Artificially Infesting Sunflower Helianthus annus L. Field Plots with Sunflower Stem Weevil Cylindrocopturus adspersus (LeConte) (Coleoptera: Curculionidae) to Evaluate Insecticidal Control

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The sunflower stem weevil Cylindrocopturus adspersus (LeConte) (Coleoptera: Curculionidae) prevents harvest of cultivated sunflower, Helianthus annuus L., by causing preharvest lodging. Adult sunflower stem weevils emerge from early May to mid-June from the previous year’s sunflower stalks and mate. Eggs are oviposited under the epidermis of the lower portion of sunflower main-stem where larvae tunnel and consume the pithy inside of the stalk. Mature larvae construct hibernacula (Rogers & Jones 1979, Charlet 1987) at or near the woody portion of the root crown. This structural damage at the base of the plant increases lodging, especially in combination with drought conditions and high winds that are common on the Central Great Plains. The sunflower stem weevil is found infesting cultivated sunflower from Texas (Rogers & Jones 1979) to Canada (Arthur & Mason 1990). Native (uncultivated) sunflower has been implicated as a significant alternate host of the sunflower stem weevil (Charlet 1983), but many other annuals and perennials have also been validated as reproductive hosts (Mitchell & Pierce 1911, Pierce 1916, Goeden & Ricker 1975, 1976, Schulz 1978, Armstrong 1997).

A recent epidemic outbreak of sunflower stem weevil occurred in the Central Great Plains states of Colorado, Kansas, and Nebraska during the 1994 growing season (Armstrong 1996). Sixty to eighty percent preharvest lodging was common, resulting in several million dollars of unharvested sunflowers left on the soil surface. Inconsistent, but invariably devastating infestations have occurred since 1994, making it difficult to conduct field studies that evaluate control strategies. Our objective in this study was to determine if sunflower stem weevil–infested sunflower stalks, from the previous year’s crop, could be used to infest a current
crop to insure a reliable infestation for evaluating management strategies. Insecticides were used in this study to determine their efficacy and to influence densities inside and outside enclosures as an artificial infesting technique. Voucher specimens of sunflower stem weevils were deposited in the C. P. Gillette Arthropod Museum, Colorado State University Department of Bioagricultural Sciences and Pest Management, Fort Collins, Colorado.

Four-row test plots (0.56-m row spacing × 15.0-m length) of ‘Triumph 565’ were planted with 54,000 seeds/ha on 14 May 1996 at the USDA-ARS Central Great Plains Research Station, 3 km east of Akron, Washington County, Colorado. Sunflowers were planted with imidacloprid (Gaucho® 480 F; Bayer Agricultural Products, Kansas City, Missouri) seed-treatment applied at 5.0, 7.5, and 10.0 g/kg seed. Carbofuran (Furadan® 4F; FMC Corporation, Philadelphia, Pennsylvania) was injected in the seed furrow at planting immediately following seed placement in a 1:1 (water: carbofuran) dilution of 0.56, 0.84, 1.11 kg AI/ha using a microinjection unit (Agri-Inject Systems, Yuma, Colorado). The seven treatment designations, including an untreated check, were replicated four times in a randomized complete block.

When sunflowers reached the three leaf stage on 10 June, an ‘A-frame’ enclosure (1.0 m high and 1.1 m in length) was covered with Lumite® (Synthetic Industries, Norcross, Georgia) and placed over one row-meter that enclosed four consecutive plants. The Lumite® nylon screening was cut an extra 0.3 m in length and covered with soil to keep weevils from entering from the outside. Four infested sunflower stalks from the 1995 crop were placed under an enclosure and at the base of four plants not enclosed within each test plot. A subsample of 16 stalks from the supply used to artificially infest the test plots had a mean (±SD) of 15.4 ± 5.7, with a high of 27 and a low of 9 sunflower stem weevil larvae/stalk.

Mature larvae were counted by dissecting the lower 0.5 m of the four stalks from each enclosed and nonenclosed area in October 1996. The larval numbers were analyzed with PROC GLM (SAS 2001) and tested for the main effects of enclosure versus no enclosure, insecticide treatment, and the split-plot of enclosure versus insecticide treatment. Sunflower stem weevil means per stalk were compared within and outside the enclosures for a given treatment using Student-Newman-Keul’s test (α = 0.05), while overall means for a given treatment, regardless of enclosure, were compared using Student-Newman-Keul’s test (α = 0.05).

The overall model for analysis of variance was significant (F = 15.43; df = 34, 21; P < 0.001), as was insecticide treatment (F = 73.00; df = 6, 21; P < 0.001), enclosure versus no enclosure (F = 14.98; df = 1, 21; P < 0.001), and insecticide treatment versus enclosure (F = 43.04; df = 6, 21; P = < 0.001) (Fig. 1). Because of the significant interaction of insecticide treatment by enclosure/nonenclosure, the means for insecticide treatment were compared separately by enclosure versus no enclosure (Fig. 1). Carbofuran treatments were significantly lower than the untreated (check), but not significant from one another for enclosed sunflowers. The untreated enclosed and unenclosed sunflowers were not significant from one another with means of 38 and 37 sunflower stem weevils per stalk, respectively. Imidacloprid does not appear to have any activity against the sunflower stem weevil, and the unenclosed imidacloprid rate of 7.5 g/kg resulted in significantly more weevils than the enclosed. Larval numbers for 5.0 and 7.5 g/kg rates
of imidacloprid were lower than the control but the higher rate of 10 g/kg was not significantly different than the control (Fig. 1).

We believe that a local population of sunflower stem weevils infested the test plots in addition to the artificially released weevils, thus increasing the level of infestation for sunflowers not enclosed. If the local population of sunflower stem weevil had not been available to infest the unenclosed test plots, the enclosure method would have had more value in terms of results of evaluation. Both methods of using either an enclosure or no enclosure for introducing sunflower stem weevils to field plots to evaluate control strategies appears to work well. Not enclosing the weevils would save on materials expense and would be less labor intensive.

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References Cited


