

Effect of a Colombian Isolate of Bean Southern Mosaic Virus on Selected Yield Components of *Phaseolus vulgaris*

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ABSTRACT

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The number and weight of seeds produced per plant were significantly ($P = 0.01$) reduced, 47.5 and 56.3%, respectively, in Diacol-Calima bean (*Phaseolus vulgaris*) plants infected with bean southern mosaic virus (BSMV). The number of pods per plant, on the contrary, was often higher in systemically infected plants than in uninoculated controls. An average of 17.4% of the pods produced by the BSMV-infected plants, however, did not produce seed. The virus was transmitted in 11.1% of the mature seeds produced by the BSMV-inoculated Diacol-Calima plants.

Bean southern mosaic virus (BSMV) is present in most of the bean-producing countries of South America (F. J. Morales, unpublished). The wide distribution of this virus is a consequence of its transmission through seed, by beetle vectors, and readily by contamination (5). The virus, however, is considered of limited importance in these countries (3). Recently, a field survey of two experimental fields near Palmira, Colombia, revealed an average BSMV incidence of

30% in both plants and beetle vectors, as determined by serological (enzyme-linked immunosorbent assay [ELISA]) tests (F. J. Morales and M. Castaño, unpublished). The purpose of this investigation was to determine the effect of the virus on the main production components of the predominant bush bean cultivar grown in Colombia.

MATERIALS AND METHODS

The BSMV isolate selected for this study had been characterized previously (4). Systemically infected Bountiful bean tissue serologically tested for the absence of contaminant viruses was used as the source of inoculum. The bean (*Phaseolus vulgaris* L.) cultivar Diacol-Calima, a red-mottled, large-seed type, was selected

for this study because of its commercial importance and known susceptibility to BSMV. This cultivar reacts with mild chlorosis and leaf malformation to the systemic invasion of the BSMV isolate tested in this study.

The experiment was conducted at CIAT, Palmira, under screenhouse conditions ($864 \mu\text{E m}^{-2} \text{sec}^{-1}$; 25.3 C; 75% RH, average annual values). The Diacol-Calima plants were grown individually in 6-in. pots. Three sowing dates at 15-day intervals were chosen to produce 120 plants for each date. Seventy plants of each planting date were mechanically inoculated with BSMV and 50 with water alone as controls. All the test plants were inoculated on one primary leaf 10 days after sowing and grown to maturity. The pods were harvested on an individual plant basis and the seeds dried to about 14% moisture content. Three yield components, number of pods, number of seeds, and weight of seeds, were analyzed for the BSMV-infected and control plants and their mean values compared by an analysis of variance for groups with unequal sample sizes.

Finally, 120 seeds harvested for each planting date were assayed by the growing-on test, both visually (symptoms) and serologically by ELISA to estimate

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Table 1. Effect of bean southern mosaic virus (BSMV) on three yield components of the susceptible bean cultivar Diacol-Calima

Planting date	Yield component					
	Pods per plant		Seeds per plant		Seed wt per plant (g)	
	Inoculated	Control	Inoculated	Control	Inoculated	Control
1	9.1 ^a (2.6) ^b	8.0 (2.2)	11.2 (8.8)	20.1 (6.2)	4.9 (4.4)	11.0 (3.2)
2	6.4 (3.8)* ^c	7.3 (1.3)	7.6 (8.8)	18.6 (3.5)	3.6 (4.4)	11.0 (2.1)
3	8.5 (2.7)	6.7 (2.3)	10.9 (9.16)	17.9 (6.6)	4.8 (4.1)	8.9 (3.3)
\bar{x}	8.0	7.3	9.9	18.9	4.4	10.3

^aMean of 70 BSMV-inoculated plants and 50 control plants per planting date.

^bStandard deviations are shown in parentheses.

^c* = Significantly different at $P = 0.05$; all other means for inoculated test plants are significantly different at $P = 0.01$ in relation to their respective controls.

Table 2. Seed transmission of bean southern mosaic virus (BSMV) to seedlings of the bean cultivar Diacol-Calima

Planting date	Assay ^a	
	Visual	ELISA
1	8/108 ^b (7.4) ^c	8/108 (7.4)
2	19/119 (15.9)	20/119 (16.8)
3	9/109 (8.2)	10/109 (9.2)
\bar{x}	36/336 (10.5)	38/336 (11.1)

^aGrowing-on test evaluated visually (symptoms) and by enzyme-linked immunosorbent assay (ELISA).

^bNumber of plants systemically infected by BSMV via seed/total number of plants tested.

^cCorresponding percentages of seed transmission estimated by each detection method.

the percentage of seed-transmitted BSMV in Diacol-Calima. ELISA (2) was carried out with plant tissue of all the plants evaluated visually in the growing-on test. In the case of symptomless test plants, two plants were tested per plate well. All the plants previously rated positive for visible symptoms were tested individually by ELISA.

RESULTS

In the BSMV-inoculated plants, pod maturation was delayed from 4 to 9 days compared with the BSMV-free controls.

There was no consistent reduction in the number of pods produced by the BSMV-infected plants. On the contrary, on two of the three test dates, the inoculated test plants produced more pods than did the virus-free controls (Table 1). However, an average of 17.4% of the pods produced by the BSMV-affected plants contained no seeds. All pods produced by the control plants contained seeds. The lower standard deviation values obtained for the control plants, relative to the high standard deviation exhibited by the BSMV-inoculated test plants, are consistent with this observation.

There was a significant difference ($P = 0.01$) in the number of seeds produced per plant between the two treatments. The BSMV-infected plants produced an average of 47.5% fewer seeds per plant than the virus-free test plants (Table 1). Consequently, the average seed weight per plant for the control plants averaged 56.3% higher than that for the BSMV-infected test plants for the three planting dates.

The percentage of seed transmission of BSMV in Diacol-Calima was 11.1%. Mild mosaic and leaf curling symptoms were visible in most affected plants with the exception of at least two systemically infected plants that were detected only by ELISA (Table 2).

DISCUSSION

We concluded from this investigation that bean southern mosaic can be an economically important disease in the tropics despite the absence of severe viral symptoms. In the case of Diacol-Calima, an average yield loss of 56.3% would represent a potential economic loss of at least \$500 (U.S.) per hectare at current market prices. Interestingly, pod production was not a reliable yield component to estimate yield loss because of the apparent deleterious effect BSMV has on seed formation in Diacol-Calima. In this study, the number of seeds produced per plant was the yield component affected most.

The relatively high percentage of transmission (11.1%) observed for BSMV in mature seed of Diacol-Calima is also an important epidemiological factor in tropical environments with continuous cropping cycles where this percentage cannot be expected to decrease because of prolonged storage of the seed (1,5). The uneven maturation of pods observed for the BSMV-inoculated plants would also constitute a negative effect of the virus.

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