Influence of Sugarcane Mosaic Virus Strain H and Pythium graminicola on Growth of Sugarcane

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ABSTRACT

The interaction between sugarcane mosaic virus strain H, the most prevalent strain in Louisiana, and *Pythium graminicola* was studied on four commercial sugarcane cultivars in replicated greenhouse tests. The virus and fungus each caused significant reductions in total height of shoots per pot (in three and four cultivars, respectively), in fresh weight of top growth (in three and four cultivars, respectively), and in dry weight of top growth (both in four cultivars). The fungus reduced growth more than the virus in some cultivars. Both agents together caused additive effects on total height of shoots per pot (in three of four cultivars), on fresh weight of top growth (in two of four cultivars), and on dry weight of top growth (in all four cultivars); synergistic effects were noted on total height of shoots per pot (in one of four cultivars), and on fresh weight of top growth (in two of four cultivars). The results suggest that, under field conditions, greater reductions in yields of some sugarcane cultivars may result from the presence of both agents. Phytopathology 61:1090-1092.

Additional key words: Saccharum spp., *Sorghum bicolor.*

Mosaic is the most important disease of sugarcane (species and interspecific hybrids of *Saccharum*) in Louisiana. Losses in yield vary with different cultivars from about 15 to 50% when completely infected (8). Sugarcane mosaic virus strain H (SCMV-H) is the most prevalent strain in Louisiana (1).

Root rot caused by *Pythium* species was at one time a major sugarcane disease in Louisiana and in many other sugarcane-growing areas (5). The disease has been of minor economic importance in Louisiana during the past 3 to 4 decades due to improved hybrid cultivars and cultural practices, particularly soil drainage. Nevertheless, we have frequently isolated pathogenic species of *Pythium* from sugarcane roots and occasionally from sugarcane field soils; but their effects on growth are usually not apparent.

It is possible that losses in yields from SCMV may increase if the plants are also infected with *Pythium*. Synergistic and additive effects of combined viral and fungal diseases have been reported for several crops (4, 10), but not for sugarcane. The objective of the tests reported here was to determine the effects of SCMV-H and a moderately virulent isolate of *Pythium graminicola* Subr., separately and in combination, on growth of four commercial cultivars of sugarcane.

MATERIALS AND METHODS.—The cultivars tested were CP 48-103 and CP 61-37, both moderately resistant, and CP 52-68 and L 60-25, both susceptible to mosaic in the field. The cultivars were field grown from hot-air treated (54 C for 8 hr), SCMV-H infected or uninfected cuttings. Single-bud cuttings were taken from the uninfected and SCMV-H infected stalks, and germinated in 3-inch peat pots which contained steam-treated vermiculite. After about 2 weeks, uniform plants were selected, the roots freed of as much vermiculite as possible, and a single plant was transplanted to a 9-inch clay pot. Each pot contained 4,000 cm^3 of a heat-sterilized silt loam of pH 6.6.

The test consisted of four treatments, replicated 5 times, for each of the four cultivars, or a total of 80 pots. Duplicate tests were conducted. The treatments were: (i) healthy control; (ii) SCMV-H alone; (iii) *P. graminicola* alone; (iv) SCMV-H + *P. graminicola.*

The appropriate plants, mosaic-infected or healthy, were exposed to *Pythium* at the time of transplanting. The soil in each of the pots to be infested with *P. graminicola* received 50 cm^3 of a 2-week-old cornmeal-sand inoculum. The inoculum was thoroughly mixed in the soil. The isolate of *P. graminicola* was obtained from sugarcane roots grown in field soil at the U.S. Sugarcane Field Station, Houma, La. It was identified from the characteristics of oospores that developed on potato-dextrose agar (3).

To ascertain the strain of virus as strain H, the standard diagnostic sugarcane cultivars CP 31-294 and CP 31-588 (1) and *Sorghum bicolor* (L.) Moench 'Rio' seedlings (7) were used.

The pots were spaced on two greenhouse benches in a randomized complete block design, fertilized with a complete fertilizer at monthly intervals, and watered as necessary. Care was taken that water did not splash from pot to pot during irrigation; the pots were elevated from the bench top with an inverted culture dish. The tests were conducted in a screened (30 mesh) greenhouse which was fumigated regularly with nicotine sulfate for insect control.

Test 1 was begun on 10 October 1969 and terminated on 9 February 1970; test 2 was begun on 17 November 1969 and terminated on 16 March 1970. The greenhouse temperature usually ranged from 25 to 35 C.

The following measurements were made at the conclusion of the tests: (i) total height of shoots per pot, including the primary shoot and tillers, measured from the soil level to the youngest visible dewlap (wedge-shaped areas at the junction of the leaf blade and leaf sheath); (ii) fresh weight of top growth; and (iii) dry weight of top growth (oven-dried to constant weight at 90 C for 72 hr). Roots of plants selected at random from each treatment were checked for the presence of *Pythium.* Water agar, amended with 10 ppm pimaricin, was used to isolate the fungus.

RESULTS AND DISCUSSION.—Data from the two tests were subjected to combined analysis, and means

TABLE 1. Effect of sugarcane mosaic virus strain H and *Pythium graminicola*, separately and in combination, on growth of four sugarcane cultivars

Treatment	Cultivars			
	CP 48-103	CP 52-68	CP 61-37	L 60-25
	Total height of shoots, cm[a]			
Healthy control	86.1[b] a	108.5 a	128.1 a	150.0 a
Mosaic	69.0 b	87.3 b	109.7 a	117.7 b
Pythium	60.0 c	72.4 c	82.7 b	102.2 b
Mosaic + *Pythium*	47.0 c	53.1 d	46.3 c	65.4 c
	Fresh weight of top growth, g[a]			
Healthy control	268.8[b] a	281.6 a	330.1 a	343.6 a
Mosaic	204.6 b	242.1 a	260.8 b	287.2 b
Pythium	179.2 b c	165.3 b	212.7 b	263.1 b
Mosaic + *Pythium*	133.1 c	138.0 b	119.1 c	174.8 c
	Dry weight of top growth, g[a]			
Healthy control	42.0[b] a	44.7 a	62.5 a	59.4 a
Mosaic	31.0 b	37.5 b	46.6 b	45.5 b
Pythium	26.6 b	26.4 c	36.4 c	39.5 c
Mosaic + *Pythium*	18.7 c	20.7 c	19.9 d	27.9 d

[a] All treatment means under any one cultivar followed by the same letter are not significantly different at the 5% level of probability according to Duncan's multiple range test.
[b] Figures are means of 10 replicates.

were separated, using Duncan's multiple range test (Table 1).

The top growth and root mass of plants infected with both mosaic and *Pythium* were smaller than those infected with each agent individually. The symptoms of mosaic were indistinguishable whether the plants were infected with the virus individually or with virus and fungus; root rot appeared to be more severe in plants infected with both the virus and fungus than with fungus alone. The early differences in top growth among plants with the different treatments (Fig. 1) persisted throughout the 4-month duration of the tests.

Total height of shoots.—Mosaic alone caused a significant reduction in total height of shoots per pot of the cultivars CP 48-103, CP 52-68, and L 60-25. *Pythium graminicola* alone caused a significant reduction in all four cultivars; the growth reductions were significantly greater than those for mosaic on CP 48-103, CP 52-68, and CP 61-37. The combined effects of both disease agents were significantly greater than those of each agent alone on CP 52-68, CP 61-37 (Fig. 1), and L 60-25; the combined effects appeared to be synergistic on CP 61-37, but additive on the other cultivars.

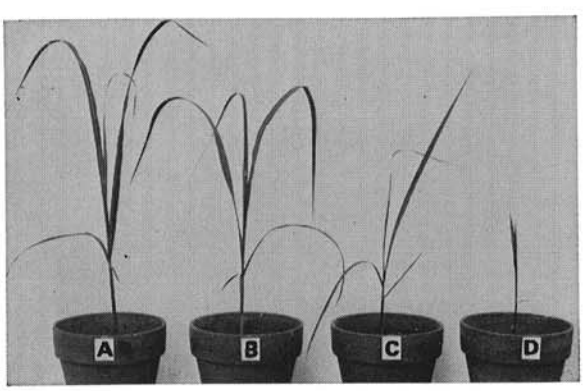

Fig. 1. Sugarcane plants (1.5 months old) of cultivar CP 61-37. **A)** Healthy control; **B)** infected with sugarcane mosaic virus strain H (SCMV-H); **C)** infected with *Pythium graminicola*; and **D)** infected with both SCMV-H and *P. graminicola*. The relative differences in growth persisted throughout the 4-month duration of the test.

Fresh weight of top growth.—Mosaic alone caused a significant reduction in fresh weight of top growth of CP 48-103, CP 61-37, and L 60-25. *Pythium* alone caused a significant reduction in all four cultivars; the effect of the fungus was significantly greater than that of the virus on CP 52-68. The combined effects of both disease agents were significantly greater than those of each agent alone on CP 61-37 and L 60-25; the combined effects appeared to be synergistic on these two cultivars, and additive on CP 48-103 and CP 52-68.

Dry weight of top growth.—Both mosaic and *Pythium* alone caused significant reductions in dry weight of top growth of all four cultivars. The reduction due to *Pythium* alone was significantly greater than that due to mosaic alone in CP 52-68, CP 61-37, and L 60-25. The combined effects of both disease agents were significantly greater than those of each agent alone on CP 48-103, CP 61-37, and L 60-25; the combined effects were additive on all four cultivars. The moisture content of top growth from the different treatments did not differ significantly at time of harvest. At the conclusion of the tests, *P. graminicola* was isolated from roots of all plants grown in soil initially infested with the fungus, but not from roots of plants grown in noninfested soil.

All plants from the mosaic treatments exhibited mosaic symptoms throughout the test period; all of the healthy control plants remained free of mosaic. The presence of strain H in the mosaic-diseased plants was confirmed by bioassays on diagnostic plants (1, 7).

Farley & Lockwood (2) observed that, over a wide range of greenhouse environmental conditions, three pea cultivars were more susceptible to common fungus root rot diseases caused by *Aphanomyces euteiches* and *Fusarium solani* f. sp. *pisi*, when the plants were infected with any one of four different viruses. *Fusarium* and *Rhizoctonia* root rots of wheat in New Zealand and Canada are considered to occur predominantly in plants previously infected with barley yellow dwarf virus (6). In a greenhouse experiment, Watson & Guthrie (9) observed that severe root rot of red clover developed only when the plants were infected with clover yellow mosaic virus (CYMV); the severe root rot symptoms were similar in plants infected with CYMV alone or in all combinations with white clover mosaic virus and the several fungus parasites most frequently isolated from field-infected plants. Williams & Alexander (10) found preliminary evidence that the presence of maize dwarf mosaic virus in corn causes a greater susceptibility to root rot caused by *Pythium graminicola*. Our results indicate that greater reductions in yields of some sugarcane cultivars may result from the presence in the field of both sugarcane mosaic virus strain H and the root-rotting fungus, *P. graminicola*.

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