BEET CURLY TOP VIRUS, INSECTICIDES AND PLANT RESISTANCE

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ABSTRACT

Beet curly top virus (BCTV), a gemini virus, remains a problem for farmers in the San Joaquin Valley of California. It is spread by the beet leaf hopper (*Circulifer tenellus* Baker), which has become naturalized. Recent dependence on non-tolerant sugar beet cultivars has led to increased concern about the potential for a BCTV epidemic, particularly in overwintered crops, which are planted when conditions for infection are greatest. Three trials were carried out in successive years in the western San Joaquin Valley to test the effects of alternative insecticides for control of BCTV on susceptible and tolerant sugar beet cultivars. Two rates of imidicloprid applied as a seed treatment (45 g and 90 g a.i. per 100,000 seeds) were compared to the current standard treatment of phorate applied to soil at 83.8 g a. i. per 1000 m of row, and an untreated control. In the third trial, clothianidan was also used at the rate of 15 g a.i per 100,000 seeds. Cultivars ranged in tolerance from the most tolerant line available to the most susceptible cultivar ever observed. In the the third trial, different planting dates were also compared. Natural BCTV infection occurred in all three years. Sugar beet root and sugar yields declined linearly with increasing rates of infection. Yields declined because roots were significantly smaller with the non-tolerant cultivar and root populations were reduced by plant loss. Sugar percentage was unaffected by treatments, but differed by cultivar. Imidicloprid and phorate provided similar levels of protection to plants, but where not able to prevent large yield losses among susceptible cultivars when infection occurred early in crop development. Plant resistance provided more effective protection than systemic insecticides.

INTRODUCTION

Beet curly top virus (BCTV), a gemini virus, remains a problem for farmers in the San Joaquin Valley of California. It is spread by the beet leaf hopper (*Circulifer tenellus* Baker), which has become naturalized. In recent years, yields in the San Joaquin Valley have risen by more that 33% due to the use of new, high yielding cultivars. These cultivars lack BCTV resistance. Recent dependence on non-tolerant sugar beet cultivars has led to increased concern about the potential for a BCTV epidemic, particularly in overwintered crops, which are planted in late spring (May) when leaf hoppers are migrating into sugarbeet fields and seedlings are most susceptible. In 2001, a large population of

leafhoppers and with high levels of infection developed and losses to BCTV in the overwintered regions of the northern San Joaquin Valley were severe.

METHODS

Three trials were carried out in successive years in the western San Joaquin Valley (2000, 2001, and 2002) to test the effects of alternative insecticides for control of BCTV on susceptible and tolerant sugar beet cultivars. Two rates of imidicloprid applied as a seed treatment (45 g and 90 g a.i. per 100,000 seeds) were compared to the current standard treatment of phorate applied to soil at 83.8 g a. i. per 1000 m of row, and an untreated control. In the third trial (2002), clothianidan was also used at the rate of 15 g a.i per 100,000 seeds. In the first two years trials, the cultivar SS 781R (partially tolerant) was compared to SS-Rifle, a newer, high yielding but non-tolerant cultivar. In the third year's trial cultivars were changed to include those in most commonly in use on the region (SS-NB7 (partially tolerant) and B4430 (susceptible). USH11, the most BCTV tolerant line available, was also included for comparison. Also in the third trial, different planting dates were compared to test the effects of date of infection on cultivar response and insecticide performance. In all three years, there were five replications of each treatment. Plots were evaluated every few weeks during the growing season for visual symptoms of BCTV using a scale published by the USDA. They were harvested in early autumn and analyzed for sugar content at the Spreckels Sugar Company laboratory.

RESULTS

Natural BCTV infection occurred in all three years but differed in severity and time of onset. In the first two years trial, sugar beet root and sugar yields declined linearly with increasing rates of infection when leafhoppers were present at or near the time of seedling emergence. Yields declined because roots were significantly smaller with the non-tolerant cultivar and root populations were reduced by plant loss. Sugar percentage was unaffected by treatments, but differed by cultivar. Imidicloprid and phorate provided similar levels of protection to plants, but where not able to prevent large yield losses among susceptible cultivars when infection occurred early in crop development. Results from the first two year's trials are presented in greater detail in Kaffka et al., 2002. Results from the thrid year's trail are emphasized here.

BCTV requires about six weeks after inoculation to become symptomatic, but susceptible varieties and younger plants may develop symptoms somewhat more rapidly. Using a six week infection rate allows for an estimate of the time of initial infection when beets are first observed to be infected. Beets planted at each of the first two planting dates avoided infection early during crop development. Individual infected plants were observed in some plots from these planting dates by mid-June, but widespread infection of susceptible controls only occurred by mid- August, suggesting that beets were infected primarily in the mid-to late-June period. Similarly for beets planted in mid-April. Isolated plants were observed with symptoms in mid-June but widespread infection was only observed beginning a month later (fig. 1). The later infection occurs in

sugarbeets, the less effect BCTV has on sugarbeet yield (Duffus and Skoyen, 1977).

The susceptible variety (B4430) was the highest yielding variety at all three planting dates (Table 1). The highest sugarbeet yields ever observed at a field scale have been achieved in recent years using this variety. Delayed infection even for a period as short as 70 to 80 days from emergence allowed this variety to express at least some of its yield potential. There were no significant differences in yield between NB7, which is moderately resistant, and USH11, which is the most resistant variety available. USH11 is an older variety without good yield potential. NB7 is a newer variety that includes rhizomania resistance, while USH11 lacks this trait. Rhizomania is widespread throughout California but is not present at the WSREC. In the absence of rhizomania and in the earlier planting date treatments in which BCTV infection occurred late in crop development, the two varieties performed equally.

Insecticide treatments were less important yield influences than varietal differences and were only observed in the last planting date. Since infection occurred later in crop development, the higher rate of imidicloprid was more effective than the lower rate. The new systemic insecticide clothianidan, which is used at a very low rate (15 g a.i. per 100,000 seeds or approximately 10 g a.i. per acre at the seeding rate used), performed as well as the higher imidicloprid rate.

REFERENCES

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Kaffka. S.R., Wintermantel, W.W., and Lewellen, R.T. (2002). Comparisons of soil and seed applied insecticides to control *Beet Curly Top Virus* in the San Joaquin Valley. J. Sugar Beet Research. 39(3-4):59-74

Table 1. Root yields and treatments (t/ha)

I45, I90: Imidicloprid at 45 or 90 g a.i. per 100,000 seeds. Clothianidan applied at 15 g a.i. per 100,000 seeds.

Planting date	*Variety*	*Root yield*	*Insecticide*	*Root yield*
Jan. 25	B4430	86.4	Control	69.9
	NB7	65.4	Thimet	73.3
	USH11	65.4	I45	75.4
			I90	73.7
	$LSD_{(0.05)}$	5.6		6.27
March 5	B4430	77.1	Control	67.0
	NB7	65.9	Thimet	69.4
	USH11	67.2	I45	71.0
			I90	72.6
	$LSD_{(0.05)}$	6.59		7.6
April 15	B4430	76.8	Control	64.3
	NB7	66.1	Thimet	67.9
	USH11	67.9	I45	69.9
			I90	74.6
			Clothianidan	74.8
	$LSD_{(0.05)}$	4.0		5.22