al (2) and Dietz et al (3) found peak periods for beetle activity in North Carolina during the end of May, the middle of July, and the middle of September.

The source of the virus infections could be either wild perennial hosts such as *Desmodium paniculatum* (L.) DC. (8) or soybean seeds that transmit the virus (4). Because no infected plants of *D. paniculatum* have been found, seed transmission could account for the presence of the virus in any particular field. Seed transmission does not explain, however, why the virus is more prevalent in a certain area of the state since the same cultivars are grown statewide. Seed sources containing virus-infected seed available in certain areas and not in others could account for the virus distribution observed.

The uniform reaction of a particular common bean cultivar to all virus collections indicates that no striking pathogenic variation exists within these collections. The reactions of the four soybean cultivars also provided no indication of pathogenic variation. The J-10 strain of BPMV described by Moore and Scott (5) reacted similarly to BPMV in most hosts, and the only differences observed in soybean and common bean cultivars were in symptom severity rather than in qualitative factors. From the results obtained with isolates collected in the North Carolina survey, BPMV appears uniform in its pathogenicity; strains with significant pathogenic differences apparently do not exist or are at least uncommon.

The differences in reactions of common bean cultivars to BPMV in this study and those of Skotland (7) may be attributed to environmental conditions or variations within a cultivar. Five of the six cultivars common to this study and those described by Zaumeyer and Thomas (10) gave a similar reaction.

The lack of visible symptoms in cowpeas inoculated with any of the isolates agrees with results of the original description of BPMV (10) but apparently differs from results obtained by Skotland (7), Moore and Scott (5), and Lin and Hill (4). This discrepancy could be caused by differences among cowpea cultivars or pathogenic differences among BPMV isolates.

LITERATURE CITED

1. Bancroft, J. B. 1962. Purification and properties of bean pod mottle virus and associated centrifugal and electrophoretic components. Virology 16:419-427.

2. Boiteau, G., Bradley, J. R., and Van Duyn, J. W. 1979. Bean leaf beetle: Flight and dispersal behavior. Ann. Entomol. Am. 72:298-302.
3. Dietz, L. L., Van Duyn, J. W., Bradley, J. R., Rabb, R. L., Brooks, W. M., and Stinner, R. E. 1980. A guide to the identification and biology of soybean arthropods in North Carolina. N.C. Agric. Res. Serv. Tech. Bull. 238. 264 pp.
4. Lin, M. T., and Hill, J. H. 1983. Bean pod mottle virus: Occurrence in Nebraska and seed transmission in soybeans. Plant Dis. 67:230-233.
5. Moore, B. J., and Scott, H. A. 1971. Properties of a strain of bean pod mottle virus. Phytopathology 61:831-833.
6. Ross, J. P. 1963. Transmission of bean pod mottle virus by beetles. Plant Dis. Rep. 47:1049-1050.
7. Skotland, C. B. 1958. Bean pod mottle virus of soybean. Plant Dis. Rep. 42:1155-1156.
8. Walters, H. J., and Lee, F. N. 1969. Transmission of bean pod mottle virus from *Desmodium paniculatum* to soybean by the bean leaf beetle. Plant Dis. Rep. 53:411.
9. Windham, M. T., and Ross, J. P. 1984. Phenotypic response of six soybean cultivars to bean pod mottle virus infection. Phytopathology 74:In press.
10. Zaumeyer, W. J., and Thomas, H. R. 1948. Pod mottle, a virus disease of beans. J. Agric. Res. 77:81-86.