

# INDUSTRY SURVEY OF CURRENT PRACTICES AND PERSPECTIVES ON CLOVER SEED WEEVIL MANAGEMENT IN WHITE CLOVER SEED PRODUCTION

*N. Kaur, K.C. Tanner, G. Tiwari, N.P. Anderson, D.M. Lightle, and S.J. Dorman*

## Introduction

Clover seed weevil (CSW), *Tychius picirostris*, has emerged as a serious insect pest in Oregon white clover seed production systems due to challenges associated with managing this insect pest (Kaur et al., 2020; Kaur et al., 2021). Insect control in white clover seed crops in Oregon depends largely on chemicals. Over the past two decades, clover seed producers have relied heavily on bifenthrin (trade names Brigade 2EC, Discipline 2EC, Battalion 2EC, etc.), a broad-spectrum type-1 pyrethroid insecticide. Growers began reporting reduced efficacy (field failures) of Brigade 2EC in 2017, and researchers observed poor control of Brigade treatments in field trials (Mattsson et al., 2021). Subsequent laboratory tests for insecticide resistance revealed high levels of bifenthrin resistance in Linn County CSW populations (Tiwari et al., 2024). Industry-wide dissemination of these research findings to diverse stakeholders was necessary to reduce reliance on bifenthrin-based insecticides by developing effective insecticide resistance management guidelines incorporating rotation of insecticide mode of action groups.

## Materials and Methods

Presentations were made at three Extension and grower meetings in 2023 and 2024 to provide information on CSW biology and management recommendations for improved weevil control. These events included an OSU Extension coffee hour (Zoom, April 15, 2023), an Insect Pest Workshop for Seed Crops (Linn County Extension office, December 1, 2023), and the Annual Clover Grower Meeting (Wilsonville, OR, January 31, 2024.)

Attendees at these events were surveyed using electronic polling tools. The poll questions were designed to gather input from growers and industry partners about their perceptions of current management strategies for seed weevil and insecticide resistance management. For this report, the results from the first survey (April 15, 2023) are presented separately because this event included education efforts based on the 1 year (2022) of laboratory and field studies reporting insecticide resistance. We combined results from the other events conducted in late 2023 and early 2024 (December 1, 2023, and January 31, 2024), which included dissemination of laboratory and field results from both years (2022 and 2023).

The surveys allowed us to identify current knowledge gaps and the adoption of new management practices. For each survey question, a “not applicable” or “I do not grow or advise on this crop” response option was included, and those respondents were not included in the results. The number of respondents for which the questions were applicable is indicated for each question (*n*) in the tables. Survey respondents included representatives who grow or make agronomic recommendations for white clover seed crops in the Willamette Valley (Linn County).

## Results and Discussion

The survey results identified CSW as a pest in white clover seed production systems. In survey 1, 84% of respondents agreed that CSW is a major pest problem, and 84% reported experiencing poor control of seed weevil in the past 5 years. Yield losses of 20% or more were reported by 77% of respondents, while 23% of respondents indicated less than 10% yield loss due to CSW (Table 1).

Other questions in both surveys centered on current management practices, including the number of insecticide applications, product selection and usage, and perception of integrated pest management or resistance management strategies. The key findings are presented in Tables 1 and 2 and are discussed below.

### Insecticide use and application frequency for seed weevil control

- Two-thirds (67%) of respondents in survey 1 indicated that at least two Brigade applications were made during each growing season for seed weevil control (Table 1), while 33% of respondents reported making only one insecticide application for seed weevil control per growing season (Table 1).
- In survey 2, when asked about insecticide application frequency prior to their learning about insecticide resistance to bifenthrin products, a similar response was captured. Seventy-three percent of respondents indicated that they used to make at least two insecticide applications using Brigade, while 27% reported making only one Brigade application for seed weevil control during the growing season (Table 2).

- When asked to name the products used, registered commercial formulations of bifenthrin (Brigade 2 EC, Group 3A) were found to be used by 100% of respondents, and malathion (Malathion 8 Aquamul, Group 1B) was found to be used by approximately 80% of respondents in both surveys (data not shown). Vantacor (Group 28) is also registered for use in white clover seed crops in Oregon, but only 24% of respondents indicated using Vantacor for seed weevil control during the 2023 growing season.

#### Reasons behind poor/failed seed weevil control

- Among the factors associated with poor control, 42% of respondents to survey 1 indicated insecticide resistance as the main factor. Additional factors included using a lower-than-recommended label rate (9%) or poor spray coverage (15%). Poor application timing in relation to both adult and larval monitoring was also identified as a contributing factor by 18% of respondents (Table 1).
- During survey 2, besides insecticide resistance (28% of respondents), poor spray coverage (24%), using a lower-than-recommended label rate (19%), and poor application timing (22%) were also identified as contributing factors to poor or failed seed weevil control with insecticide treatments (Table 2).

#### Plans for insecticide resistance mitigation

- The survey responses (Tables 1 and 2) show that growers and industry representatives are aware that CSW is resistant to bifenthrin products, the causes of this resistance, and the strategies they can use to manage resistance. This bodes well both for adopting insecticides with new modes of action when they become available and for utilizing best management practices for application timing and spray coverage.
- The impact of the recent research and Extension work on CSW was shown in the difference between respondents' past management and their plans for future management. Past management efforts have relied heavily on bifenthrin products, but nearly two thirds (64%) of respondents plan to stop using bifenthrin for CSW control. All of the remaining respondents planned to adjust their management by increasing the use of other products, and none of the respondents planned to continue using bifenthrin as before (Table 2).

#### **Conclusions**

These results provided helpful information for OSU Extension and research faculty to identify knowledge gaps and to design future educational programs to

disseminate current OSU management guidelines for seed weevil management in white clover seed crops. Industry-wide training for the development of effective chemical control plans and rotational strategies will be an ongoing effort.

Vantacor offers a new mode of action (Group 28) and has systemic activity, making it an ideal tool for CSW management. We found a lower utilization rate of this insecticide in current grower practices. In the near future, our goal is to continue generating efficacy data that supports the registration of effective new chemistries and to develop an understanding of Vantacor's utility for CSW control. As an alternative to bifenthrin, improving efficacy of Vantacor will provide growers with another insecticide option, which will help reduce resistant CSW populations.

#### **References**

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#### **Acknowledgments**

We thank Western SARE and the Oregon Clover Commission for their funding support. The authors appreciate the growers and other stakeholders who participated in these surveys.

Table 1. Survey questions, answers, and response rate for survey 1 (n = total respondents).

<i>Is clover seed weevil a major pest problem in white clover seed crops that you manage? (n = 25)</i>		<i>What might have contributed to the poor control/field failures of CSW in your production systems? Choosing multiple options was allowed. (n = 25)</i>	
Yes	84%	Insecticide resistance development	42%
No	16%	Poor spray coverage	15%
<i>In the past five years, have you ever experienced poor clover seed weevil control or field failure using Brigade 2EC or other bifenthrin-based products? (n = 25)</i>		Using a lower spray rate than suggested on the label	9%
Yes	84%	Poor timing of application	18%
No	16%	Other reasons	16%
<i>On average, how much yield do you estimate is lost due to seed weevil? (n = 13)</i>		<i>What steps can you take to mitigate insecticide resistance? Choosing multiple options was allowed. (n = 25)</i>	
10%	23%	Rotate modes of action to reduce selection pressure	21%
20% or more	77%	Optimize insecticide application timing	29%
<i>How many insecticide applications do you make to white clover for seed weevil control during the growing season? Participants were asked to list the products they use in a text box. (n = 9)</i>		Ensure good coverage and proper application method	2%
1	33%	Use products with prolonged residual activity	21%
2	67%		

Table 2. Survey questions, answers, and response rate for survey 2 (n = total respondents).

<i>Before learning about bifenthrin resistance, how many bifenthrin sprays did you typically apply to a white clover field? (n = 22)</i>		<i>What might have contributed to the poor control/field failures of CSW in your production systems? Choosing multiple options was allowed. (n = 22)</i>	
1	27%	Insecticide resistance development	28%
2 or more	73%	Poor spray coverage	24%
<i>What do you plan on after learning that bifenthrin products are no longer effective against seed weevil in our area? (n = 42)</i>		Using a lower spray rate than suggested on the label	19%
I do not plan to use bifenthrin for seed weevil control in the near future	64%	Poor timing of application	22%
I will increase the use of other products for CSW control, but will probably continue to apply bifenthrin as well	36%	Other reasons (changing climate, no field burning, loss of chlorpyrifos)	7%
I plan to continue using bifenthrin as I have in the past	0%	<i>What steps can you take to mitigate insecticide resistance? Choosing multiple options was allowed. (n = 25)</i>	
<i>Did you use Vantacor for CSW control in 2023? (n = 21)</i>		Rotate modes of action to reduce selection pressure	32%
Yes	24%	Optimize insecticide application timing	28%
No	76%	Ensure good coverage and proper application method	28%
		Use products with prolonged residual activity	12%