Effect of Planting Date and Vector Control on the Suppression of Curly Top and Yellows In Sugarbeet[1]

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Curly top and the yellows viruses often jointly infect sugarbeet in the San Joaquin Valley of California. Sugarbeet varieties used in this area are resistant to the curly top virus but can be damaged when infected in the seedling stage (3)[4]. Giddings (4) has shown that curly top resistant varieties infected with the beet yellows virus are more susceptible to damage by the curly-top virus.

Temik, [aldicarb, 2-methyl-2(methylthio)propionaldehyde-O-(methyl carbamoyl)oxime], a soil applied granular insecticide has been under test for the control of aphids and other insects. This material has been effective in controlling the green peach aphid, *Myzus persicae* (Sulzer), on sugarbeet (6). Georghiou (2), O. A. Hills (5), and Burtch (1) have shown that soil or seed applications of phorate (Thimet) can suppress curly top in sugarbeet. Concurrently with the experiments reported here, Malm and Finkner (7) have shown Temik and other soil applied granular materials to be effective in suppressing curly top and improving beet yield.

Two experiments were conducted at the University of California's West Side Field Station in Western Fresno County. The objective was to obtain information on the effects of planting and harvest dates with and without insecticide treatment for virus suppression. Temik was selected as an insecticide that would provide maximum control of the green peach aphid and thus maximum suppression of the beet yellows and western yellows viurses.

Procedure

In each of the two trials, main plots of five planting dates with and without Temik (10 treatments) were established in four randomized complete blocks. Temik, two pounds active ingredient per acre, was applied three inches under the seed just prior to planting. At each subsequent date of planting Temik, at

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[4] Numbers in parentheses refer to literature cited.

two pounds per acre, was side-dressed to previously treated plots. This resulted in five applications of Temik for the first planting date decreasing to one for the final planting. Each main plot was twelve 30-inch rows wide and 125 feet long and was split at random for four dates of harvest. A curly-top resistant variety, Spreckels Sugar Company's 301-H, was used in both experiments.

Aphids were counted by examining ten plants per main plot until plants reached the sixteen leaf stage. Thereafter, five plants per main plot were examined. Sugarbeet leafhopper [*Circulifer tenellus* (Baker)] populations were determined as the number of leafhoppers per ten sweeps of a standard insect net. Percent virus infection was based on visual symptoms on twenty-five plants per main plot.

Results and Discussion

Results of the 1967 trial are summarized in Table 1. In this trial yellows suppression was evaluated too late in the season to show maximum effects of Temik treatment. Temik did, however, produce an overall significant reduction in percent yellows. The effects of Temik and planting dates on curly-top infection were striking. Early planting and Temik application both reduced the incidence of curly top and improved root yield.

To better understand the effects of planting date and Temik treatment, the 1968 trial was expanded to include periodic evaluation of infestations of the green peach aphid, the beet leafhopper, and of yellows and curly top diseases. The results are summarized in Tables 2 through 5.

The number of green peach aphids per plant for each treatment on different dates (March 12 to April 30) are shown in Table 2. This 7-week interval covered the period of aphid population buildup in late March and early April and also the population decline in late April as predator activity increased and temperatures became too warm for aphid reproduction. Over this period there was an average of 15 aphids/non-treated plant as compared to 0.5/Temik treated plant of the first 3 planting dates. The March 15 planting only received the at-plant application of Temik during the period aphid counts were taken. This application kept the aphid level below 0.5 aphid/plant through mid-April, but aphid numbers increased from 0.3 on April 17 to 3.5 on April 23 and to 7.0 aphids/plant on April 30. Thus a single 2 pound application was effective for about 4 weeks.

Temik markedly suppressed the incidence of yellows early in the growing season (Table 4). Even though many of the Temik treated beets eventually became infected, more grew yellows-free for a longer period of time. This gave a yield advantage to the

Table 1.—Effect of planting date and vector control on the incidence of yellows and curly top and on sugarbeet production at three harvest dates. Values are means of four replications. West Side Field Station 1966-67.

Date of observation or harvest	Planting date and number of Temik applications										LSD 5%	Significant effects, 5% or less[1]
	Nov. 1		Jan. 2		Feb. 2		Mar. 30		May 4			
	5	0	4	0	3	0	2	0	1	0		
						% Yellows						
7/15	81	81	70	86	81	88	62	82	16	19	14	P, T
						% Curlytop						
7/15	5	5	1	9	4	23	19	76	54	98	27[2]	P, T, PXT
9/13	42	78	38	52	54	94	74	93	88	90	22	P, T, PXT
						Tons roots per acre						
8/17	30.4	25.9	28.6	26.0	25.1	21.6	19.3	13.9	12.8	10.3	3.0	P, T
9/13	33.8	28.7	32.6	30.8	31.1	25.4	22.6	10.2	15.0	12.7	2.6	P, T
10/11	35.8	30.9	37.5	33.9	33.5	26.0	25.2	18.8	14.6	13.7	3.6	P, T
						% Sucrose						
8/17	13.6	14.1	13.8	13.8	13.4	13.5	12.7	13.6	11.8	11.6	0.8	P
9/13	13.7	13.8	14.2	14.2	13.2	13.8	13.3	13.2	13.2	12.7	0.8	P
10/1	13.9	13.3	14.4	13.8	14.1	13.5	13.1	12.1	12.8	12.2	1.3	P, T

[1] P = plant date, T = Temik.

[2] Analysis of variance only includes March and May planting dates.

Table 2.—Effect of planting date and Temik treatment on the number of green peach aphids per plant. Two replications were counted on each date. West Side Field Station 1967-68.

Date observed	Planting date and number of Temik applications							
	Nov. 1		Dec. 15		Feb. 1		Mar. 15	
	5	0	4	0	3	0	2	0
	Number of aphids per plant							
March 12	0.2	4.0	0.4	2.0	0.2	1.5	...	...
March 20	0.1	3.0	0.2	3.8	0.1	5.0	...	...
March 27	0.4	5.0	0.2	11.0	0.6	9.0	0.0	0.5
April 4	0.0	11.0	0.1	20.0	1.0	9.0	0.0	5.5
April 9	1.0	13.0	0.5	35.0	1.0	15.0	0.3	6.5
April 17	1.0	17.0	0.2	100.0	0.3	35.0	0.3	2.0
April 23	1.5	5.0	2.0	38.0	0.9	12.0	3.5	10.0
April 30	0.6	6.0	0.5	6.5	0.3	3.5	7.0	7.5

Table 3.—Effect of planting and Temik treatment on relative numbers of sugarbeet leafhoppers. Values are means of four replications. West Side Field Station 1967-68.

Date observed	Planting date and number of Temik applications									
	Nov. 1		Dec. 15		Feb. 1		Mar. 15		May 1	
	5	0	4	0	3	0	2	0	1	0
	Number of leafhoppers per 10 sweeps of standard insect net									
5/16/18	0.3	1.5	0.0	2.0	0.0	2.3	0.3	3.3	[1]	
5/28	0.3	1.3	0.3	1.5	1.3	1.5	0.5	1.3	0.0	1.0
6/6	0.0	6.5	0.0	10.0	0.0	10.0	0.0	11.0	1.3	1.3
6/14	0.3	3.0	0.0	4.0	0.0	3.3	0.5	5.3	3.8	4.0
6/20	0.5	2.5	1.0	4.8	0.8	3.8	0.8	4.3	4.5	2.8
6/25	0.0	1.5	0.0	10.0	0.0	3.5	0.5	10.5	1.0	0.5
7/5	0.0	6.0	0.0	5.5	0.0	1.0	0.0	16.0	2.0	1.5
7/10	0.0	0.8	0.0	2.0	0.0	0.8	0.0	3.5	0.0	0.0
7/16	0.0	5.0	0.3	6.0	0.0	2.0	0.0	6.3	0.5	3.0
7/25	0.0	8.3	0.3	7.5	0.0	6.3	0.0	10.5	2.0	3.3
7/31	0.7	4.0	0.3	8.0	0.0	4.0	0.0	10.7	2.3	1.0

[1] Plants too small for accurate counts.

Table 4.—Effect of planting date and Temik treatment on per cent disease. Percentages are averages of three replications. West Side Field Station 1967-68.

Date observed	Planting date and number of Temik applications									
	Nov. 1		Dec. 15		Feb. 1		Mar. 15		May 1	
	5	0	4	0	3	0	2	0	1	0
	% Yellows									
4/23/68	12	66	[1]	...	...	...	...	...	...	...
5/16/68	33	68	38	85	38	75	8	42	...	...
6/27/68	55	62	60	68	53	83	63	83	3	3
	% Curlytop									
5/16/68	0	5	0	0	0	2	3	30	...	...
6/27/68	0	15	5	2	2	17	8	95	83	90
8/8/68	2	30	0	12	0	15	7	92	93	90

[1] Where percentages are not shown plants were too small for symptom evaluation.

Table 5.—Effect of planting date, Temik application, and harvest date on sugarbeet root yield and sucrose concentration. Values are averages of four replications. West Side Field Station 1967-68.

Harvest date	Planting date and number of Temik applications										LSD 5%	Significant effects, 5% or less[1]
	Nov. 1		Dec. 15		Feb. 1		Mar. 15		May 1			
	5	0	4	0	3	0	2	0	1	0		
	Tons roots/A.											
7/17[2]	32.8	30.8	29.5	25.2							3.0	P, T
8/14	39.8	33.5	32.7	28.2	32.5	30.2	26.5	21.0	6.3	6.1	3.9	P, T, PXT
9/11	43.6	35.5	37.2	32.6	39.1	33.4	31.3	19.7	10.1	10.4	3.9	P, T, PXT
10/9	44.6	41.4	38.0	34.6	40.0	34.7	32.8	20.5	11.3	9.0	3.9	P, T, PXT
11/13[3]					41.8	37.3	33.8	21.2	11.3	11.5	4.8	P, T, PXT
	% Sugar											
7/17	14.8	14.5	14.8	14.7							ns	
8/14	15.3	14.7	15.3	14.4	15.8	15.5	14.3	13.5	13.8	14.2	0.5	P, T, PXT
9/11	15.2	14.9	15.7	15.6	15.4	15.2	14.8	13.6	13.7	14.3	0.5	P, T, PXT
10/9	14.7	14.2	15.2	14.4	15.4	14.8	14.8	13.3	13.5	13.8	0.5	P, T, PXT
11/13					15.3	14.7	14.6	13.2	14.0	14.5	1.1	P

[1] P = planting date, T = Temik, ns = not significant.
[2] Only the first 2 planting dates harvested.
[3] Only the last 3 planting dates harvested.

Temik treated beets since the larger a sugarbeet is before being infected with yellow viruses, the less will be the yield reduction caused by the viruses.

Sugarbeet leafhopper populations were high enough to evaluate the ability of Temik to control this insect. Temik treatment consistently kept the average leafhopper level at less than 1 per 10 sweeps for the first 4 dates of planting (Nov. 1 - March 15) but did not consistently reduce the number of leafhoppers on May 1 planted beets (Table 3). The incidence of curly top in the various treatments (Table 4) paralleled the level of leafhopper control. That is, Temik treatment significantly reduced curly top in the first 4 planting dates but not in the May 1 planting.

Yield results are given for the 1968 trial in Table 5. In both trials (Table 1 and 5), Temik significantly increased root production for the first 4 dates of planting but not for the May planting. For the 4 earlier planting dates Temik applications resulted in an average yield increase over all harvest dates of 4.2 and 6.0 tons of beets per acre in 1967 and 1968 respectively. The inability of Temik to control leafhoppers and prevent infection of May planted beets by the curly top virus accounts for the very poor root yields of this planting date. Therefore, although Temik appears to be an excellent insecticide for suppressing yellows and curly top, other virus control measures such as early planting, maintaining beet-free periods, and use of a virus resistant variety are necessary for successful crop production.

The incidence of curly top in untreated plots planted November 1, December 15, and February 1 of the second trial (Table 4) was quite low and, therefore, most of the yield increase resulting from Temik applications for these 3 dates of planting can be attributed to suppression of yellows. The yield increase from the March 15 planting was due to suppression of yellows and curly top.

Temik rather consistently increased the sucrose percentage of beet roots. Most likely this was due to yellows suppression as curly top is not known to affect sucrose concentration.

Since Temik is also effective as a nematocide, soil samples were collected from plots that had and had not received Temik. Examination of these samples did not reveal nematodes that affect sugar beets. It is our conclusion that the yield increase due to Temik application was due to the suppression of yellows and curly top.

Summary

Temik, a soil applied insecticide, reduced the incidence of yellows and curly top and increased root production and sucrose concentration of sugar beets. Improved sugar production was associated with control of the insect vectors of these diseases.

Early planting (November to February) was important in maximizing root production. Delaying planting until May greatly reduced the incidence of yellows but increased the incidence of curly top to the extent that a profitable root yield could not be achieved at any date of harvest.

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