ABSTRACT

Research into practical control methods for carpenterworm, *Prionoxystus robiniae* (Peck), a large wood boring larva, was continued. Observations indicate this pest primarily attacks older trees of the Hartley variety that are infected with deep bark canker, a stress-related bacterial disorder. Carpenterworm (CW) also attacks the Franquette variety. Hartley orchards with substantial deep bark canker appear capable of sustaining moderate production until the additional stress factor of CW is encountered; this results in a much more rapid decline in orchard quality and yield.

Results from monitoring adult flight activity correlated with observations made in figs: CW adults begin emerging during the second or third week of March and end by the first week in July. The initial date and rate of emergence is quite temperature dependent. Fall application of two parasitic nematode species, *Neoaplectana carpocapsae* and *N. bibionus*, indicated that neither could be applied by a backpack blower-mister (simulating a Speedspray application) and obtain successful CW control even with concentrations of approximately 3000 nematodes/cm². Fall applications using a commercially available hand-held pressure sprayer at 2,500, 8,333 and 25,000 nematodes/ml of each species provided about 60 percent control; this was 20 percent less than the previous season's study. These results would suggest that CW control with parasitic nematodes has practical limitations. However, it is presently the only method other than preventing stress conditions which encourage initial infestation.

OBJECTIVE

To develop a practical and efficacious method of controlling carpenterworm (CW) in walnuts. To determine if CW is a primary or secondary pest by evaluating the relation between plant stress, deep bark canker (DBC) and CW infestation.

PROCEDURE

Three Hartley walnut orchards varying in their level of CW infestation and distance from the Kings River (site of several CW host species) were monitored twice weekly for adult flight activity from March 15 to September 30 using the standard wing trap and a host-specific pheremone. Trap density was approximately one per acre; they were placed at least 100 feet in from each orchard's perimeter. A fourth orchard was selected for conducting two completely randomized and replicated trials designed to evaluate two methods of applying parasitic nematodes as well as two species, *Neaplectana carpocapsae* and *N. bibionus*, for efficacy. Fall applications were considered optimum due to favorable temperatures and nighttime relative humidity in excess of 70 percent. Fall is also when CW oviposition is completed and early instars are vulnerable.
The first trial involved the use of a backpack blower-mister to simulate a speedspray application. Fifteen trees containing at least ten active CW galleries in the lower 12 feet were selected. Prior to treatment, each gallery was marked with a colored plastic push-pin for later identification without making the gallery location obvious during treatment. The blower-mister treatments were applied the night of September 26, 1985, under favorable environmental conditions. The lower 12 feet of five trees were treated with *N. carpocapsae* at the rate of four million nematodes suspended in 1900 ml of distilled water and 100 ml of powdered charcoal used for commercial shipment and coverage evaluation. Counts made on 1.5 cm diameter foam disks taped to the tree before treatment indicated an average nematode population of about 3200/cm². An additional two trees were each treated with an equal amount of *N. bivonius*, a species reported in recent studies as more virulent than *N. carpocapsae*. The control treatment consisted of five trees each sprayed with only the charcoal-water mixture. One week following treatment, five galleries from each tree were excavated and the recovered CW examined for mortality and parasitic nematode invasion.

The second trial, applied October 8, utilized a two-quart hand-held pressure sprayer (Spray Doc®) capable of stream sprays up to 15 feet. Both nematode species were applied at three concentrations (2,500, 8,333 and 25,000 nematodes/ml) to approximately 15 active galleries on individual trees. An equal number of galleries were treated with the charcoal-water mixture on a seventh tree for a control. One week following application, ten galleries per treatment were excavated and evaluated for nematode parasitization.

A third study was initiated in 1985. It consisted of treating 20 CW infested Hartley trees in a commercial orchard with the hand-held sprayer at the concentration of 25,000 nematodes/ml. Each tree will be retreated if needed and observed for growth response in comparison to untreated trees.

**RESULTS AND DISCUSSION**

Results from monitoring the adult flight of CW in the three selected Hartley orchards is shown in figure 1. With the exception of the average number of moths/trap/night caught during peak activity, each orchard is surprisingly similar in CW flight pattern. Significant moth emergence began about March 30 and then rapidly reached a distinct peak April 9. Following the peak, a lower, erratic trap count was sustained in all three orchards until July 1. Flight activity during 1985 was substantially different than that of 1984; the flight began about 10 days earlier and then experienced two peaks, one on March 25-30 and the other on May 15-20. Review of weather records for the two seasons indicates CW emergence increases with the transition to warmer temperatures. The single, sharper peak in 1985 correlates well with an extended cool period in mid-March followed by a distinctly warmer April. Field observations also indicate that pupation occurs sooner in galleries located on the southern side of the tree.

Neither nematode species applied by the blower-mister resulted in effective CW control. None of the CW excavated from the treated or untreated trees were parasitized.
Results from the hand-held pressure sprayer trial indicated an average CW mortality of 60 percent using the *N. carpocapsae* species with no significant difference between the three concentrations applied. These results were approximately 20 percent less than the preliminary trial performed with the same applicator in 1984 using nematode concentrations equal to 25,000/ml. The lower performance in 1985 was attributed to a less healthy population of *N. carpocapsae* which apparently suffered during shipment from Australia.

Trials with *N. bibionus* resulted in an average CW mortality of only 30 percent with greater efficacy observed at the lowest concentration. This response has been reported by other researchers investigating this species. They have suggested that CW may be capable of sensing and then avoiding parasitic nematodes if present in sufficient concentrations.

**CONCLUSION**

Field observations suggest that carpenterworm (CW) can have an adverse effect on the quality and productivity of the walnut tree. It does not, however, appear to invade healthy, vigorous trees but acts as a secondary pest invading trees already under stress. Therefore, the orchardist's primary defense should be to adopt cultural practices which minimize problems of poor infiltration and deep bark canker. One should also avoid planting stress-sensitive varieties such as Hartley on soils prone to such problems. Establishment of CW in Hartleys already infected with deep bark canker will compound the stress problem and thus increase the tree's rate of decline.

Research conducted during the past two seasons demonstrates the difficulty in controlling CW once infestation occurs. Presently, the only method known to control this pest is the use of parasitic nematodes which is quite labor intensive since they must be applied directly to the gallery by means of a hand-held sprayer. Results from 1985 research indicated *N. carpocapsae* is a more effective species than *N. bibionus*. Nematode concentration can also apparently be reduced from the originally recommended 25,000/ml to 2,500/ml without sacrificing effectiveness. This decreases the material cost per treated gallery from approximately $0.30 to $0.03, making it more economically feasible to consider treating.

As in many other biological control agents, parasitic nematodes are adversely affected by poor handling. This can be a major problem since the typical user lacks the skills needed to evaluate nematode viability.

Another disadvantage is the preferred treatment time; Fall application in September and October provide the proper environment and an opportunity to control young larva but it also coincides with the walnut grower's busiest time of year.

An alternate and hopefully more practical method of CW control in walnuts would possibly be to develop a means of using the commercially available pheremone to disrupt adult mating during their relatively short flight period. This concept is presently being evaluated for
Oriental Fruit Moth control in stone fruits and it appears promising. However, the limited market and large tree size are two obstacles which might make this unfeasible for walnuts.
CARPENTERWORM MANAGEMENT IN WALNUTS
TRAP-COUNT DATA FOR 1985

AVG. MOTHS/TRAP/NIGHT

VERBOON ORCHARD
VAN BEEK ORCHARD
VIERRA ORCHARD

FIGURE 1