# DISRUPTION OF OLFACTORY COMMUNICATION IN ORIENTAL FRUIT MOTH AND LESSER APPLEWORM IN A VIRGINIA PEACH ORCHARD[1]

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*Abstract*: Dispensers (20-cm polyethylene capillary tubing; "ropes") containing Oriental fruit moth pheromone were placed in a 4-ha block of peaches shortly before first male flight. This placement of ropes disrupted attraction to conventional pheromone traps for the duration of the season. Fruit damage was not significantly different from that in a control block (conventional pesticide application); twig damage was significantly lower relative to the control. Implications for pest management in mature and nonbearing blocks are discussed.

Key Words: Oriental fruit moth, *Grapholita molesta*, lesser appleworm, *G. prunivora*, pheromone, disruption, peach.

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Oriental fruit moth, *Grapholita molesta* (Busck), is an introduced pest of peach and apple. It has three to four generations in the northern part of its range (four in Virginia) and six to seven in the south (Bobb 1973; Brunner and Howitt 1981). Larvae of early generations tunnel in ends of twigs, while those of later generations bore into fruit flesh.

Lesser appleworm, *G. prunivora* (Walsh), is a native species that causes damage similar to that of *G. molesta* (Brunner and Howitt 1981). It appears to have only one to two generations throughout its range (Quaintance 1908; Brunner and Howitt 1981), and is attracted to pheromone traps used for *G. molesta* (Gentry et al. 1974, 1975; Cardé et al. 1977).

Several studies (reviewed by Gentry et al. 1982) have employed the sex pheromone of *G. molesta* in a variety of dispensers to attempt disruption of olfactory communication in that species. Most studies examined disruption of attraction to conventional traps but did not examine damage. Such disruption of male capture using varying pheromone-release technology has been reported for periods ranging from two to five weeks (Gentry et al. 1974, 1975) to 121 days (Cardé et al. 1977). Other studies have used small experimental orchard units which may have allowed immigration of gravid females from outside the treated area (Rothschild 1982).

The present study, in which a new type of dispenser was used in a block large enough to minimize the effect of immigrating gravid females, was undertaken to determine not only the disruption of attraction of *G. molesta* to conventional traps, but also the feasibility of this technique for preventing damage by this species in the Appalachian fruit-growing region.

## MATERIALS AND METHODS

The treated area was a 4-ha 'Monroe' peach block at Batesville, Virginia. Dispensers were made of 20-cm polyethylene capillary tubing (hereafter called

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"ropes"; Shin-Etsu Chemical Co., Ltd., Tokyo), each loaded with 75 mg of pheromone [93% (Z)-8-dodecenyl acetate: 6% (E)-8-dodecenyl acetate: 1% (Z)-8-dodecenol]. On 4 April 1986 (about petal fall stage), two ropes were placed in each tree at ca. 2-m height to achieve a rate of 1000/ha. In 1987, ropes were placed on 14-15 April (full bloom). Release rate from ropes is 5-12 mg/ha/hour (P. Kirsch pers. comm.). The block was 26 rows wide at the widest point but narrowed to a bottleneck of 10 rows at one edge where it adjoined an additional peach orchard. Except for an apple orchard across a road from the treated area, the block was surrounded mainly by mixed deciduous woodland. The treated block had no insecticide treatment for the entire season, except for one parathion spray applied mistakenly.

The control area for both years was a 4-ha block of 'Rio-Oso-Gem' peaches separated from the treated block by 0.2 km of apple orchard and woodland. The control treatment consisted of a program of conventional insecticide applications, parathion 0.85 kg ai/ha, every two weeks from petal-fall until two weeks before harvest. The control treatment was defined as such (rather than a totally untreated control) because of the need to compare disruption technology with conventional insecticide practices. The control cultivar is expected to be equivalent to the treatment cultivar in susceptibility to injury by *G. molesta* because both have late-maturing fruit, an important factor in varietal susceptibility to this species.

Because of the large size of plots deemed necessary, the cost of replication would have been very high. Therefore each plot was treated as a nonreplicated experimental unit and inferential statistics were not applied (Hurlbert 1984). Descriptive statistics were employed (Altieri and Schmidt 1985).

As a means of determining disruption, seven commercially available *G. molesta* pheromone traps (Trece Inc., P. O. Box 5267, Salinas, CA 93915) were placed in each block on 11 April 1986. In 1987, four traps were placed in each block on 13 April. Each trap was separated by at least 60 m. Numbers of captured *G. molesta* and *G. prunivora* were recorded weekly and the moths were removed from the traps. Identifications were periodically confirmed by dissecting genitalia (Heinrich 1926). Lures were replaced after six to seven weeks. Trap bottoms were replaced when they became excessively contaminated with insect parts, dust, etc.

In 1986, damage was evaluated on 3 July and 21 August (harvest). On 3 July, five trees per block were randomly selected for sampling; on 21 August, ten trees per block were sampled. In 1987, damage was evaluated on 21 July on five trees per block. Twig damage was recorded as the number of affected twigs seen during a two-minute examination of each sampled tree. Fruit damage was recorded as the number of fruit damaged in a sample of 20 fruit per tree. Damage was assumed to be caused by *G. molesta*.

## RESULTS AND DISCUSSION

Olfactory communication in both *G. molesta* and *G. prunivora* was totally disrupted for the entire growing season as determined by pheromone trap captures in both 1986 and 1987 (Table 1). Relatively low population densities of *Grapholita* spp. were present in both orchard blocks; population suppression by olfactory disruption is more effective at low population densities because males experience increased difficulty in finding the lower number of females (Kydoneius and Beroza 1982). Population densities of *Grapholita* spp. and twig damage may have been reduced by early hardening off of terminals induced by drought (Schoene et al. 1937). The years of the study were drought years [1986: 5.9, 7.2, 6.6, 6.5, and 11.2 cm rainfall in April through August, respectively; 1987: 23.2, 6.3, 3.0, 10.9, and 3.0 cm in the same months (unpublished data)].

Table 1. Seasonal trap capture data for *Grapholita molesta* and *G. prunivora* in peach orchards at Batesville, VA.*

| | Mean *G. molesta* per trap | | Mean *G. prunivora* per trap | |
|---|---|---|---|---|
| | 1986 | 1987 | 1986 | 1987 |
| Pheromone-treated | 0.0(0.0) | 0.0(0.0) | 0.0(0.0) | 0.0(0.0) |
| Insecticide-treated | 40.7(7.4) | 64.5(9.8) | 46.6(10.5) | 43.2(3.1) |

* Numbers in parentheses represent standard deviations.

No fruit or twig damage was observed in the pheromone-treated block in either year (Table 2). Fruit damage was also very low in the parathion-treated control block in both years. More affected twigs were seen in the control block than in the pheromone treatment in 1986. Fewer damaged twigs were seen on 21 August than on 3 July. This is probably due to the majority of this damage being caused by larvae of earlier generations, and after weathering and plant development some affected twigs were not clearly recognizable as such. Random variation may also present a factor in the discrepency between the two dates since different trees were selected for each sampling date. It was concluded that disruption of olfactory communication was at least as effective as a conventional insecticide program.

Table 2. Damage data for *Grapholita molesta* in a peach orchard at Batesville, VA.*

| 1986 | | | | 1987 | |
|---|---|---|---|---|---|
| Infested twigs per tree | | Damaged fruit per 20 fruit | | Infested twigs per tree | Damaged fruit per 20 fruit |
| 3 Jul | 21 Aug | 3 Jul | 21 Aug | | |
| Pheromone-treated | | | | | |
| 0.0(0.0) | 0.0(0.0) | 0.0(0.0) | 0.0(0.0) | 0.0(0.0) | 0.0(0.0) |
| Insecticide-treated | | | | | |
| 6.0(2.3) | 2.0(0.6) | 0.0(0.0) | 0.1(0.1) | 2.0(1.1) | 0.0(0.0) |

* Numbers in parentheses represent standard deviations

The source of the dispensers (Pacific Biocontrol, 1121 L. Street, Sacramento, CA 95833) directs that ropes be applied prior to first moth emergence and replaced 90 days later. Cost of ropes is estimated to be $225-240/ha for two applications. This cost would be reduced to $112-120/ha by using a single application, thus enhancing economic feasibility. The present study used a single placement to effect season-long disruption. Insecticide costs for seasonal control are $116, 52, or 90/ha for azinphosmethyl 50W, parathion 25W, and carbaryl 50W, respectively [based on seven insecticide applications recommended against *G. molesta* (Virginia 1987)]. Current assessments of economic feasibility of the mating disruption technique vary (Rothschild 1975; Vickers et al. 1985). The use of mating disruption for control of such low population densities of *G. molesta* can be justified since disruption is more effective against low population densities and will more effectively maintain this pest at low levels.

It is important to note that the above costs for pheromone and insecticide do not include labor or other related costs (fuel, machinery, etc.). In this study, the application of ropes was timed to precede flight of *G. molesta* and occurred in the bloom to petal-fall period, a time when laborers are not normally in the orchard. Labor for such an application would cost $12-15/ha (at a $4-5/hour base). However, first-generation *G. molesta* larvae damage only the shoot tips and this damage is not considered important except in trees three years old or younger (Bobb 1973). Therefore it may be possible to wait until slightly later in the season, that is until fruit-thinning operations when workers give individual attention to each tree. This would greatly reduce the labor cost.

Insecticide application still retains the benefit of controlling other pests, such as catfacing insects and plum curculio in the early part of the season and Japanese beetle later in the season. However, this pheromone technology may lend flexibility to orchard pest management programs by eliminating the need to monitor and control a direct pest, thereby allowing orchardists to concentrate on other insect pests. An alternative emphasis of a pheromone suppression program centers on young orchards. An early placement of ropes could significantly reduce twig damage relative to insecticide applications. Twig damage is more important in young orchards than in bearing orchards because this is when initial tree training occurs. Actively-growing twigs are present on such young trees for a greater proportion of the growing season than on mature trees (Schoene et al. 1937). Lack of fruit in young orchards eliminates the need for insecticides directed against fruit pests, so an early placement of pheromone dispensers could greatly reduce total insect control costs in addition to elimination of twig damage.

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