Slug Summit Conference Report
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This is a report of the proceedings of the "Slug Summit" conference held at Roth's Event Center, Salem, Oregon, on 25 March 2015. Over 80 participants spent more than half of the day in discussions and group work. Participants came representing a broad spectrum of Oregon agricultural and natural resource industries, growers, consultants, university and government scientists, State and Federal agencies, legislative representatives, and a reporter. Sujaya Rao was lead organizer and Jay Noller took notes, which are assembled in this document. This is meant as an account of what was shared by participants and this ought to be read as a limited sketch of the current state of the issue of slug control. This is the first of a series of reports to come out of renewed efforts by Oregon State University, stakeholders and partners to address the vexing issue of controlling slugs.

Impacts/Economics of Slugs

A broad spectrum of Oregon industries report that slug infestations are a problem that is only getting worse. It is a multi-million dollar problem affecting a wide array of seed growers, field crops, row crops, Christmas tree farms, and horticultural nurseries. It is a problem that has worsened in recent years and shows no sign of lessening its detrimental impacts to the Oregon economy. Researchers note that slugs are a worldwide problem. In Oregon, half of the identified three dozen slug species are exotic with unknown potential to do damage. We need to quickly develop appropriate management strategies.

For seed growers, it seems like dealing with slugs is "money out the window." Based on participants at the summit, we estimate grower costs of $35-40 per acre to combat slugs. Such treatments often involve two to three rounds of actions. We need more information to come up with a solid estimate of statewide and industry-wide impact, but just grass seed alone would make this an estimated loss of about $15 million per year at present. In one north valley field, there have been 5 treatments and 2 plantings just this year. Growers find yields are 70-95% less due to slugs; bait costs plus yield decreases lead to at least a $1k/ac loss. Every 2 weeks they are baiting, yet there are more slugs.

Slugs are a pest in a variety of crops. Slugs attack the radish tuber and are an issue with specialty seed crops. In peppermint fields, slugs eat roots. Fields of small seeds may be most vulnerable. Growers are seeing more and worse shredding on the creeping red fescue, tall fescue and fine fescue. 3-yr perennial fields are "getting hammered." In wheat the issue is that slugs eat seeds, and this appears to be an emerging problem.

Slug infested fields are spotty. One grower observes that heavy soils are preferred by slugs and that they avoid gravelly soils. "No till grows more slugs," says one grower, "and there has been a 15-year shift in the slug problem." NRCS recognizes that slugs

present a barrier to no-till adoption nationwide. One grower with a 15-year no-till field has no slugs. Going back to tilling seems not to reduce slugs. Growers have concluded that, "there is more to it than throwing a chemical at it." "In the north valley, we are losing a lot of soil and in the future the loss of soil will get us reduced yields."

Slugs are a costly issue for the Christmas tree industry in Oregon. Hawaii is a major importer and the presence of slugs in imported trees is a big issue. In the past, 16% of containers were rejected because of slugs. This year 1 out of 74 containers was rejected at a cost of $50K. Shaking, blowing, washing and other treatments of trees knock down the number of slugs in export trees; but not 100%. Trees stored on ground could be source of slugs showing up in containers. Following rains, trees stored on ground get more slugs. The industry wants to know "Why are slugs in the Christmas trees"?

For Oregon nurseries, the problem is more than just slugs. Snails – semi aquatic snails are in container yards. Oregon nurseries use Mesurol. During some seasons, nursery workers are limited in applying products, like Mesurol, to control the snails. Cost to control slugs and snails can be up to $50,000 per nursery yard. Nursery industry has talked with chemical companies, which identify EPA as the reason for the lack of progress. Toxicity of the chemicals would bring on new problems in that they are toxic to desired species. Robin Rosetta, OSU NWREC Horticulture, runs a slug webpage: http://oregonstate.edu/dept/nurspest/mollusks.htm

Potential Control / Management Strategies

We must recognize that what works for one industry may not work for others.

We need to identify the appropriate bio controls or biological agents. What are the slugs' predators? Potential of the introduction of beneficial insects needs to be looked at. Cutworm control takes out beneficial insects including slug predators; this needs to be avoided as we take on slugs. Could nematodes (native) that are predatory on slugs be used? Could beetles complement other agents? "Week after first rain, out come the slugs and a huge amount of carabid beetles." Seems beetles suppress slugs early in season, but lose efficacy later on.

Presently, the strategy for control involves pre-crop treatment with standing–crop baiting. Growers note that earthworms eat ¾ of metaldehyde before slugs get to it. Growers advise others to be proactive by heavy baiting prior to field conversion. IR-4 Program is hampered in addressing slugs unless we learn something new. Known chemical agents include, carbamates, Mesural, metaldehyde, iron- phosphate formulations, and EDTA chelations. No known efforts by chemical companies to work on new products.

A range of other controls are available or need to be developed. Is seed surface area enough for use of seed treatment in some crops? Researchers note that it is getting the molecules to the slugs that are a problem. This effort will require partnering with industry. We should seriously look at RNAi pesticides that will shut off genes that are critical for the slug's life cycle. RNAi could be formulated perhaps as a spray-on product to match current management practices. Need for economic malacologists involvement. Novel solutions include orange peels and hot pepper, which shows equivalent control with carbamates, which need direct contact,

and have no residual efficacy. Clove oil seems to be effective (UC Riverside) but is not economical.

Growers need help identifying the problem. To growers it is difficult to tell if the slugs are dead. In most studies there is the tendency to look at adults because juveniles do not go after baits.

Many growers wonder if the elephant in the room is field burning, i.e. is a return to burning a solution? Growers note more problems since the phase out of burning and therefore think burning was useful. Growers ask many questions, such as "is thermal vs. nonthermal no-till worth investigating?" "What was it about burning that knocked down slugs?" "Did burning tighten up soil and reduce viability of habitat?" "Is it dry vs. wet plowing?" "Is tillage part of the issue or part of the solution?" "What has changed in our ag practices?" "Does the current soil environment allow the slugs to survive?"

In the end, we are left with many examples of problems, many questions, few solutions, and no "silver bullet" or unique solution or management practice.

Before lunch, Dean Dan Arp, College of Agricultural Sciences, Oregon State University, made a presentation during which he indicated that OSU will step up to assist in addressing this problem, bringing faculty and other College resources to bear on the issue.

Next Steps

Over lunch, participants deliberated in groups and came up with this list of Next Steps for addressing the slug issue.

- Action-based solution
  - → Synthesis of knowns
  - → we need to <u>ACT</u>

  "Tell growers how to deal with slugs based on existing knowledge"

- Develop impact story
- Develop an accounting of multi-industry loss
- Contact legislators - hold slug issue luncheon at capitol
- Synopsis of research to date
- Refocus current funding and researchers
- Research should be on controls
- OSU should hire a fulltime, permanent researcher
- Obtain/Seek research funds that cut across sources and address all affected industries
- All options on table for solutions
- Product registration
- Develop market for slug treatments
- Monitoring and communication, including grower reporting