An Aggregation of Root Weevils

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Abstract

When developing strategies for integrated management of root weevils in the Pacific Northwest, it is important to determine which species are present onsite, since each species may have different life cycles or respond differentially to pesticides. This study included 450 nocturnal collections of adult weevils and was conducted in landscapes and nurseries in the Pacific Northwest. Although most (60 percent) of the technical root weevil literature and most of the literature on landscape and nursery plants focuses on the black vine weevil, *Otiorhynchus sulcatus* (F.), this study revealed that the black vine weevil is not always the only weevil present. Indeed, it is sometimes not the dominant weevil at a site. As expected from the literature, eight weevil species in five genera were commonly observed: *O. sulcatus, O. ovatus, O. rugosostriatus, O. singularis, Nemocestes incomptus, Sciopithes obscurus, Trachyphloeus bifoveolatus,* and *Dyslobus granicollis.* However, nine other species and three genera were found in the study: *O. meridionalis, N. horni, N. montanus, Barypeithes pellucidus, Strophosoma melanogrammum, Sciaphilus asperatus, O. raucus* (a new state record) and one undescribed species, *Nemocestes* n.sp. This brings the total to 17 species in 8 genera. A brief overview of the expected weevils, summary of the new species, and a table with a photo and brief synopsis of each weevil is presented; a short consideration of seasonal weevil activity is also included.

Introduction

Despite more than a century of research on root weevils and the registration of scores of pesticides, root weevils remain among the top pests that damage plants in the Pacific Northwest (PNW) and in the United States. They cause substantial economic losses in nurseries and new landscapes, and aesthetic damage and some losses in established gardens. The members of the Washington State Nursery and Landscape Association listed root weevils as one of their top five research priorities, and 43 of those responding specified root weevils as their number one research priority (McGonigal and Goodman 1993). The Washington State Department of Agriculture (WSDA) has found that growers and pesticide applicators request Special Local Needs (SLN) labels and Section 18 exemptions for pesticides not currently registered for control of root weevils on ornamentals (Mary Toohey, WSDA 1997, personal communication).

Before an effective integrated pest management (IPM) program can be developed, the pest species must be identified correctly. Most of the primary literature published on root weevils focuses on the black vine weevil *Otiorhynchus sulcatus* (Fabricius), as do articles in trade publications and garden literature. It is reasonable to assume that most growers, pesticide applicators, and homeowners follow the management strategies in these articles. However, these strategies for black vine weevil may not control the other weevil species that cause significant damage to landscape and nursery plants.

Failure to control root weevils might be a result of missing the "window of vulnerability" for the unidentified species when following recommendations outlined for black vine weevils. Since timing of pesticide applications is aimed at the adult weevils, it is important to know when the adults of different species are likely to be present. The literature points to about 2 week differences in emergence of *O. sulcatus, O. ovatus,* and *O. rugosostriatus*. Breakey (1965) found all stages of *Nemocestes incomptus* all year long.

Also, there are differences in response to pesticides by different root weevil species. For example, Breakey (1965, p.3) reported that, "Both Eide […] and the writer have found that aldrin, dieldrin, heptachlor and chlordane have no effect on the woods weevil when incorporated in the soil for weevil

control." Yet, the native woods weevils (*Nemocestes* spp.) were killed by diazinon and DDT. At the time, aldrin, dieldrin, heptachlor, chlordane, and DDT were the recommended, and very effective, pesticides for controlling introduced *Otiorhynchus* weevils such as black vine weevil and strawberry root weevil. In recent studies, Rosetta et al. (1999) also found differences in efficacy of pesticides against different weevils.

More than 60 percent of the root weevil literature focuses on black vine weevil biology and control, but only a few (0–20 percent) feature the other 14 root weevil species found in this study. Only five species in three genera (*Otiorhynchus sulcatus, O. ovatus, O. singularis, Nemocestes incomptus, and Sciopithes obscurus*) have been studied extensively in the United States. Since most studies focus either on agricultural crops (berries, hops, and grapes) or nursery production grown under uniform conditions, the results must be adapted to landscapes and small nurseries with diverse plant material and environmental conditions. Furthermore, many of the studies on ornamentals were for black vine weevil in Ohio, Connecticut, and New York, where soils and climate differ significantly from the PNW. It is reasonable to expect that strategies designed to control the black vine weevil would not be as successful in the PNW or where the black vine weevil is but one in a complex of root weevil species in several genera.

It is also reasonable to assume the black vine weevil is not the only weevil in landscapes and nurseries. Wilcox et al. (1934) found 11 species in 6 genera in strawberry fields in Oregon. Andison (1948) reported that four species (*O. sulcatus, O. singularis, O. ovatus* and *O. rugosostriatus*) occurred on small fruits in British Columbia. Bell and Clarke (1980) stated that the obscure root weevil (*Sciopithes obscurus* Horn) comprised 95 percent of the weevils collected on rhododendron in Oregon. *Beetles of the Pacific Northwest* (Hatch 1971) listed 181 weevil species in 61 genera that feed on roots of plants. By eliminating the species that feed on field crops (such as alfalfa), seed crops, or vegetables this number is reduced to 43 possible pests of ornamentals in 13 genera. This shorter list includes only species that have been reported in the literature as feeding on plants likely to be used in home or commercial landscapes, or on native species grown and used for restoration.

In 1972, R. Lee Campbell (Washington State University Research and Extension Center, Puyallup) developed a key for 12 species in 8 genera that were root weevils of concern in nurseries and landscapes (unpublished file copy). Carmean (1986) reduced this to nine species in eight genera. All were potential pests of landscape plants, but few were documented extensively in the literature.

Is black vine weevil solely responsible for damage in PNW nurseries and landscapes? Pilot field collections (Collman personal collection data) suggested that several other species were present and feeding in landscapes and possibly in nurseries and that the dominant weevil species varied among and within sites. Research for my Ph.D. dissertation focused on the relative abundance and species diversity of adult root weevils in nurseries, landscapes, public gardens, and remnant natural areas, timing of adult occurrence, and their *in situ* host preferences. The data are still being analyzed, however, it is possible to share some notes on the weevil species that have been identified from these sites. The results presented are based on 450 nocturnal field collections and observations of weevils on their *in situ* free-choice host plants.

Methods

Weevil Census in Nurseries and Landscapes

Of the 85 field sites, 77 are located in Washington, 3 in western Oregon in the United States, and 5 in western British Columbia, Canada. Small and large nurseries, private landscapes, public gardens, and remnant natural areas are represented. Sixty-nine of the Washington sites were visited at least once; many sites were visited monthly, weekly, or on consecutive nights. At the remaining Washington sites, weevils were collected during the day or sent in by homeowners. Most of the study sites (61) were located in western Washington and eight sites were in eastern Washington. The sites ranged from sea level to the foothills of the Cascade Mountain Range; from the Puget trough to Spokane, and included two sites on San Juan Islands and three on Vancouver Island, British Columbia. West of the Cascades sites stretched from Vancouver, British Columbia to Corvallis, Oregon with most sites around the lowlands of Puget Sound.

Because this was a census of weevils at a site, most of the plants in a selected landscape or nursery area were inspected. Where a site was too large for an evening's survey, areas with known weevil problems were selected with guidance from the owner or manager. Start time varied from shortly after dusk to after midnight. It usually took 2 to 4 hours to complete the census of an area. Most collections were completed by 1:00 or 2:00 a.m. but on several occasions longer searches were conducted, and occasionally searches lasted until dawn.

All the plants in a selected area of a site were visually searched by flashlight with a strong central beam (K-2, Garrity, MagLites, or BioQuip Headlamp).

The light was focused on leaves (especially edges), stems, flowers, or pods. Shining the light through leaves (backlighting) sometimes revealed weevils hiding on the ventral surface. Visual searching was necessary in order to determine whether the weevils were actually feeding on the host. Each weevil was removed from the plant and placed in a collection container (sampling without replacement). The host and number of each weevil species were recorded. Following the visual search, a beating sheet was often placed under plants and the foliage shaken to dislodge weevils hidden under leaves, in leaf axils or flower heads, or on branches. These weevils were also removed, identified, counted, and placed in the same container. The next day weevils in the containers were identified to species and tallied.

Environmental conditions for each night (wind, rain, clear, cloud cover, moon, temperature, and relative humidity) were noted. For each host plant, the time, method of collection, identity and quantity of each weevil species, and whether actual feeding was observed were recorded. A weevil was determined to be feeding if the weevil was in the feeding position (posterior end tilted slightly away from the leaf), if the mouthparts were moving or the weevil was "rocking" as it chewed, or in very close proximity to fresh (wet) damage.

Board Trap Study

Root weevils were collected daily from board traps by the owners of a nursery site east of Seattle. Weevils were placed in plastic vials with one square of SCOTTTM 1000 Tissue to absorb condensation, labeled, and placed in a refrigerator. Weevils were then sorted and identified to species and data noted.

Results and Discussion

Weevil Census in Nurseries and Landscape

The following table (Table 1) contains photos (left column) and species name and a subjective summary based on observations to date, along with some descriptive notes on weevil abundance or pertinent literature (right column). The photos are arranged to facilitate identification of species that are similar in appearance, rather than taxonomically. This is meant to serve only as a preliminary guide to some of the weevil species in nurseries, landscapes, public gardens, and remnant natural areas in the PNW.

Board Trap Study

Based on the articles in both journal and popular literature, black vine and a few other weevils are generally considered to be spring and early summer pests. In this study several species of weevil were found beneath boards: *Otiorhynchus sulcatus, O. ovatus, O. rugosostriatus, O. singularis, Nemocestes incomptus, N. horni, N. montanus, and Sciopithes obscurus*. Although the data on individual species have not yet been completely analyzed, a monthly composite of all species in the system (Fig. 1) shows many more weevils in autumn and the presence of adults throughout the year. Subjectively, the high autumn numbers can be accounted for by the abundance of woods weevil, *Nemocestes incomptus*. Their numbers began to increase in mid-August and peaked in September and October. They remained active throughout the winter months. General subjective comments based on 450 site collections are as follows:

- Weevils were present and feeding through the entire night and until the first light of dawn whenever an all-night survey was conducted.
- Weevils fed in the rain and cold (lowest temperature at which feeding was recorded was 37°F).
- Some species, notably those in the genus *Nemocestes*, are abundant and active all winter long in the mild Puget Sound climate.
- A few individuals of species commonly thought to die off in the fall were found in winter months, although they were not numerous. (On one occasion, individuals of several species were found the night before a snowstorm. None were present while snow was on the ground, but they returned even before the last patches of snow had melted during the week that followed.)
- Root weevils are still providing surprises after 8 years of nocturnal gathering.

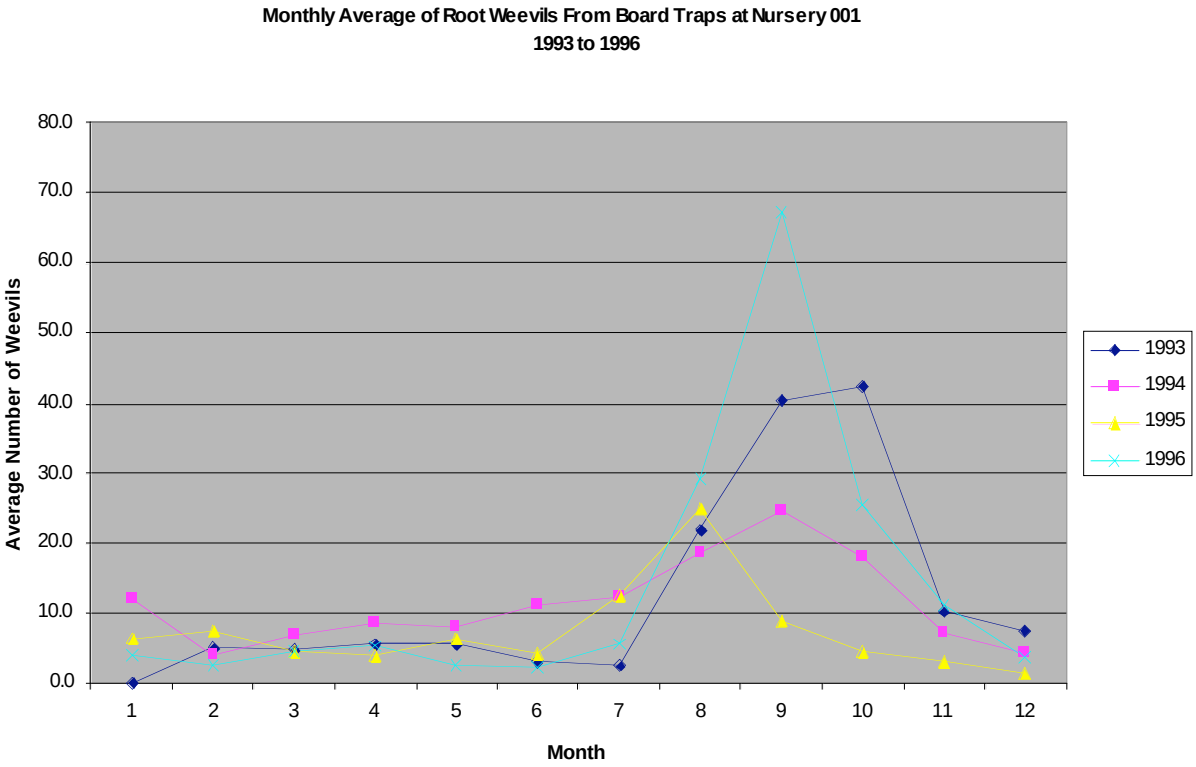

Figure 1. Daily average number of all root weevil species per month. Weevils were active throughout the year with the number peaking in August, September, or October.

Table 1. Root weevil species commonly found in the Pacific Northwest nurseries or landscapes. Most of the photos presented here were taken with a Nikon CoolPix 950 digital camera through a dissecting scope by Dan Bennett except where noted. The format follows that of Zimmerman's *Australian Weevils* (1992). Photos are not to scale. They are arranged in order of similarity rather than taxonomically for easier comparison of features. Dates of species introduction into the United States and the PNW and on species measurements are from Hatch's *Beetles of the Pacific Northwest* (1971).

Photo	Notes on the Root Weevil Species
	***Otiorhynchus sulcatus* (Fabricius 1775)—black vine weevil** • Introduced: E. N.Am. (since 1832); PNW (Victoria BC, 1891); (East Sound, WA, 1910 or 1911). • Size: 8–11 mm. • Color black with patches of yellowish hairs on elytra; thorax smooth with rounded tubercles. • Adults are always very common in nurseries and landscapes but not always the most numerous or the dominant species at a site. • Several hundred publications focus on this species. Smith (1932) provided a comprehensive summary of the known biology and hosts in Pennsylvania. Maier (1978) and Garth (1976) studied dispersal of adults. Cowles (1995) and Cowles et al. (1997) provide a comprehensive urban and nursery perspective. • A summary of black vine weevil biology and links by Yongsoo Son, Dept. Entomology, Virginia Tech, http://filebox.vt.edu/users/yson/bvweevil.htm

***Otiorhynchus ovatus* (Linnaeus 1758)—strawberry root weevil**

- Introduced: N. Am. (MA, 1852); PNW (Sydney, BC, 1894); (OR, 1900) (Downes [1922] argues that it is a native species).
- Size: 4–6 mm.
- Shiny, reddish-black to black in color; appears smooth but with small hairs on magnification; legs reddish.
- Often present in small numbers, but only occasionally the dominant or co-dominant weevil at a site.
- A comprehensive review of this root weevil in OR is presented by Emenegger (1976). Downes (1922) gave account of this weevil in British Columbia. See also Wilcox et al. (1934) and Shread (1950).

Ralph Berry has an excellent website with developmental and degree-day modeling for this weevil based in mint, but applicable to other settings http://mint.ippc.orst.edu/srwcycle.htm

***Barypeithes pellucidus* (Boheman 1834)**

- Introduced from Europe: N. Am. (NY, 1886); PNW (1931), (Ellensburg, WA, 1939).
- Size: 2–4 mm.
- One of the smallest weevils; looks like a tiny strawberry root weevil but is thinner in the side profile; males and females (often tandem); color varies from dark to reddish brown; soft "down" of hairs.
- In OR has begun to emerge as a pest of strawberry plantings (Todd, pers. comm., Jan. 2001).

Appears in early spring and "seems" to disappear by mid-summer.

***Otiorhynchus meridionalis* (Gyllenhal 1834)—lilac or privet weevil**

- Introduced: N.Am. (CA 1931); PNW (Pullman, 1948).
- Size: 8–9 mm.
- Males smaller than females (often found tandem, possibly male "guarding"); both appear uniformly blackish and shiny.
- The most common, and often dominant species, in eastern WA. Known from collections in eastern OR.
- Unique damage was photographed in Ellensburg WA, in the 1960's but the weevil has not been, and is not, listed in the PNW Insect Pest Management Handbook.

It would be instructive to conduct additional surveys in eastern WA and OR.

***Otiorhynchus rugosostriatus* (Goeze 1777) — rough strawberry root weevil**

- Introduced: N.Am. (NY, 1891); PNW (Oswego, OR, 1911), (Seattle, 1914).
- Size: 6–8.5 mm.
- Distinguishable by the squared shape of the elytra when viewed from above; uniform dark mahogany color (reddish brown) with a "matte finish" and short stiff hairs (just barely visible in the outline of the elytra).

Common but usually in low numbers. Exception was one site in the Bellingham area where it was abundant and was the dominant weevil on weeds adjacent to field-grown rhododendrons.

***Strophosoma melanogrammum* (Forster 1771)—nut leaf weevil**

- Introduced: N.Am. (NJ & MA; 1899; PNW (Agassiz, BC, 1923), (Spanaway, WA, 1960).
- Size: 4.5–6 mm.
- Small weevil with a distinctive, partial dorsal stripe and slightly iridescent coppery-brown scales.
- Increasingly common in landscapes and native areas. Hatch reported it from Spanaway, WA and Victoria, BC, as "introduced on Rhododendron, which it sometimes injures." The highest populations have been associated with rhododendrons in forested areas in western WA and BC.

Voracious feeder with somewhat distinctive feeding pattern, often a "maze" of channels from the leaf edge; often found in groups of several.

***Otiorhynchus singulars* (Linnaeus 1758)—clay-colored weevil**

- Introduced: N.Am. (MA, 1891); PNW (Seattle, 1931 & 1946).
- Size: 6–9 mm.
- Mottled brown (due to tan and brown scales) with scales on legs; no hairs on elytra or thorax; underside dark brown and shiny.
- Common and often the most numerous and dominant in landscapes; less common in nurseries in WA.

Andison (1941) summarized the biology of this weevil in Canada. Dr. Lynell Tanigoshi and Geoff Menzies have placed information from their studies in raspberries at http://whatcom.wsu.edu/ag/comhort/CCWREP1.htm

Ventral

← dull

or

← shiny

Comparison of *Otiorhynchus raucus* (top) and *O. singularis* (bottom)

Photos (3) by Eric LaGasa WSDA.

***Otiorhynchus raucus* (Fabricius 1776)**

- First record of this species in WA (O'Brien, pers. com., 2001), found subsequently in southwest WA by Tanigoshi; known to occur in OR.
- Slightly shorter and broader than clay colored weevil.
- Light brown with a darker thorax; thorax with hair-like setae; underside dull brown rather than shiny (photo not to scale)
- So far, found most commonly on fences and around foundations, especially in fall at a two adjacent sites in East Wenatchee, WA; reported to be diurnal.

Additional surveys would be instructive.

***Trachyphloeus bifoveolatus* (Beck 1817)—grass weevil, crusted grass weevil**

- Introduced: N.Am. (NY, 1917); PNW (southeast BC, 1934), (western WA, 1944).
- Size: 3–4 mm.
- Tiny, gray-brown weevils.
- Uncommon in gardens, although frequently found entering houses in large numbers in fall.
- Barstow and Getzin (1985) reported on the fall migration from grassy areas to, and spring return from, buildings in Puyallup Valley, WA.

Rarely taken on vegetation; found migrating to garage foundation in fall at one site.

***Sciopithes obscurus* (Horn 1876)—obscure root weevil**

- Native: this native species often associated with wooded areas but has been reported as a pest in strawberries and nurseries in OR.
- Size: variable from 3 to 6.6 mm.
- Actual specimens appear more gray with brownish markings (than this photograph), note the V-shaped line at the declivity (rump).
- Consistently present in low numbers in WA; abundant at just a few sites and dominant at only one nursery and one landscape in WA. Reported to be a serious problem OR; dominant (~90 percent) in two OR sites.

Bell and Clark (1980) reported on the larval development and adult activity of this weevil on strawberries in western OR and on adult host preferences within the genus Rhododendron (see also Bell's M.S. Thesis, OSU).

Photo: S.J. Collman

***Nemocestes incomptus* (Horn 1876)—woods weevil**

- Native species: very common in landscapes and field plantings of some nurseries in western WA and in landscapes in BC, Canada.
- Size: 6–9 mm.
- Sooty dark brown to blackish color with short hairs on thorax and elytra.
- Adults emerge in late summer with numbers peaking in fall. They feed throughout the winter months. Breakey (1965) found all stages throughout the year.
- Adults can lay eggs at cold temperatures (in refrigerated storage) and with increased production with rising temperature when they are brought out to room temperature.

Breakey's (1965) short Experiment Station publication emphasizes the biology of woods weevils, and other species in western WA.

L–R: N. incomptus, N. horni, N. montanus.

Photo by Eric LaGasa,
Washington Department of Agriculture

***Nemocestes horni* (Van Dyke 1936)—Horn's woods weevil**

- Native: rarely abundant except dominant at one site on San Juan Island, WA.
- Size: 5–8 mm.
- Easily mistaken for woods weevil but slightly smaller with lighter color

***Nemocestes montanus* Van Dyke 1936**

- Common in small numbers at many sites; occasionally abundant.
- Size: 4–5 mm.
- Sooty brown with light stripe along pronotum and first one-third of elytra (typical of the *Nemocestes*).
- Seems to be more abundant in the fall.

Photo by S.J. Collman

***Dyslobus* (syn. *Lepesoma) granicollis* (Leconte 1869)—woodburn weevil**

- Native: found in low numbers at some sites especially near wooded areas; became "dominant" in 2001 in one landscape in eastern WA.
- Size: 7–9 mm.
- Occasionally a pest in strawberry fields (Wilcox et al. 1934).
- The genus *Dyslobus* was, for a time, listed as the genus *Lepesoma.*
- Wilcox et al. (1934) provide a good overview of this genus in strawberries.

Damage to rhododendron
by *Strophosoma melanogrammum*

Distinctive damage
by *Otiorhynchus meridionalis*

Damage to *Thuja plicata* (western redcedar)
by unspecified root weevil adult

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