INTRODUCTION

Navel orangeworm (NOW) is one of the most important insect pests of walnut in California.

NOW overwinters in walnuts ("mummies") left in the trees following harvest. Consequently, within our total control program for NOW we first recommend orchard sanitation; i.e 1) Dormant tree shaking and the removal of mummy walnuts; and 2) the destroying of these nuts once they are on the ground by shredding.

Not all growers have shredders and must rent or contract for this service, an added expense. Further, shredding is not always compatible with a grower's existing cultural program (e.g. cultivated orchards).

The effect of other orchard floor management systems (e.g. sod) or other cultural practices (e.g discing and or irrigation) on overwintering NOW survival is unknown. If other orchard floor management systems or cultural practices are effective in destroying mummy walnuts, then growers would have additional alternatives to shredding mummy nuts.

OBJECTIVE

The study was designed to determine effects of several orchard floor management practices on survival of overwintering NOW in mummy walnuts on the ground.

PROCEDURE

In early December 1990, approximately 80 lbs of in-shell Serr walnuts were collected from the orchard floor of a mature orchard in Porterville CA (having had an economic level of NOW damage the previous harvest). Twenty, randomly collected, ten nut lots were sub-sampled from the 80 lbs were "cracked-out" to estimate the level of NOW infestation of the entire lot. From that crack-out, we found 27% of the nuts infested with one or more NOW. Infested nuts had an average of 1.19 +/- 2.99 NOW larvae and pupae per nut.

250 randomly selected NOW-infested nuts were assigned to each of four treatments. The treatments were: 1) nuts placed on a weed free "berm" (to simulate bare ground); 2) nuts placed in
weed cover on the orchard floor; 3) nuts placed on the orchard floor and shredded with a flail mower; and 4) nuts placed on the orchard floor and disced in two directions. Each of these treatments was replicated four times. Thus, according to our pretreatment crack-out average infestation of 1.19 NOW per nut, approximately 300 NOW larvae or pupae were included in each replicate or 1200 in each treatment.

Nuts were subjected to the above treatments on December 20, 1990 in the same orchard where they were collected. Each replicate was covered with a 1m x 1m square base by 1m high mesh pyramid cage. Each cage was equipped with a quart canning jar affixed to the apex of the pyramid to catch emerging adult NOW moths. Any nuts spread out by the disking treatment wider than 1m x 1m were gathered and placed under their respective cage in their same position within the soil. Ambient temperatures and rainfall were monitored throughout the experimental period in the orchard. Due to low rainfall, the orchard, and all treatments except where nuts were placed on the berm, were irrigated twice during the winter (approximately 10" of water total). Approximately 7.5 in. of rainfall occurred during March.

Each cage was monitored once every other week during the winter until moth emergence began in March. Following initial moth emergence, the cages were monitored weekly and adult moths recorded until June when field emergence activity ceased. An additional 127 nuts (approximately 150 NOW larvae or pupae) from the sample lot were reserved for observation of moth emergence and occurrence of any parasites under laboratory conditions.

RESULTS AND DISCUSSION

Effects of the December 1990 freeze: Nuts assigned to treatments were placed in the orchard on 20 December. From December 21st to 25th minimum ambient temperatures below 20 degrees F were sustained in the orchard. Lowest minimum during the period was 16 degrees F. Following the freeze, we cracked-out nuts in the orchard outside of the experiment and detected minimal NOW mortality that could be attributed to cold temperatures. This observation was verified comparing total moth emergence in the field with that in the laboratory where freezing conditions did not exist. In that comparison, only about 15% more total moths emerged as adults under ideal lab conditions than in the field. From this we conclude the December 1990 freeze did little to confound the results cited below.

NOW survival vs orchard floor management: Significantly higher moth emergence occurred when mummy nuts were placed on a bare berm than either in weeds, disced up, or shredded (see table 1.). Mummy nuts placed on the bare berm yielded an average of 63.3 adult NOW moths per replication during the emergence period,
29 March - 19 June. This compares with an average of 8.8 total adults trapped from nuts placed in weeds, an average of 2.3 total moths trapped from disced nuts and 0 moths trapped when nuts were shredded (see Fig. 1). Percent recovery from the initial population was 21%, 3%, 1% and 0% respectively.

As expected and previously recommended, shredding mummy nuts destroys the entire population of overwintering NOW. Where shredders are not available, disking or allowing nuts to remain in a weedy cover results in a considerable reduction of the population, perhaps to sub-economic levels. Allowing nuts to remain on a bare berm (like bare, weedless ground) allows optimal conditions for continued development and ultimate emergence of adults from overwintered larvae and pupae.

*Adult NOW emergence:* Adult NOW, from overwintered larvae and pupae, emerged in the field for a 9 week period of time. Initial emergence began on 1 April 1991 peaked on 30 April. Following that date, emergence declined and ceased 8 June (see Fig 2).

It is important to note that peak adult NOW emergence coincided closely with peak adult codling moth activity as monitored with a pheromone trap placed high in the tree canopy (Fig 3). Further, substantial NOW egg laying activity in the test orchard, as monitored with black NOW egg traps baited with almond press cake and oil and placed high within the trees’ canopy, occurred during the last one half of May, probably coincident with codling moth infestation from first generation larvae (see Fig. 3).
Figure 1
"NOW" OVERWINTER SURVIVAL
Serr Walnut; Bob Saak, Porterville - 1991
Average Moths Emerged per rep 3/29 - 6/19 - 4 reps

On Berm
63.25
In Weeds
8.75
Shredded
0
Disced Up
2.25

Treatment
Overwintering Adult Moth Emergence

NOW OVERWINTER SURVIVAL

Figure 2
Eggs/Trap day

Moths/Trap Day

NAVEL ORANGE WORM - 1991
Tulare County: 3/11 - 8/31/91

Date

Note 92

Codling Moth Flight

Tulare County: 3/11 - 8/31/91
Table 1. Total Adult NOW catches  
March 29 - June 19, 1991

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total</th>
<th>Ave.</th>
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<td>Bare Berm</td>
<td>72.0</td>
<td>91.0</td>
<td>50.0</td>
<td>40.0</td>
<td>253.0</td>
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<td>Weeds</td>
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<td>18.0</td>
<td>1.0</td>
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<td>Schredded</td>
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<tr>
<td>Disced</td>
<td>4.0</td>
<td>0.0</td>
<td>5.0</td>
<td>0.0</td>
<td>9.0</td>
<td>2.3 b</td>
</tr>
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Numbers followed by the same letter are not significantly different (p=0.05 DMRT)