MOBILITY OF THE GRAY FIELD SLUG

R.J. Mc Donnell, N.P. Anderson, A.J. Colton, and B.C. Donovan

Introduction

Slugs are among the most important pests of the grass seed industry in Oregon, and the gray field slug (*Deroceras reticulatum*) is the most damaging species. Although it is one of the best studied species worldwide, to the best of our knowledge no information exists on its mobility within crops, which is surprising given its status as a significant pest of global agriculture. Such knowledge would not only provide important insights into the ecology of this slug, but from a practical standpoint the data could also be used to inform the size of plots needed to perform more meaningful field trials by ensuring that plots are at least the size of the slug's home range. Thus, the aim of this study was to generate the first data on the mobility of the gray field slug, with the ultimate goal of using the information to design a spring baiting trial.

Materials and Methods

Field sites

This study was carried out in established perennial ryegrass fields in both the south and the north Willamette Valley. The southern site was located near Shedd, OR, and the northern site was located near Banks, OR. Visual surveys at each site prior to setup showed that both locations were infested with *D. reticulatum.*

Tagging slugs

To investigate mobility in a species, it is crucial to recognize and track individual specimens. Wallin and Latty (2008) successfully marked slugs (*Ariolimax columbianus*) by injecting a small, colored elastomer, i.e., a polymer with elastic properties (Northwest Marine Technology, Shaw Island, WA), just below the surface of the foot. This resulted in a highly visible colored tag on the underside of the body. An added advantage of these tags is that they fluoresce under ultraviolet (UV) light. To determine whether these elastomers would be a suitable approach for marking *D. reticulatum*, ten adult slugs were injected with the tagging material using a 29-gauge, 0.3-ml syringe (BD Microfine Plus U0100 insulin syringe). For the most part, we followed the procedure outlined by Wallin and Latty (2008), although some modifications were made. First, the test slugs were not anesthetized, as it was deemed too time-consuming to do so. Second, to increase the longevity of the elastomer prior to injection, it was not mixed with the curing agent. Although the slugs did eject some of the material immediately after tagging, a sufficient amount remained inside the foot to enable identification. However, there was some migration of the elastomer inside specimens, so individual slugs could not be given a specific identification mark.

After tagging, the slugs were placed individually in plastic Tupperware containers with a perforated lid, damp paper towel, and a piece of organic carrot. The slugs and marks were checked daily for 14 days. At that time, there was 100% slug survival, all of the tags were clearly visible, the slugs appeared to crawl normally, and there were no indications of atypical behaviors, e.g., reluctance to move.

Mobility study

At each field site, we deployed a standard slug blanket trap (DeSangosse, Agen, France) about 75 m from the field edge on November 8, 2019. This trap was termed the central trap. Radiating out from this blanket, we set up concentric rings of traps at 3 m (4 traps total), 5 m (8 traps total), 10 m (12 traps total), 25 m (18 traps total), and 50 m (30 traps total). Traps were roughly equidistant from each other in each ring. A 75-m ring (50 traps total) was set up at the South Valley site only on December 15, 2019. In addition to these traps, we deployed 50 blankets about 450 m away from the rings and adjacent to the field edge on November 8, 2019. These traps were termed the satellite traps and were used to supplement the total number of slugs tagged per month.

On November 13, 2019, all slugs underneath the central trap were marked with one of the tags, and additional slugs were collected under the satellite traps to ensure that a minimum of 100 slugs were tagged monthly. A different colored tag was used each month (Table 1). Slugs were tagged in the foot because there are no vital organs in this part of the slug's body and the brightly colored tags are also hidden from potential predators. After tagging, the slugs were released just north of the central trap. The central trap and all traps in the concentric rings were then checked monthly until

May 2020 for previously tagged slugs, and a new batch of slugs was tagged and released each month (Table 1). A UV light was used to confirm the presence/absence of tags in ambiguous specimens. All slugs were tagged only once with a single color, i.e., previously tagged slugs were not retagged.

Results and Discussion

A total of 2,380 slugs were tagged (1,190 at each site). Of these, 12 live, previously tagged slugs were recovered (Table 2). Eleven were found underneath the blanket traps, and one was found crawling on the grass about 14 m from the central trap. Such low recapture rates are not unusual for mark-recapture studies involving invertebrates (e.g., Birley and Charlwood, 1989). For our study, the low recapture rate is likely due to some of the tagged slugs moving underground and others not finding a trap under which to take refuge. Nevertheless, the mean (± SE) distance moved by recaptured specimens was 6.4 m (± 1.3 m) (Table 2). At the South Valley site, the slugs moved 6.3 m (± 1.3 m), and at the North Valley site they moved 6.8 m (± 3.2 m). Thus, the mean distance moved by the recaptured *D. reticulatum* over the 7 months was comparable between the two locations.

The distance moved per slug per month is also presented in Table 2. It varied from 1.7 m to 10 m with a mean (± SE) of 4.5 m (± 1.1 m). At the South Valley site, the slugs moved an average of 4.5 m (± 1.3 m) per month, and at the North Valley site they moved an average of 4.4 m (± 2.1 m) per month. Thus, as above, the mean distance moved by *D. reticulatum* per month was comparable between the two locations.

To the best of our knowledge, these data are the first estimates of mobility for *D. reticulatum*. The data will be useful for informing plot size for future field trials for researchers and fieldmen throughout the Willamette Valley. For example, for a month-long baiting trial, the minimum plot size used for treatments and controls should be at least 10 m x 10 m because our data suggests that slugs appear to be able to move a maximum of 10 m per month.

Limitations to this study include the low number of recaptures and the lack of data on juvenile and neonate slugs, which may be more active dispersers than adults. Future mobility studies with *D. reticulatum* should consider utilizing micro-RFID tags, as these would enable individual slugs to be tracked both on the surface and in the soil and thus would likely yield more accurate data on the mobility of this species.

Table 1. Total number of gray field slugs (*Deroceras reticulatum*) tagged per month and the corresponding tag color.

Month	Tag color	Number of slugs tagged
November 2019	Orange	200
December 2019	Green	115
January 2020	Pink	250
February 2020	Yellow	250
March 2020	Black	250
April 2020	Blue	125

Table 2. Distance moved by tagged gray field slugs (*Deroceras reticulatum*) from November 2019 to May 2020 in established perennial ryegrass fields at the North (white background) and South (shaded background) Willamette Valley study sites.[1]

Slug number	Distance moved	Months elapsed	Distance moved per month
	(m)		(m)
1	0	1	0
2	3	1	3
3	10	1	10
4	14	3	4.7
5	0	1	0
6	5	1	5
7	10	1	10
8	10	1	10
9	5	1	5
10	5	3	1.7
11	10	3	3.3
12	5	4	1.3
Mean (± SE)[2]	6.4 (± 1.3)	—	4.5 (± 1.1)

[1]Slugs that were recovered under the central trap were assumed to have moved 0 meters.
[2]At the North Valley site, the mean (± SE) total distance moved and the mean distance moved per month by recaptured tagged slugs was 6.8 m (± 3.2) and 4.4 m (± 2.1), respectively. At the South Valley site, the mean (± SE) total distance moved and the mean distance moved per month by previously tagged slugs was 6.3 m (± 1.3) and 4.5 m (± 1.3), respectively.

References

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