Project Number: 79-C6

Title: Project 79B - Insect Parasitic Nematodes

Prepared by: James E. Lindegren

I. Objectives: To determine the biological control potential of the insect parasitic nematode, Neoaplectana carpocapsae for the control of navel orangeworm.

II. Interpretive Summary: Invasive stage insect-parasitic nematodes, Neoaplectana carpocapsae (Mexican strain), were effectively applied by helicopter and commercial ground application with a respective 45.2% and 72.3% nematode distribution. (Table 1 Test #2) Both 2% emulsifiable Volk oil and semi concentrate water nematode applications increased nematode distribution and baited NOW mortality, compared to standard dilute applications, by approximately 1/3. (Table 1 Test #1)

A California exemption from tolerance was obtained for the 1979 almond tests.

The insect parasitic nematode rearing procedure published this year is being modified. Preliminary data indicates that nematode rearing costs may be reduced to less than $.10 per million.

III. Experimental Procedure and Results: See Table 1

Subsequent statistical analysis of 1 lb in hull almond samples, one sample/treatment, indicated that there was no significant difference for treatment vs control in any of the applications. (Table 2) and raw data (Table 3)

IV. Discussion:

The 1979 test applications determined that the invasive stages of the insect parasitic nematode N. carpocapsae could successfully be applied with conventional delivery systems and that semi concentrate applications with 2% Volk oil increased the nematode distribution.

However, probably because of sample size and variability, no significant difference was found in nut damage for treatment vs control. Future nematode applications will be concerned with the evaluation of NOW nut damage after optional application of N. carpocapsae (ie 5 acres, 3 to 4 applications at maximum dosage, 450 x 10^6 nematodes/acre).

There exists a potential in N. carpocapsae and/or N. glaseri for the control of the American plum borer and the Pacific peach tree borer attacking almond trees in the Turlock and Tracy areas.

of Neoaplectana carpocapsae, 1979

Illustrated in the histograms below are results from commercial spray applications of the insect-parasitic nemotode, Neoaplectana carpocapsae Weiser. To indicate nematode distribution navel orangeworm larvae were placed into random split-hull almonds at varying heights in the trees. Trees were then sprayed and after three days the monitor almonds were inspected for NOW mortality, parasitism and the % distribution of nematodes. High air temperatures experienced during the first nematode application account for lower readings in test #1. *Test 1 indicated that low volume or oil or a combination of these might give optimal distribution. The low volume-oil applications of Test 2 did manifest this prediction, even at 1/2 the nematode concentration.

Subsequent statistical analysis of 1 lb in hull almond samples, one sample/treatment, indicated that there was no significant difference for treatment vs control in any of the applications. (Table 2) and raw data (Table 3)

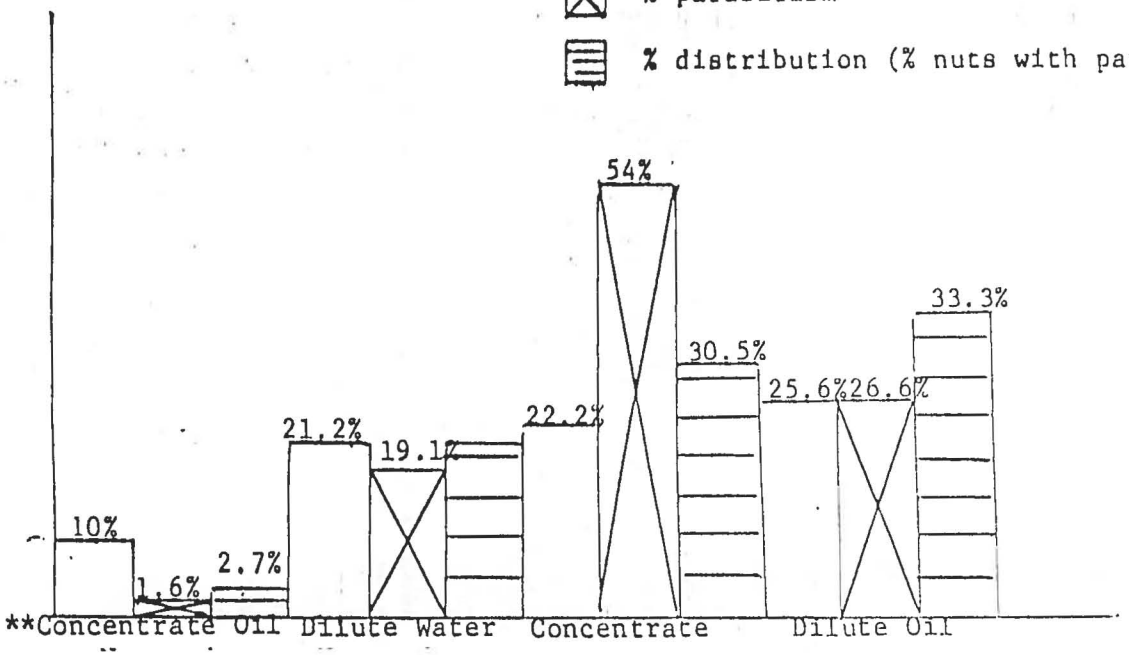
Plot Size	Test 1: 54 Nonpareil Almond Trees
	Test 2: 80 Nonpareil Almond Trees (Helicopter)
	40 Nonpareil Almond Trees (ground rig)
Date	Test 1: 7-17-79 6 pm - 9:45 pm
	Test 2: 7-19-79 6 am - 6:15 am (helicopter)
	8:30 am - 12:00 noon (ground)
Spray rate	Test 1: N. carpocapsae @ 450 million/acre in 450 gal dilute or 100 gal semi concentrate
	Test 2: N. carpocapsae @ 225 million/acre (helicopter & ground) 100 gal/A semi concentrate
Equipment used	Test 1: Mayers Mity Mist 3 point sprayer
	Test 2; Helicopter and Bean (Power takeoff) sprayer

☐ % mortality

☒ % parasitism

▤ % distribution (% nuts with parasitized larvae)

st #1



Test #2

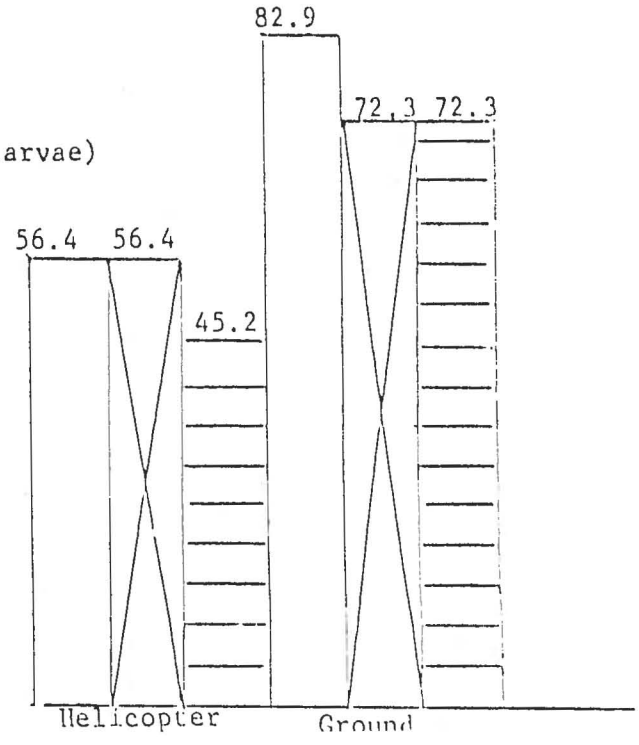


Table #2

Data Tabulation: Neoaplectana carpocapsae Weiser (Mexican Strain)

Spray Application on Almonds (Sanger 1979)

Treatment	Nut Damage From NOW	Nut Damage From Others	Nut Damage Total Nut Damage	Hull Damage	NOW Larvae	Other Larvae	Total Larvae	NOW Pupae	Other Pupae	Total Pupae
*Untreated control	36	3	39	96	30	44	74	58	2	60
Dilute Water Nem.	16	0	16	63	4	36	40	9	1	30
Dilute Water Control	30	1	31	134	16	85	101	31	7	38
Dilute Oil Nem.	23	1	24	47	13	16	29	14	6	20
Dilute Oil Control	21	2	23	82	6	46	52	16	3	19
Conc. Water Nem.	19	1	20	88	6	69	75	8	2	10
Conc. Water Control	10	3	13	86	12	48	60	13	3	16
**Conc. Oil Nem.	17	2	19	122	15	88	104	17	6	23
Conc. Oil Control	26	1	27	60	12	31	43	23	4	27

*Untreated control trees within the test blocks

**Nematodes inactivated by high temperatures during spray application

***Raw data recorded from 300 random nut samples

Table #3

Duncan's MR W/Various Factors — Na carpocapsae Spray Application on Almonds: Sanger 1979

5%	Nut Damage	Hull Damage	Nut & Hull	Larvae	Papae	Combined
Raw	UNC 6.50A	DWC 22.33A	DWC 27.50A	DWC 23.17A	UNC 10.00A	DWC 50.67A
	DWC 5.17A	CON 20.33AB	CON 23.50A	UNC 22.33A	DWC 6.33AB	UNC 44.83A
	COC 4.50A	UNC 16.00AB	UNC 22.50A	CON 21.00A	COC 4.50B	CON 44.50A
	DON 4.00A	CWN 14.67AB	CWN 18.00A	CWN 14.17A	CON 3.83B	CWN 32.17A
	DOC 3.83A	CWC 14.33AB	DOC 17.50A	CWC 12.50A	DON 3.33B	CWC 29.00A
	CWN 3.33A	DOC 13.67AB	CWC 16.50A	COC 11.67A	DOC 3.17B	DOC 28.83A
	CON 3.17A	DWN 10.50AB	COC 14.50A	DOC 11.33A	CWC 2.67B	COC 26.17A
	DWN 2.67A	COC 10.00AB	DWN 13.17A	DWN 8.33A	CWN 1.67B	DWN 21.50A
	CWC 2.17A	DON 7.83B	DON 11.83A	DON 8.17A	DWN 1.67B	DON 20.00A
5% SRT	UNC 2.31A	CON 4.46A	CON 4.85A	CON 4.55A	UNC 2.77A	CON 6.62A
	DWC 2.11A	DWC 4.37A	DWC 4.80A	DWC 4.35A	DWC 2.35AB	DWC 6.43A
	DOC 1.95A	UNC 3.78A	UNC 4.42A	UNC 4.13A	COC 2.04AB	UNC 6.05A
	COC 1.89A	CWN 3.72A	DOC 4.19A	CWN 3.56A	CON 1.94AB	CWN 5.45A
	CWN 1.86A	DOC 3.71A	CWN 4.15A	DOC 3.35A	DOC 1.82AB	DOC 5.35A
	CON 1.80A	CWC 3.62A	CWC 3.91A	CWC 3.24A	DON 1.79AB	CWC 5.04A
	DON 1.799A	DWN 3.19A	COC 3.62A	COC 3.16A	CWC 1.55B	COC 4.76A
	DWN 1.76A	COC 3.09A	DWN 3.50A	DWN 2.90A	CWN 1.42B	DWN 4.57A
	CWC 1.54A	DON 2.76A	DON 3.24A	DON 2.60A	DWN 1.41B	DON 4.12A

5% = 5% level of significance

RAW = Raw Data

SRT = Square Root Transformation

Note: in concentrated oil nematode (CON) treatment, nematode mortality was high due to high temperatures experienced.