EVALUATION OF NEWLY FORMULATED MOLLUSCIDES FOR CONTROL OF SLUGS IN WESTERN OREGON GRASS SEED FIELDS

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Introduction

Economically, slugs are still among the most important pest species causing damage to grass seed production in western Oregon. Two of the most prominent slugs are the gray field slug (*Deroceras reticulatum*) and the brown-banded slug (*Arion circumscriptus*). Reduction or elimination of open field burning, adoption of minimum or no-tillage farming practices, improved field drainage, and greatly increased levels of organic matter and post-harvest residue in western Oregon's grass seed fields have increased food, habitat, and moisture essential for sustaining large populations of slugs. Sustainable cultural practices such as direct seeding and chopping back and returning post harvest residues to soil surface appear to increase slug populations. The gray field slug has become one of the most costly grass pests in Oregon, resulting in extensive loss of seedling stands, and increased production costs incurred for reseeding and control. Fall grass seedling establishment is problematic if large populations of slugs are not controlled prior to planting and weather is favorable. The objective of these trials was to evaluate four newly formulated molluscide products for control of slugs in grass seed fields in western Oregon in late fall.

Materials and Methods

Two trials were conducted in grass seed fields for control of slugs in October, 2010. Trials were located at: 1) 3 year old tall fescue field in Washington County and 2) a newly direct seeded intermediate ryegrass field in Linn County. At each study site, 50 ft x 50 ft plots were established in a randomized complete block design and replicated 3 times. Seven molluscide treatments included: 1) untreated control; 2) Deadline MP® pellet bait applied at 10 lbs/acre; 3) Sluggo® pellet bait applied at 15 lbs/acre; 4) Slugkill 2% FeEDTA pellet bait applied at 15 lbs/acre; 5) Slugkill 5% FeEDTA pellet bait applied at 10 lbs/acre; 6) NEU1165P pellet bait applied at 15 lbs/acre; and 7) Sluggo Plus® pellet bait applied at 15 lbs/acre. Baits were applied with a rotary bait spreader. Treatments were established in areas of the fields where heavy slug populations were documented prior to baiting. Baits were applied when temperatures were between 45-50°F, soil moisture was present, and wind speed was less than 10 MPH.

Slug populations were evaluated prior to- and post-application of test materials. Three 18 x 18 in. slug blankets (designed by Liphatec Inc.) were soaked in water and randomly placed and secured in each plot. The study began on October 19 in Washington Co. and October 25 in Linn Co. Number of slugs per blanket was recorded 2 days prior to application of all treatments, 2 days post-application, and at 7, 10, and, 14 days after treatment. The 14 day post treatment evaluation at the Washington Co. site was not possible due the grower's planting schedule for the field. At each evaluation, slugs were removed and blankets were relocated in a new location within the plot. Observations of slug species diversity and age were documented.

Due to the continuing high population of large slugs at the study location in Linn Co., and the emergence of populations of juvenile slugs (0.250 g or less), bait was re-applied at this study location 14 days after the initial evaluation. Evaluations were made 2, 7, 10 and 16 days after the second baiting occurred. Following the second bait application, adult and juvenile slugs were differentiated and recorded.

Data were statistically analyzed using ANOVA and LSD. Slug- days were calculated by averaging the number of slugs counted per plot on a given evaluation day by the number of slugs counted in the same plot on the previous evaluation day. This average was then multiplied by the number of days between the two evaluation days.

Results

Pre-bait evaluations showed that high numbers of gray field slugs (*Deroceras reticulatum*) were present at both sites. A small number (<5%) of brown-banded slugs (*Arion circumscriptus*) were also documented.

There were significant differences between treatments *($P \leq 0.05$)* at both sites. At the Washington Co. site, Slugkill 2% FeEDTA was the only treatment with significantly less slug days/blanket compared to the control (Table 1). A confounding pattern at this site was the decline in the control plots that paralleled the decline seen in the treated plots (Figure 2). Weather events, including cold temperatures at night, most likely influenced reduced numbers of slugs found under blankets.

At the Linn Co. site, NEU1165P, Sluggo, Slugkill 5% FeEDTA and Deadline MP-treated plots had significantly less slug-days/blanket compared to the control (Table 2).

The second baiting at the Linn Co. site was more effective than the first baiting (Figure 2). Seven days after the first baiting the average slug population over all the bait treated plots was 23% less than the untreated control. Seven days after the second baiting the average population in treated plots was 94% less than the untreated control. The poor slug control from the first baiting period resulted in extensive damage to the newly-emerged seedlings. By the time the second bait was applied there was already significant stand loss.

The average high and low temperatures over the 5 days subsequent to the first baiting were 54.8 °F and 41.2 °F, respectively. For the second baiting period they were 52.8 °F and 40.5 °F. Rainfall during this five day period was 0.74 inches after the first baiting and 0.26 inches after the second baiting. Wind may have played a role in reducing numbers.

Over the course of the two baiting periods the proportion of small juvenile slugs (0.250 g) increased.

Table 1. Slug days[1] per blanket in a 3 year old tall fescue field in Washington Co.

Treatment	Rate	Slug Days / Blanket[2,3]
Sluggo	15 lbs/acre	44.63 a
Sluggo Plus	15 lbs/acre	43.57 ab
Control	0	40.17 ab
Deadline MP	10 lbs/acre	37.87 ab
NEU1165P	15 lbs/acre	32.90 ab
Slug Kill 5% FeEDTA	10 lbs/acre	30.43 ab
Slug Kill 2% FeEDTA	15 lbs/acre	23.90 b

[1] Slug-days were calculated by averaging the number of slugs counted per plot on a given evaluation day by the number of slugs counted in the same plot on the previous evaluation day. This average was then multiplied by the number of days between the two evaluation days.
[2] Each plot contained 3 blankets per plot, totaling 9 blankets.
[3] Means were separated using LSD (0.05) test. Means followed by different letters are significantly different.

Table 2. Slug days[1] per blanket in a newly direct seeded intermediate ryegrass field in Linn Co.

Treatment	Rate	Slug Days / Blanket
Control	0	440.8 a
Sluggo Plus	15 lbs/acre	386.77 ab
Slug Kill 2% FeEDTA	15 lbs/acre	369.07 ab
NEU1165P	15 lbs/acre	331.43 bc
Sluggo	15 lbs/acre	328.93 bc
Slug Kill 5% FeEDTA	10 lbs/acre	291.13 bc
Deadline MP	10 lbs/acre	271.3 c

[1] Slug-days were calculated by averaging the number of slugs counted per plot on a given evaluation day by the number of slugs counted in the same plot on the previous evaluation day. This average was then multiplied by the number of days between the two evaluation days.
[2] Each plot contained 3 blankets per plot, totaling 9 blankets.
[3] Means were separated using LSD (0.05) test. Means followed by different letters are significantly different.

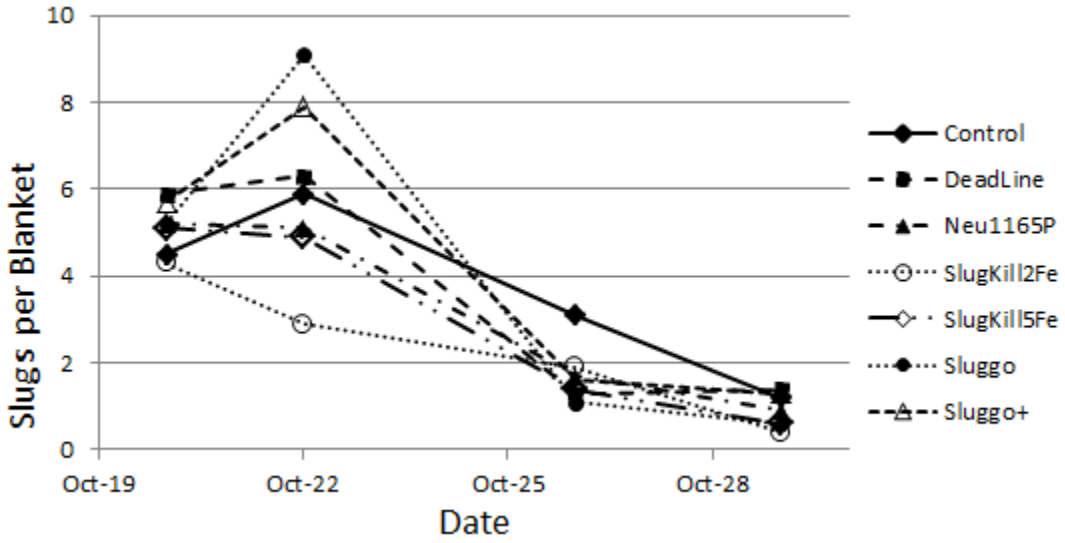

Figure 1. Slug counts (means) from monitoring blankets in Washington Co.

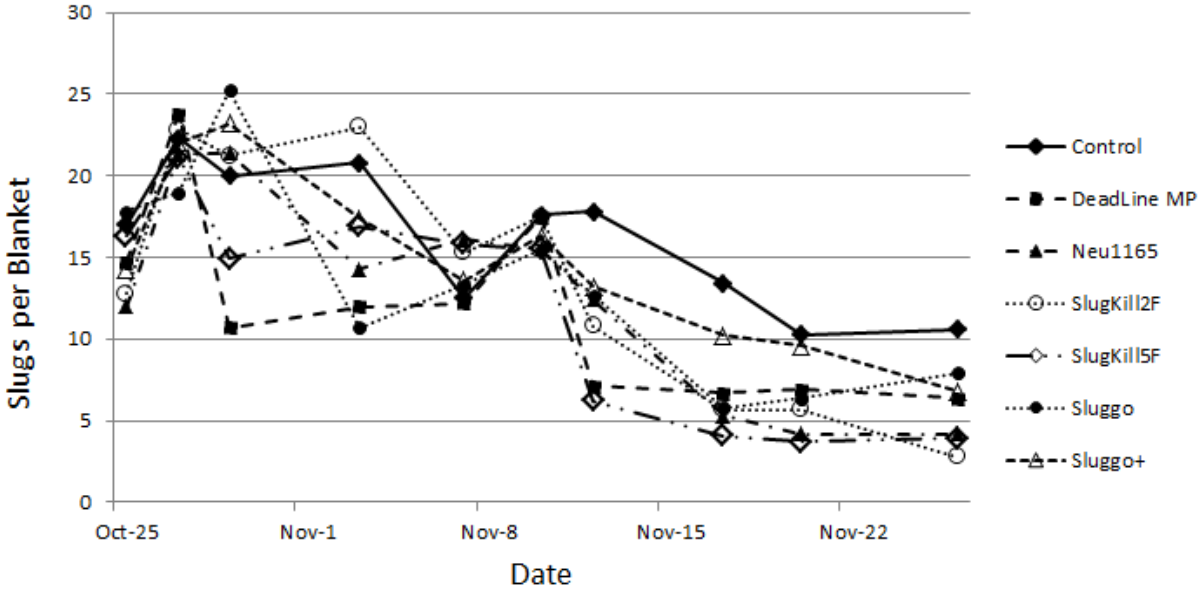

Figure 2. Slug counts (means) from monitoring blankets in Linn Co.

Discussion

This study indicated that economic control of large slug populations continues to be a challenge in western Oregon. Seedling grass is most susceptible to damage and crop loss up to the third leaf stage. As seen at the Linn Co. site, fall seedling establishment is problematic if a large population of slugs is not controlled prior to seedling emergence.

Slugkill FeEDTA 2% significantly reduced slugs at both sites, and was the only treatment that was significantly different than the control at the Washington Co. site. At the Linn Co. site, three of the newly formulated baits were significantly different than the control. However, Deadline MP, a metaldehyde bait currently labeled for use in Oregon, was the most effective at reducing slug numbers.

There is no clear explanation for the difference between the first and second baiting at the Linn Co. site. The second application may simply have been more toxic to the slugs because of their previous exposure to the baits. High rainfall and low temperatures also may have limited the effectiveness of slug baits, however large differences in environmental conditions between the two application periods were not seen.

We observed that younger slugs are more difficult to control than older slugs. Younger slugs may not feed as much on the baits, so are more difficult to kill. They are a continual source of re-infestation, and along with the surviving large slugs required the additional baiting. It is important that adequate slug control coincides with the emergence of grass seedlings to ensure good establishment.

No attempt was made to quantify differences between mixtures versus single product treatments. We recommend that these and other newly formulated baits continue to be tested in replicated field trials in western Oregon as there is a continued need for product development and registration to provide adequate control of these damaging pests.

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