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ROOT WEEVILS: SOME ADULTS OVERWINTERED, OTHERS ARE STILL EMERGING

Damage

The larval stage of most root weevils is generally the most damaging. However, an exception is the damage done to arborvitae from feeding of the adult stage of the strawberry root weevil. The adult strawberry root weevil (*Otiorhynchus ovatus*) may cause significant damage to arborvitae (the larval root damage by this weevil is usually insignificant). The adults devour the new foliage and may girdle the steins, resulting in dead or dying terminals. Damage is usually restricted to the upper half of the plant and is most noticeable in late summer and fall (Lehman, 1983). Adult feeding on arborvitae and other plants may be significant in geographic areas where winter temperatures rarely fall below freezing.

Young root weevil larvae feed on root tips and small roots thereby reducing uptake of water and fertilizer ions by the plant. This results in reduced plant growth and possibly wilting and nutrient deficiency symptoms. The older larvae feed upon the larger roots and the bark at the base of the stem. This feeding may result in girdling of the plant: complete girdling of the stem will lead to death of the plant.

Life cycle

Larvae are the most common overwintering form, although adults occasionally will overwinter under mulch and debri at the base of the plant.

The larvae overwinter in the soil at a depth of 6-14 inches. Through the winter months the larvae feed on the plant rootlets, -even at soil temperatures as low as 35 degrees Fahrenheit: larval and pre-pupal development can occur at rather low temperatures from autumn-spring. Prior to the third molting period, the young larvae confine their feeding to the smaller roots, but after that they commence to feed upon the larger roots and also the crown, that portion of the bark where the base of the stem joins the root mass (Brydon, 1945). During the last stages of their development, the larvae are crescent-shaped, legless grubs, dirty white in color, about one-half inch to five-eighths inch long and have a brownish head.

When the soil temperature warms to 53 degrees F in the spring, pupal development may occur. The larvae pupate at a depth of 1-2 inches from the soil surface. The soil temperatures in the northern portion of the Willamette Valley generally exceed 53 degrees F after May 115. **When**

soil temperatures exceed 53 degrees F, the pupation period is relatively short, and adults begin to emerge in late May to early June (Stenseth, 1979).

The adult emerges from the pupal stage and feeds upon the foliage, causing notches along the leaf margins. At air temperatures below 49 degrees F, though adults feed on the leaves, they do not develop to the reproductive phase. Maturation of the ovaries and **egg laying takes place after two-four weeks feeding, but occurs only if air temperatures are above 53 degrees F.** Outdoors in the Pacific Northwest, adults start emerging in May and continue to emerge until September, with greatest emergence occurring in July.

The mature adult deposits its eggs on the ground or in the crevices of bark, or under litter around the plants (the Obscure root weevil may deposit its eggs in folded leaf tips). The adult has the potential to produce over two hundred eggs, and actual number produced will depend upon host plant, temperatures and other environmental factors. Photoperiod (daylength) as well as air temperature determine the length of the egg laying period of the black vine weevil (Nielsen and Dunlap, 1981). Nielsen reported that egg laying by an individual adult peaks 3 weeks after commencement, and may continue at a low level until several weeks after the daylength has decreased to 12 hours or less (that would be several weeks after the fall equinox, September 22). Occasionally, adults will go into hibernation in the fall and produce eggs in early spring. Twenty-five percent of adults caged outdoors at Vancouver, Washington, survived the winter of 1975-76 (Garth and Shanks, 1978). However, within greenhouses and other protected areas, adults may survive and resume egg laying as daylength increases and exceeds 12 hours (after March 21) if air temperatures are above 53 °F. Greenwell (1978) reported that it is not uncommon to find adults, larvae, and pupae simultaneously in greenhouses in early spring.

The eggs hatch 11-22 days, depending upon the prevailing temperature, after they are deposited by the adult. For example, eggs deposited in late May would hatch into young larvae around mid-June.

The larvae feed on the plant root system throughout the summer, fall and winter months when the soil temperature is above 35 degrees F, - feeding initially on smaller roots, then larger roots, and progressing to the crown of the plant where feeding of the mature larvae may girdle the plant. The larvae will not develop to the pupal stage at soil temperatures either above 80 or below 53 degrees F. These temperature thresholds combined with the feeding time required at each stage of larval development result in the life cycle being approximately 1-year in length from egg-laying to emergence of the adult the following year.

Hosts

Black vine weevils utilize a number of wild plants as hosts. Adults feed on a wider range of plant types than do larvae (Smith 1932). Thus, some plants will show foliar feeding (leaf edge notching) and yet have good root systems undamaged by root weevil larvae. Weevils can persist on wild plants and invade cultivated plants when they become available. Two common weeds, Himalaya blackberry (*Rubus thyrsanthus* Focke) and salal (*Gaultheiria shallon* Pursh), are preferred hosts in British Columbia (Cram and Pearson 1965). Euonymus and wild grape are also suitable hosts for adults.

A few examples of other plants attacked are: arborvitae, azalea, rhododendron, viburnum, yew, rose, camellia, conifer seedlings, and seedling deciduous trees such as maples, cherry, and plum. Nonwoody plants such as strawberry, begonia, Lily of the Valley, primrose, and peony are also hosts of root weevil.

Control

The stages when control by insecticide applications is most feasible are the ADULT and the EARLY LARVAL STAGE. Weevil resistance to control chemicals listed in Tables 1 and 2 has NOT been detected. However, to minimize potential for development of resistance, the applicator should alternate in selecting insecticides for application among the different chemical groups (organophosphates, pyrethroids, carbamates) in Tables 1 and 2.

FOLIAR SPRAYS (Table 1) - The foliar spray applications at 3-4 week intervals commencing with sighting of the first fertile adult in the spring through the long summer days when the emerged/emerging adults are fertile (i.e. until late September early October) are an attempt to apply an insecticide to the adult weevils before they begin to lay eggs. Complete spray-coverage of the plant, especially making sure that the spray penetrates the interior of the plant and undersides of the leaves where the adults may reside to avoid sunlight, and coverage of the soil under the plants is required. The spray directed at the base of the plant may contact adults and hatching larvae. Nielsen (1985) emphasizes that "Level of control is directly related to the degree of coverage, so use a hydraulic sprayer to control root weevils."

TABLE 1. FOLIAR CHEMICAL APPLICATIONS for control of adult root weevil.

Insecticide	Rate/100 gallons	Rate/gal
1. CARBAMATES:		
Turcam or Dycarb 76WP	Rates vary from 12 to 20 ounces. SEE LABEL FOR RATES.	
2. **ORGANOPHOSPHATES:**		
Orthene 75S	1.0 lb	1.0 Tbs.
Guthion 50 WP*	1.0 lb	1.0 Tbs.
3. **PYRETHROIDS:**		
Pounce 3.2 EC	8.0 ounces	
Pydrin 2.4 EC	5 1/3 - 10 2/3 oz	
Mavrik Aquaflow 2.0 lbs/gal	9.6 ounces	

*** A restricted use pesticide**

DRENCHES (Table 2) - Drenches should be thoroughly applied to bring the insecticide into contact with the larvae. Drenches are most effective against young, recently hatched larvae: The first larvae may hatch as early as mid-June in the Pacific Northwest. Applying a drench in the spring or early summer has not been recommended in the past, but several of the drench insecticides in Table 2 have a relatively long residual effect. Furadan has been reported to give up to 18 weeks residual control (Greenwell, 1978). Good control was obtained when drenches

were applied early and the larvae were young, i.e. .Mid-July (Greenwell, 1978). The frequency of application of drenches during the summer months will be determined by how long the chemical used will remain active in the soil. It should also be noted that during the summer period prior to the onset of cooler temperatures in the fall, the larvae will be closer to the soil surface where there is a higher probability that the insecticide will contact them. Nielsen (1985) states "Recent evidence indicates that overwintered larvae may also be susceptible to drenches in early spring."

CONTAINER DRENCHES:

1. CARBAMATES:

Furadan 4F ..... 1-2 ounces/100 gallons
Comments: Drench media thoroughly

Dycarb 76WP** ..... 2-4 ounces/100 gallons
Comments: 8 ounces drench solution/6-inch container; 1 pint/1-gallon container; 3 pints/3-gallon container; 5 pints/5-gal. container

2. ORGANOPHOSPHATES:

Orthene Tree &
Ornamental Spray ..... 1.0 lb/100 gallons
Comments: Drench media thoroughly

FIELD DRENCHES:

1. CARBAMATE:

Furadan 4F ..... 2 1/2 gallons/100 gallons
Comments: Direct spray to crown and root area. Follow with irrigation. Root zone must be drenched. Apply minimum of 100 gallons of drench per acre.

***A restricted use pesticide**

**Changes in the Dycarb label to include the use of Dycarb as a soil drench for control of black vine weevil larvae in container production of nursery plants were approved by EPA on January 25, 1985. Note: "Avoid alkaline water. For soil drench, buffer at pH 6.5-7.2 for best results." During the winter, plants dug for shipment should not be treated since control is marginal and hazard to those who may contact the treated foliage or soil in shipment or at destination is substantial.

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