Physical Barriers as a Means to Reduce Grape Root Borer, *Vitacea polistiformis* (Harris), Infestations in Vineyards and in Greenhouse Muscadine Plants[1, 2]

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ABSTRACT Grape root borer, *Vitacea polistiformis* (Harris), larval populations were apparently reduced in an old abandoned muscadine vineyard when physical barriers (ground cloth) and other methods were used in a 3-yr test. Statistical differences among treatments for any one year did not exist, but overall larval counts were statistically lower at the end (1991) than at the beginning (1989) of the test. Weed Barrier, a ground cloth, was consistently effective in reducing neonate larval penetration by 42 - 45% in potted muscadine ('Fry') plants in the greenhouse during studies in 1990 and 1992. Also, significantly fewer larvae became established in roots of plants in the weed barrier treatment than in the no-barrier treatment. An experimental woven polypropylene was less effective.

KEY WORDS Sesiidae, *Vitacea polistiformis,* physical barriers, ground cloths, larvae, muscadine

The grape root borer, *Vitacea polistiformis* (Harris), has long been reported to attack bunch and wine grapes (Brooks 1907), but their presence became noticeable in mature vineyards much later in the Southeast (Wylie 1972, All and Dutcher 1978). Control strategies for *V. polistiformis* are limited. Treatments of the insecticide chlorpyrifos (a standard recommended treatment) require applications during fruit development to coincide with beginning moth flight in south Georgia. Timing applications is critical, and effective treatment is difficult, particularly in early-maturing varieties because of allowable residue tolerance of fruit at harvest (All et al. 1985). Alternative control measures are much needed. There has been limited success with mating disruption using a pheromone, but to date, few of these control measures have proven to be as effective as insecticides (Johnson et al. 1991, Wylie 1972).

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[2] Mention of a trademark or proprietary product does not constitute a guarantee or warranty of the product by USDA and does not imply its approval to the exclusion of other products that may also be suitable.

Physical barriers (ground coverings) such as Weed Barrier® and an experimental polypropylene (BASF Corp., 100 Cherry Hill Road, Parsippany, NJ) offer potential for control of grape root borer. These materials also provide other benefits. They are water permeable and exclude light to discourage weed growth as well as retain soil moisture. Grape root borer larval feeding activity is generally confined to the crown (trunk) area, and they must feed on varying-sized roots that extend out 50 cm in all directions from either side along the trunk (Dutcher and All 1978, 1979). Logically, ground coverings installed to cover the root area could interrupt neonate larval entry into the soil as well as reduce moth emergence. However, data are difficult to obtain in vineyard situations because of the small size of neonate larvae. Larval counts and root damage assessment can best be done by excavating and destroying the plants.

This paper reports a three-year vineyard study with concurrent greenhouse testing to determine the effects of ground covering materials in reducing grape root borer infestations in muscadines.

Materials and Methods

A portion of an old commercial vineyard near Ocilla, GA, that was known to have an infestation of grape root borer, was used for testing. The test was set up during the spring of 1988, well before the beginning of moth flight. Treatments consisted of a black polyethylene plastic (commonly used for fumigating), Weed Barrier (a commercially available spun fabric), an experimental polypropylene woven fabric, chlorpyrifos insecticide (applied as a drench in July), and a control. Before ground coverings were installed, the ground beneath the main vine (1 m wide × 3 m long) was cleaned (grass and weeds removed). Then, ground coverings were installed and covered with 5 cm of sand to hold covers in place and in contact with the ground. Gutter nails were used to stake the perimeter of the coverings for stability. A completely randomized block design was used consisting of 7 treatments and 7 replications (7 vines/rep). Treatments and replications were set up in triplicate at the beginning of the experiment. Thus, 49 vines (7 treatments × 7 reps) were excavated (destroyed) each year (November) and eventually a total of 147 vines (49 × 3) were removed and evaluated by the end of the test in 1991.

Greenhouse studies using potted 2-yr-old 'Fry' muscadine plants obtained from a commercial nursery were started in 1990. Young larvae to be used for infesting plants were obtained by collecting gravid grape root borer females from a commercial muscadine vineyard during mid-day (11 AM - 3 PM EDT) during September, 1990, near Ocilla, GA. Collectors searched the grassy middles between trellis lines observing moth flight activity. Female moths are larger than males and their characteristic flight pattern is generally slower as they hover near the ground at the edge or under the vines. Insect sweep nets were used to collect them while they were ovipositing during mid-day. The majority of females captured were gravid because they mate during late afternoon and deposit most of their eggs the following day (Dutcher et al. 1978). They were retained individually in ventilated snap-cap plastic vials and immediately placed into ice chests and transported to the laboratory within 3 h. Females were placed in clear plastic Petri dishes on moistened filter paper under clear plastic funnels in the laboratory rearing room at the end of each day of collecting. Mesh filter paper was renewed each day for the life of each female (6-10 d). Filter paper containing eggs were dated and held for hatch. Eggs were held until just before projected hatch and then used to infest potted muscadine plants. The availability of eggs determined the number of plants that could be infested on a given day. The first eggs collected were refrigerated to delay hatch so that a wider age range of eggs could be used to initiate a uniform experiment. Treatments consisted of a spun fabric and a woven polypropylene ground covering. Each of the materials was secured to the open end of plastic cups (7 cm) and twenty eggs were placed inside. The cups were inverted so that the ground coverings were in direct contact with the soil surface in each pot containing one muscadine plant. Consequently, upon hatching, neonate larvae could only escape through the ground covering to enter the soil to infest the root system. Treatments were set up in 10 days. Ten days later, dead larvae were counted and eggs were examined for hatch. Larvae not accounted for were assumed to have penetrated through the ground covering. Later (approximately 9 wk), test plants were removed from the soil pots and their roots were examined for grape root borer larvae and root injury. There were 25 replications. In 1992, a similar test was run except that 24 replications were used.

Results

Vineyard Test. Muscadine vines were first excavated and examined for live larvae during November, 1989. Counts ranged from 0.71 - 2.29 larvae/vine (Table 1). Statistical differences were noted among treatments, but the first year's data had little value because exact larval infestations were not known before treatments were applied. In 1990, larval counts were substantially lower than in the previous year, and there were no statistical differences among treatments. In fact, vines in three of the treatments had no larvae. The untreated vines produced only slightly more larvae than any of the other treatments. In 1991, again there were no statistical differences among treatments, but overall larval counts were higher than the previous year. When comparisons were made for the entire treatment period, each of the treatments showed that larval numbers were reduced except for the no-barrier treatment. Percentage of larval reduction for the 3 years ranged from 20-81% in all treatments while the untreated check increased by 55%. When total larvae recovered from all treatments and the check were compared for the 3 years, counts were significantly reduced (1989 = 1.12a, 1990 = 1.15 c, 1991 = 0.64 b) (F = 1.30; df = 78; P > 0.05).

Greenhouse Tests. In 1990, Weed Barrier, a spun fabric, effectively reduced neonate larval penetration by 42% (Table 2). Fewer roots were damaged and significantly fewer larvae were recovered. In 1992, ground coverings produced similar results. Weed Barrier was again most effective in significantly reducing larval penetration. Larval recovery from roots under the Weed Barrier was significantly less than either the experimental polypropylene or the untreated check. Larval infestations in all treatments were greater in 1992 than in 1990.

Table 1. Comparison of several ground coverings and a standard insecticide treatment for reduction of graperoot borer larval infestations in an old commercial muscadine vineyard, Ocilla, GA.

Treatments	Mean No. Larvae Recovered per Vine*		
	1989	1990	1991
Untreated	0.71 b	0.33 a	1.57 a
Weed Barrier	1.14 ab	0.00 a	0.71 a
Weed Barrier (W/C)**	2.29 a	0.29 a	0.43 a
Exp. Polypropylene	0.71 b	0.00 a	0.57 a
Exp. Polypropylene (W/C)**	0.86 b	0.14 a	0.29 a
Black Polyethylene	1.14 ab	0.00 a	0.40 a
Chlorpyrifos (drench)	1.00 ab	0.29 a	0.25 a

* Means followed by the same letter in a column are not significantly different (DMRT, $P \leq 0.05$).
** Treated topically with chlorpyrifos (2.24 kg/ha) once each year during July.

Discussion

The use of ground coverings in mature vineyards may offer potential control of grape root borer if they are well maintained. Results of the field test revealed an overall reduction in infestation of grape root borer. However, it must be noted that the muscadine vineyard in this test was past its prime in production. It was not maintained culturally as a commercial vineyard, i.e., it was not fertilized, weeded, mowed, or irrigated to allow vines to grow with maximum vigor. Consequently, the overall vigor and health of the plants and roots may have been inadequate to support healthy larval growth. Gravid grape borer females may not be attracted to a declining vineyard (Sorensen 1975).

Greenhouse studies provided an opportunity to gather quantitative data with much lower variability. Neonate larvae did have difficulty penetrating the Weed Barrier (spun fabric). Small muscadine plants supported an average of 2.5 larvae/plant when larvae were allowed to enter the soil without restriction to find roots. Because 20 eggs were placed in each pot and hatch was usually ± 95%, an infestation success rate of 13% appeared to be maximum. These plants may not be able to support any more larvae because of their small size. Other factors such as parasitic fungi and lack of moisture very likely contribute to neonate larval mortality, but these factors are minimal in greenhouse confinement. Potentially, infestation success rates are much less in vineyards (< 5%) because of the factors just mentioned (Sarai 1972, All et al. 1987). The large root systems in mature muscadine vineyards can support more larvae than smaller plants, but the effect on the plant is less damaging (Sorensen 1975). However, the data from this study suggest that physical barriers (ground coverings) can contribute to reducing grape root borer populations.

Table 2. Effects of ground coverings on grape root borer neonate larval penetration, root feeding injury, and subsequent larval infestation in roots of potted muscadine plants in the greenhouse, Byron, GA.

Treatments	No. Plants	Total Eggs	% Hatch	% Larval Penetration	% Plants w/Root Damage	Mean No. Larvae/Plant
			1990*			
Untreated	50	933	94 a	100 c	36 ab	1.0 c
Exp. Polypropylene	50	977	91 a	84 b	46 a	0.9 b
Weed Barrier	50	951	96 a	58 a	20 b	0.6 a
			1992*			
Untreated	48	868	99 a	100 c	–	2.5 b
Exp. Polypropylene	48	953	98 a	84 b	–	2.2 b
Weed Barrier	48	950	95 a	55 a	–	1.2 a

* Means followed by the same letter in a column and year are not significantly different (DMRT; $P \leq 0.05$).

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