EVALUATION OF BIFENTHRIN RESISTANCE IN FIELD-COLLECTED CLOVER SEED WEEVILS

N. Kaur, W.P. Jessie, C.S. Sullivan, D.L. Walenta, E.C. Verhoeven, and N.P. Anderson

Introduction

Clover seed weevil (CSW), *Tychius picirostris* Fabricius (Coleoptera: Curculionidae) is one of the key insect pests in white clover seed production cropping systems and requires control in western Oregon. Besides white clover, CSW is also known to attack other clover species, including alsike, arrowleaf, and Ladino clovers (Anderson, 2019). The small, gray weevil (about 0.1 inch in length) has a characteristic long snout and brushes of gray and white hair (Reeher et al., 1950). CSW has a potential to cause significant yield loss, as larvae feed on developing clover seeds for a prolonged period during the growing season. The adult weevils create feeding punctures to feed at the base of the calyx on the florets of clover heads. In contrast, egg punctures are created midway up the calyx.

CSW has two generations per year. First-generation adults tend to migrate from noncrop hosts to white clover in spring and early summer. The first clover flowers can appear as early as April, depending on stand age and management, and may attract adults as they emerge from overwintering sites. Adults mate and lay eggs inside developing pods as early as 1 week after locating flowers. Eggs hatch, and larvae begin to feed on developing seeds inside the pods. Each larva can destroy up to four seeds before reaching the fourth and final instar. Prior to pupation, larvae exit the pod and fall to the soil surface. Within 3 weeks, second-generation adults begin to emerge. It is not advised to control second-generation adults because they neither harm seeds nor lay eggs; the insects can lay eggs only in partially developed seeds (Reeher et al., 1950). At this later stage in the growing season, when second-generation adults appear, seeds are hardened enough to prevent egg laying.

Since 2010, an increase in the number of CSW adults has occurred during field scouting efforts in commercial white clover fields in the Willamette Valley. Such increased CSW populations are speculated to be associated with the recent increase in the acreage of white clover seed production in Oregon (Extension estimates for Oregon legume seed crop acreage, 2010). The close proximity of clover seed production fields without the presence of any noncrop hosts to disrupt dispersal is considered a contributing factor for CSW population growth.

The economic threshold level to treat with insecticide is when an average of two or more weevils are encountered per straight-line sweep (made at 90° in the field). Straight-line sweeps are made by walking in a straight line and sweep sampling with each step (10–15 steps).

Both bifenthrin and chlorpyrifos are recommended for chemical management of CSW in white clover seed fields (Anderson, 2019). However, the use of chlorpyrifos is incompatible with the recommended application timing. Early-season (prebloom) applications of chlorpyrifos do not reduce in-field CSW populations during clover bloom. In recent years, several cases of failed CSW control with bifenthrin application have been reported, but confirmation of bifenthrin resistance has not been investigated nor documented. The objective of this laboratory study was to generate preliminary data and documentation needed to characterize bifenthrin resistance levels among CSW populations collected in commercial white clover seed production fields in the Willamette Valley.

Materials and Methods

In 2019, CSW adults were collected from three field sites in Linn County located more than 3 miles (5 km) away from each other. Adult CSW were kept in separate large, ventilated chambers for 24 hours prior to conducting bifenthrin dose-response assays. Adult weevils were collected three times from each field during May–June, and assays were conducted within 24–48 hours of capture. Adult CSW were exposed to various bifenthrin rates by treating the inside surface of a glass vial with formulated insecticide (Brigade). The treated vials were then placed on a vial roller to dry and to ensure uniform product distribution on the vial's interior surface. For each collection event per site, three vials were prepared for each of six treatment rates: 0.75, 1, 3.9, 6.4, 8, and 12 oz/acre. A fourth vial treated only with water was included for each collection site and time (n = 9). Ten field-collected CSW adults were then placed in each vial, and the vial was closed with a cotton stopper. Vials were inspected for mortality at 12, 24, and 36 hours.

Results and Discussion

For each location and collection time, rates as low as 1 oz/acre killed more than 50% of the population, and the maximum labeled rate (6.4 oz/acre) resulted in good control (> 90% mortality) (Figure 1). The lower label rate (3.9 oz/acre) resulted in approximately 85% mortality. Mortality in untreated vials remained < 10% across all populations. Therefore, bifenthrin-resistant CSW adults were not detected in the populations tested in this study.

Additional work is needed to further clarify the extent to which resistance may be developing in the Willamette Valley, including using molecular tools to assay target-site mutations that may confer resistance. Based on these preliminary results, it may also be advisable to develop additional hypotheses to address the poor CSW control observed in the field. Optimization of agronomic practices, including improved application timings to coincide with economic thresholds, management of clover canopy height and density to promote effective spray coverage, and crop mowing to remove early-season inflorescences, need to be tested and implemented. Currently, the industry does not have access to decision-making tools that will help predict CSW life stages during the growing season. The development of phenology/predictive models would help growers more effectively deploy CSW management tactics.

Observations from fields across Linn County revealed that the earliest application timings (typically in May) always required subsequent applications in late June or early July, as weevil numbers rebounded quickly after the first application. The mobility and abundance of clover seed weevils allows rapid recolonization of fields following early applications, particularly as the crop continues to produce new florets throughout early summer.

One important consideration for insecticide timings is the progression of flowering in white clover. High numbers in the early spring may seem alarming, but applications at this stage (and likely through May) to protect clover florets may not be warranted, as early florets will likely drop/shatter long before swathing and combining operations. It is recommended that the bulk of the florets that should be protected occur at around 20% brown-down (Reeher et al., 1950). It is during this time that the first seed pods form in the heads. The percentage of brown heads can be measured by selecting small areas in several representative sections of the field and counting the brown heads and the heads in full bloom. Applications at this time both maximize the percentage of florets being protected and reduce the likelihood of needing subsequent applications.

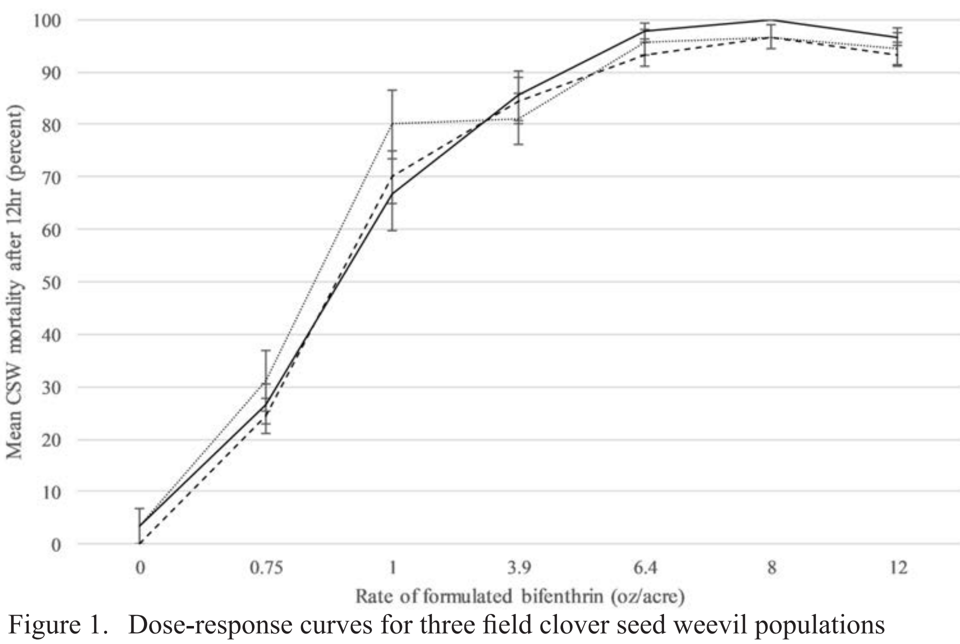

Figure 1. Dose-response curves for three field clover seed weevil populations collected in Linn County. Laboratory test with different rates of bifenthrin.

References

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