TITLE : Project 75-B. Insect Pathology and Storage Control.

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I. OBJECTIVES & GOALS: Field evaluation of commercial products of *Bacillus thuringiensis* for navel orangeworm control on Nonpareil Almonds.

II. ABSTRACT. We tested 2 wettable powder products, Dipel and Biotrol XK, at high dosage rates of application using a Kinkelder sprayer. Five applications were made at about 10-day intervals, starting at hull crack. A synthetic molasses feeding stimulant was added to the spray to attempt to overcome any possible reluctance of larvae to feed on areas covered by the B.t. Fifty trees were used in each test plot and each plot was sprayed with 50 gal. of B.t. suspension.

Samples of nuts for examination were removed from the experimental trees about 5 days after the last application. Analysis of the data showed no significant reduction in NOW damage attributable to the B.t. treatments.

We feel that the timing of the applications and coverage of the spray in this field trial were good. Perhaps a greater volume of spray per tree would provide better penetration into the hull-shell interspace where larvae feed.

III. EXPERIMENTAL PROCEDURE: Field trials with Bacillus thuringiensis were conducted at the Holly Farm, McFarland, Calif. Five applications were made on the following days: July 18 and 30, August 12, 22, and 29. Nuts were harvested on September 2 and 3. The four test plots were as follows:

Control	Untreated
Mo-Bait*	1 qt/treatment
Biotrol XK + Mo-Bait	4 lbs/treatment
Dipel + Mo-Bait	2 lbs/treatment

*Synthetic molasses feeding stimulant.

All products were mixed with 50 gal. water and sprayed with a truck mounted Kinkelder sprayer. Each test plot consisted of 50 Nonpareil trees.

To obtain an estimate of the effectiveness of spray penetration and stability of the spores, bacteriological "swab samples" were taken 11 days after one application and then immediately after the next. (Untreated control samples were also checked.) A sample was taken from each of five nuts from one tree.

IV. RESULTS: The results of bacteriological samples are presented in table 1.

They indicate that there is a relatively low level of naturally occurring B.t. on the inner surface of the almond hull. Further, after 11 days the viable spore count may drop to about ½ that which occurred immediately after the treatment is applied.

(Eleven days was the longest period between treatments in the 1976 trial). We didn't take enough swab samples to obtain statistically valid numbers; the samples were taken only to obtain a rough indication of how well the spores penetrated the hull-shell space relative to the untreated control nuts. Generally, we feel that good penetration was obtained with the Kinkelder sprayer; however, also note the very high dosage rates used.

The results of analyses of the treatment of rejected nuts caused by NOW is presented in Table 2.

The numbers are the % by weight of NOW damaged nuts in a random 1 lb sample taken from each tree. Results are presented as 10 samples from 5 replicates in each test plot (10 x 5 = 50 trees).

To briefly summarize, the results are as follows:

Control..... 8.54% rejects

Mo-Bait.....10.91% "

Biotrol XK + Mo-Bait.....12.37% "

Dipel.....13.08% "

Because of the variability in the samples, there is no statistical difference (Analyses of Variance) between the amount of damage in the control and the damage in the Mo-Bait and Biotrol XK + Mo-Bait. The difference between the control and Dipel + Mo-Bait is statistically significant (0.05 level).

V. DISCUSSION: We interpret the results to indicate that Mo-Bait does not increase the efficacy of the B.t. products used in this

test. Also, the B.t. products did not reduce the incidence of NOW damage. Why? We feel that the answer may lie in the feeding behavior of the newly hatched NOW larvae. Because of their negative response to light, the larvae may seek the deepest recesses of the hull-shell interspace before starting to feed. The bacteriological samples indicated a degree of penetration, apparently it was not sufficient. Perhaps a greater volume of B.t. suspension/tree would provide greater penetration into the hull-shell interspace.

Table 1.--Estimates of B.t. Concentrations on Almonds - McFarland, CA. - 1975

Sample*	Control	DIPEL		BIOTROL XK	
		Immediate post spray	11 days post spray	Immediate post spray	11 days post spray
1	0**	1200	576	592	1048
2	14	1160	488	274	1248
3	7	1680	544	888	272
4	0	1048	216	1560	1336
5	0	416	592	224	496
Total	21	5504	2416	3538	4400
Avg.	4.2	1100	483	707	880

*Swab sample taken from inner surface of hull and exposed shell.

**24 hr cultures on nutrient agar (number of colonies)

(Note: Rate of application - 2 lbs Dipel/50 trees in 50 gal water -- 4 lbs Biotrol XK/50 trees in 50 gal water)

le 2.--1975 Field Test with B.t. on Almonds (McFarland)

	Replicates--Control					Replicates-"Mo-Bait"				
	1	2	3	4	5	1	2	3	4	5
ple 1	6.0*	10.0	6.1	17.3	7.6	19.5*	15.3	13.2	15.4	13.7
2	7.9	7.6	11.1	5.6	15.1	12.4	17.8	14.4	14.8	11.9
3	-	7.1	8.1	7.8	4.4	11.0	12.6	9.0	11.8	10.3
4	3.2	13.8	5.7	10.4	9.5	9.1	5.7	8.4	11.7	11.5
5	2.7	5.4	7.8	10.7	7.7	9.2	12.8	5.5	16.4	12.7
6	12.2	14.7	6.2	12.8	4.0	6.6	8.8	7.5	13.9	9.8
7	2.9	5.5	8.6	5.8	4.7	7.5	6.1	11.0	10.9	5.0
8	2.6	7.6	10.8	4.1	10.1	9.6	8.3	5.0	10.8	12.7
9	4.1	15.6	5.4	14.9	8.2	7.0	11.5	16.2	14.3	5.4
10	14.0	15.7	8.5	12.3	11.0	10.3	7.9	13.4	9.7	10.0
al	55.6	103.0	78.3	101.7	82.30	102.2	106.8	103.6	129.7	103.0
	6.18	10.30	7.83	10.17	8.23	10.22	10.68	10.36	12.97	10.30
iation	4.32	4.22	2.02	4.31	3.43	3.73	3.99	3.86	2.27	2.97

NOW damage (rejects) to nutmeats (weight basis)

vg. for
ıtrols: 8.54 ± 0.77
std. error)

% Avg. for
Mo-Bait: 10.91 ± 0.52

le 2 (cont'd)

	Replicates-Dipel + Mo-Bait					Replicates Biotrol XK + Mo-Bait				
	1	2	3	4	5	1	2	3	4	5
ple 1	17.5*	11.8	16.4	4.3	16.2	9.4*	20.0	16.9	10.6	12.6
2	21.5	16.2	11.1	12.6	9.5	21.4	15.9	8.9	16.8	5.9
3	20.5	6.3	16.3	7.6	7.3	15.2	9.1	17.7	7.8	10.5
4	13.2	11.0	19.1	10.0	8.7	10.3	19.0	15.7	11.9	10.3
5	14.3	15.4	18.5	14.6	9.8	16.0	8.7	8.6	5.6	10.6
6	13.6	18.3	17.6	4.4	8.3	17.2	12.3	22.7	6.6	10.9
7	7.3	13.1	15.7	9.3	9.1	22.0	17.9	12.9	6.1	5.7
8	14.3	8.6	12.9	2.9	10.0	16.0	8.2	19.9	14.1	7.8
9	18.2	10.8	12.3	8.3	12.9	21.1	14.4	11.6	20.1	16.4
10	7.8	17.2	22.5	6.2	7.0	6.8	21.2	9.0	10.3	7.5
al	148.2	128.7	162.4	80.2	98.8	155.4	146.7	143.9	109.9	98.2
	14.82	12.87	16.24	8.02	9.88	15.54	14.67	14.39	10.99	9.82
iation	4.78	3.89	3.46	3.75	2.76	5.29	4.88	4.96	4.83	3.25

NOW damage (rejects) to nutmeats (weight basis)

Avg. for Dipel: 12.37 ± 1.52 % Avg for Biotrol: 13.08 ± 1.12
± Std. error)