

# PEST SLUGS IN WESTERN OREGON SEED CROPS: STAKEHOLDER KNOWLEDGE, BAITING STRATEGIES, AND ATTITUDE TOWARD NOVEL MANAGEMENT TOOLS

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## Introduction

Slugs are among the most damaging pests of agricultural production in western Oregon. A diverse range of crops are damaged by these invertebrates (Godan, 1983; Barker, 2002), particularly in the agriculture-rich Willamette Valley. Seed crops, including grasses, clovers, and radishes, are particularly vulnerable. For example, in recent years, slug damage has accounted for nearly \$100 million in damage to the \$500 million grass seed industry alone. Despite the economic losses caused by these organisms, control measures are focused heavily on the use of chemical molluscicides. However, considerable variation in efficacy of the most widely used active ingredients (metaldehyde, iron phosphate, and iron EDTA) is frequently reported by growers. During times of the year when slug populations are high, slug baits can no longer be relied on to provide effective control. Furthermore, other traditional slug management strategies now have limited use in Oregon. For example, in the early 2000s, the practice of burning crop residue after seed harvest was phased out in the Willamette Valley, and straw residue provides ideal microhabitat for slugs. Additionally, some seed producers have adopted no-till production for soil conservation purposes, and this change in cultivation practice has increased slug populations.

To gain insight into stakeholder knowledge of pest slug identification, current slug baiting strategies, and grower willingness to use potential novel approaches, such as biological control, we conducted a survey of more than 200 seed growers and other stakeholders (e.g., crop consultants) throughout the Willamette Valley. The ultimate goals were to identify topics for statewide grower training programs and educational events and to identify limitations with the current utilization of molluscicides by growers.

## Methods

Live surveys using TurningPoint clickers were conducted during the winter OSU Extension seed crop and cereal production meetings held in Albany, Salem, and Forest Grove, OR, on January 9–10, 2018. Participating growers (more than 200) answered 16 multiple-choice questions (see Appendix) related to their slug identification knowledge, control methods,

and willingness to use novel tools. For the purpose of this report, the results from the three survey locations are pooled together.

## Results and Discussion

### Grower knowledge of pest slug identification

Three of the most damaging slugs of seed and cereal crops grown throughout the Willamette Valley are the gray field slug (*Deroceras reticulatum*), the white-soled slug (*Arion circumscriptus*), and the marsh slug (*Deroceras laeve*). When polled, 46.4% of growers answered that they could identify one or two pest slug species that they commonly encounter in their production system. When tested using photographs of each species, 33.3% and 52.1% of growers correctly identified the marsh and white-soled slugs, respectively. However, to our surprise, only 10.8% of attendees correctly identified the gray field slug, which is the most damaging pest slug in the Valley. These data suggest that grower training in slug identification is urgently needed.

### Current slug control strategies

Growers consider slugs as serious pests of their seed crops, with 92.2% of those surveyed answering that slugs are among the top five pests, 69.7% stating that they are among the top three pests, and 17% stating that they are the top pest in their production system. Also, according to 80.2% of stakeholders, slug pressure has increased on their farm over the past 20 years. In terms of slug baits, which are the mainstay of pest slug control throughout the Willamette Valley, only 29.5% were satisfied (27.6%) or very satisfied (1.9%) with their performance. This demonstrates that most users are neutral or unsatisfied with these management tools. Of the active ingredients available, metaldehyde is clearly preferred (86%) over iron phosphate (6.5%) and chelated iron (7.5%). In terms of metaldehyde formulations other than pelletized baits, only 24.2% of growers utilize liquid metaldehyde, 28.3% use the granular form, 20.1% use both formulations, and 27.4% use neither.

In established clover and grass seed fields, the majority of stakeholders (80.1%) on average have applied one or two applications of slug bait per year over the past

10 years. In seedling clover or grass seed fields, 48.3% and 42.6% of growers have applied one or two and three or four applications annually, respectively. As expected, this suggests that slug pressure is most damaging in seedling fields, compared to established crop fields, and that protecting the emerging crop from slugs is critical for yields. In terms of broadcasting rate, most growers (55.6%) apply 6–10 lb/acre, with 15.4% and 22.4% of growers applying less than 5 lb/acre and 11–15 lb/acre, respectively. Only 6.5% of growers apply more than 15 lb/acre. This indicates that growers prefer to apply multiple applications of bait at less than the label rate as opposed to a higher rate in a single application. Lastly, the majority of stakeholders (76.9%) surprisingly do not apply bait in the spring when the bulk of eggs are being laid by adult slugs.

#### Novel slug control tools

If novel slug control tools were available to stakeholders, 80.5% of those surveyed would use them if they were the same price as current methods, while 18.1% would wait for others to try first. If these tools were more expensive but gave more reliable control, 68% would use them and 31.1% would wait for others to try them first. In terms of cost, only 14.8% of growers would not pay more for these novel products, while 46.3% would pay 1.5 times as much, and 31% would pay twice as much. A small number of those surveyed would be willing to pay three times (4.4%) and up to five times (3.5%) as much. These data demonstrate the need and stakeholder desire for new strategies such as biological control for slug management in seed and cereal crops throughout the Willamette Valley.

#### **Conclusions**

The data collected through these surveys suggest that stakeholder training in slug identification is needed in the Willamette Valley. It is critically important that growers be able to identify different pest slugs in crops because different slug control tools have different efficacies against different pest species. For example, *Deroceras* slugs are more susceptible to metaldehyde than *Arion* slugs (Wedgewood and Bailey, 1988). Also, the use of liquid metaldehyde and the use of spring baiting by growers was lower than expected. Therefore, over the coming years we will try to determine the reasons for this low utilization and at the same time assess the impact of spring baiting (using a variety of active ingredients and formulations) on slug populations in the fall.

#### **References**

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**Appendix.** Multiple-choice questions used to survey seed crop and cereal stakeholders. The total number of growers and percentage of growers selecting a specific answer are provided for each question below.

1. How confident are you that you can correctly identify different pest slugs in your crops?

Only know it's a slug	46.38%	96
Know 1 or 2 species	46.38%	96
Know 3–5 species	6.28%	13
Know >5 species	0.97%	2

2. What is this slug? Asterisk denotes correct answer

Gray field slug*	10.81%	16
White-soled slug	8.11%	12
Leopard slug	62.16%	92
Banana slug	18.92%	28

3. What is this slug? Asterisk denotes correct answer

White-soled slug	53.74%	79
Marsh slug*	33.33%	49
Banana slug	7.48%	11
Leopard slug	5.44%	8

4. What is this slug? Asterisk denotes correct answer

Banana slug	13.82%	30
Leopard slug	15.67%	34
White-soled slug*	52.07%	113
Dusky slug	18.43%	40

5. In your opinion has slug pressure increased on your farm over the past 20 years?

Yes	80.28%	175
No	8.72%	19
I don't know	11.01%	24

6. Which of these slug baits do you use most often?

Metaldehyde, e.g., Deadline	85.98%	184
Iron phosphate, e.g., Sluggo	6.54%	14
Chelated iron, e.g., IronFist, Ferroxx	7.48%	16

7. In addition to metaldehyde pellets do you use the following formulations?

Granular, e.g., Durham	28.31%	62
Liquid, e.g., SlugFest	24.20%	53
Both	20.09%	44
Neither	27.40%	60

8. How many lb/acre of slug bait do you typically use per application?

0–5 lb/acre	15.42%	33
6–10 lb/acre	55.61%	119
11–15 lb/acre	22.43%	48
16–20 lb/acre	5.61%	12
>20 lb/acre	0.93%	2

9. How satisfied are you with the performance of slug baits?

Very unsatisfied	4.67%	10
Unsatisfied	22.90%	49
Neither satisfied nor unsatisfied	42.99%	92
Satisfied	27.57%	59
Very satisfied	1.87%	4

10. Over the past ten years, on average how many applications of slug bait do you make per year in an established clover or grass seed field?

1–2 applications	80.09%	169
3–4 applications	16.59%	35
5–6 applications	3.32%	7
>7 applications	0.00%	0

11. Over the past ten years, on average how many applications of slug bait do you make per year in a seedling clover or grass seed field?

1–2 applications	48.33%	101
3–4 applications	42.58%	89
5–6 applications	7.18%	15
>7 applications	1.91%	4

12. Do you regularly apply slug bait in the spring to your grass and clover fields?

Yes	23.15%	50
No	76.85%	166

13. Considering overall costs and damage, how would you rank slugs as a pest?

The worst	16.97%	37
Second worst	33.03%	72
Third worst	19.72%	43
Top 5	22.48%	49
Top 10	5.50%	12
Not top 10	2.29%	5

14. If novel tools such as biocontrol were available for slugs, how likely are you to use them if they were the same price as current methods?

I would try	80.47%	173
I would wait for others to try first	18.14%	39
I would not try	1.40%	3

15. If these novel tools were more expensive but gave more reliable control, how likely are you to use them?

I would try	67.94%	142
I would wait for others to try first	31.10%	65
I would not try	0.96%	2

16. If these tools consistently controlled slugs, how much extra would you be willing to pay?

Would not pay more	14.78%	30
1.5 times as much	46.31%	94
Twice as much	31.03%	63
Three times as much	4.43%	9
Five times as much	3.45%	7