

NON-CHEMICAL CONTROL OPTIONS FOR SLUGS – RESULTS FROM THE RIVERINE PLAINS INDUSTRY SURVEY

Report prepared by Dr MA Nash for Riverine Plains, October, 2024

KEY MESSAGES

- **A 2024 Riverine Plains' slug survey found that slug damage had increased over the past five years, likely in response to wetter seasonal conditions.**
- **Slug management cost 33 percent of respondents between \$1– 50/ha, while 56 percent spent \$50–100 /ha, and 4 percent spent over \$100/ha.**
- **The survey revealed a high reliance on three insecticide groups — 4A, 1B & 3A — which are all disruptive to carabid beetles (predators of slugs).**
- **The survey suggests some confusion between the direct impacts of modern farming practices, such as conservation agriculture on slug populations, and the indirect effects of burning and cultivation.**

BACKGROUND

Despite the increase in molluscicide sales (Figure 1), damage to establishing crops caused by slugs has increased across southern Australia.

The extent of slug threats has expanded in recent years, both into new regions, including

northern Victoria and the central slopes of NSW, and to crops such as lentils. Several contributing factors have been suggested for the increase, yet none have been directly tested. Some hypotheses include favourable weather conditions (i.e. wet springs), the application of calcium, the overuse of seed treatments limiting natural enemies such as carabid beetles, increased nitrogen usage, adoption of conservation agriculture (for example stubble retention, no or minimum till), exotic slug species adapting to new niches and tightening crop rotations.

In the Riverine Plains region, which includes south east NSW and north east Victoria, slugs have become a significant threat to productivity, with the economic cost to farmers of annual chemical control programs also significant. However, it has been identified by Riverine Plains that the use of non-chemical control options for slugs poses key knowledge gaps for farmers.

To better understand grower needs, a survey was developed through funding from the Victoria Drought Resilience Adoption and Innovation Hub, supported by the Australian Government's Future Drought Fund, to capture current

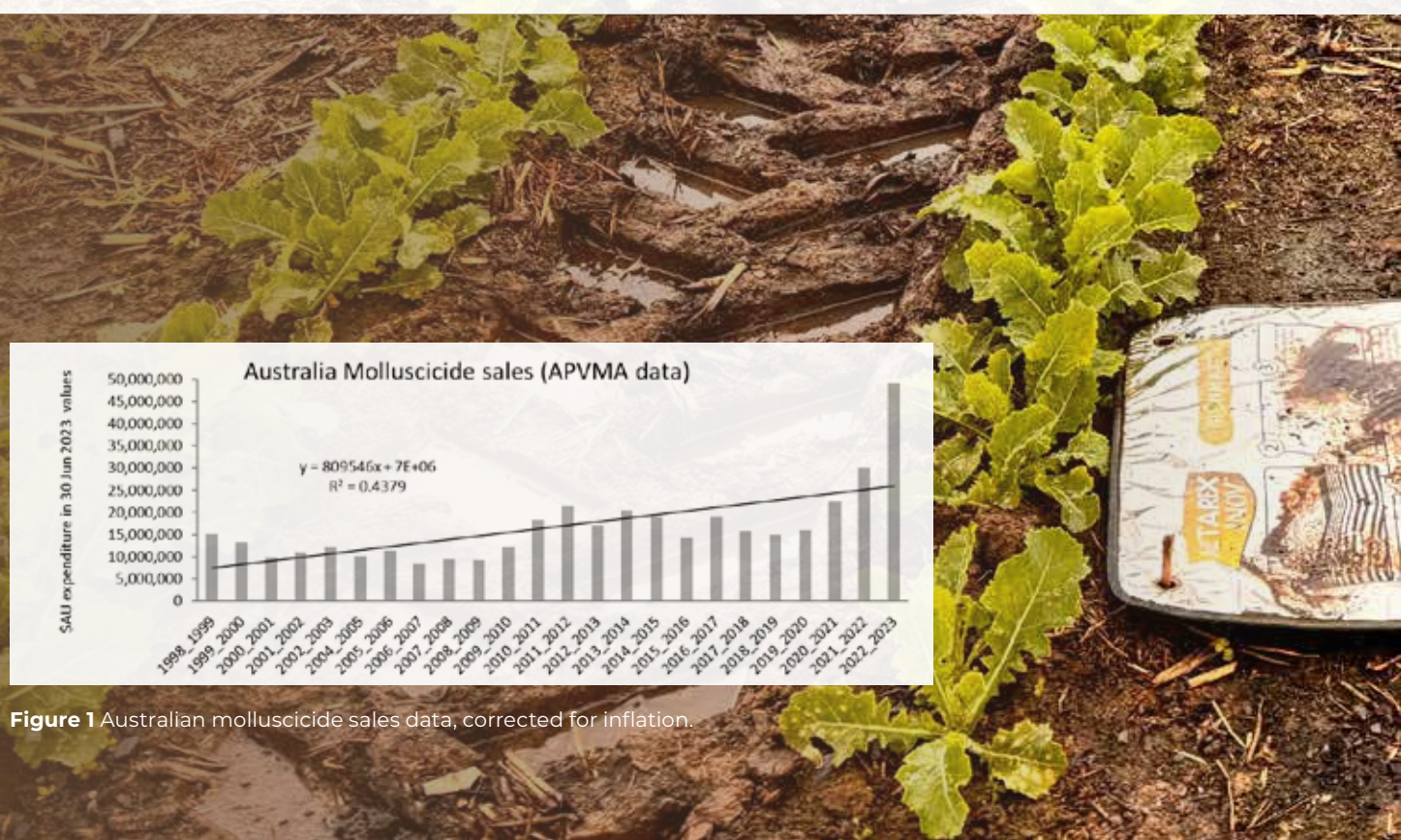


Figure 1 Australian molluscicide sales data, corrected for inflation.

practices used by Riverine Plains members and others to manage slugs. Riverine Plains is the North-East Node lead of the Hub and the aim was to develop a broader understanding of the slug problem across the region's cropping ecosystems to inform larger research projects, such as the GRDC slug modelling project.

AIM

This survey was developed to better understand current practices used by farmers. The survey also aimed to investigate patterns that may have caused increases in slug populations in north east Victoria and southern NSW over the last five years.

METHOD

The survey was designed in consultation with several experts. It was open from June to September 2024, and run in collaboration with the Irrigation Farmers Network, Vic No Till, and Birchip Cropping Group (the North-West Node lead for the Victoria Drought Resilience Adoption and Innovation Hub). The survey was promoted at several events including the GRDC Grains Research Update at Numurkah during July 2024.

A total of 17 questions were asked of respondents using SurveyMonkey® (Appendix 1), with key results described below.

RESULTS

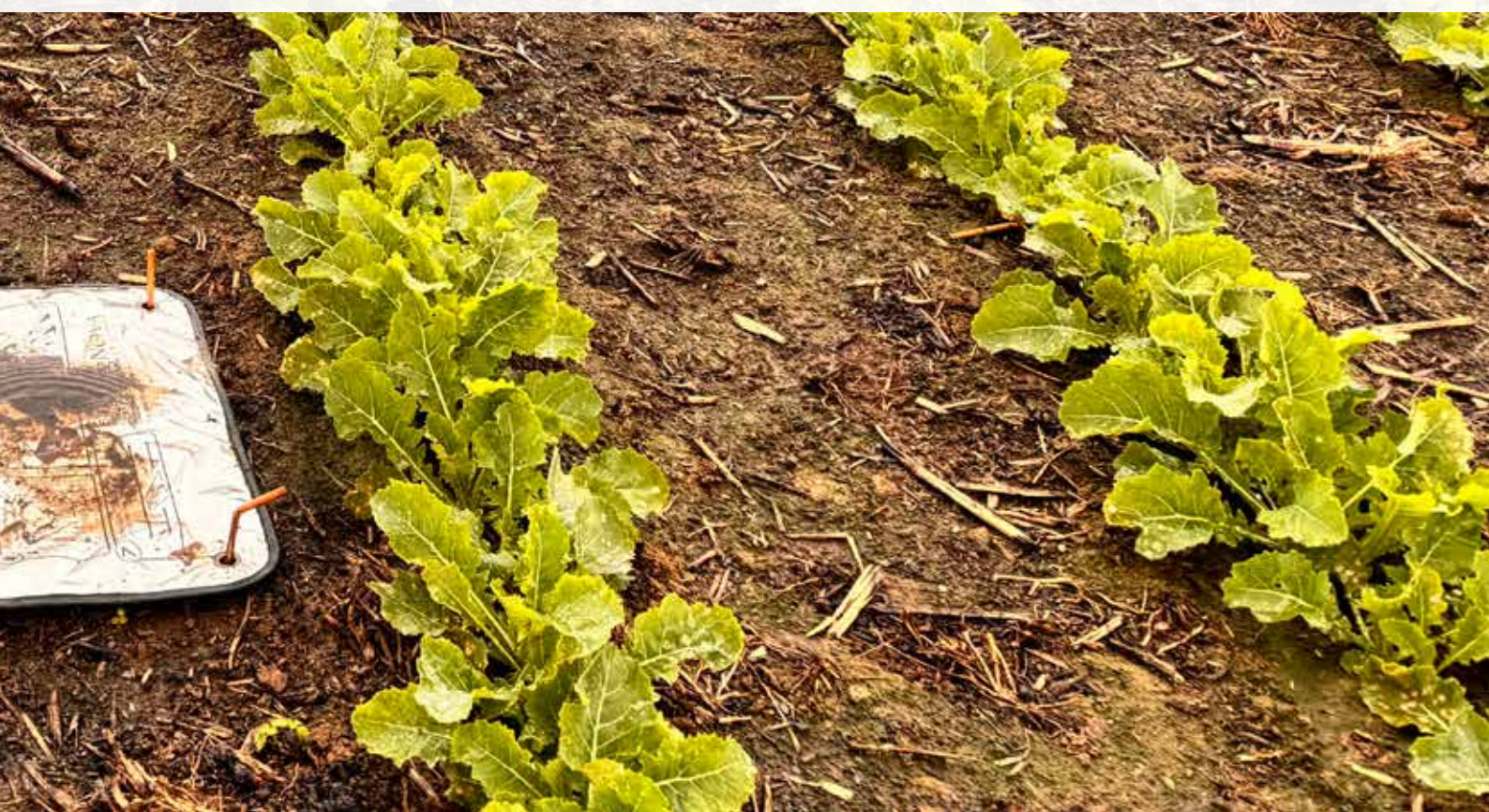
DEMOGRAPHICS – WHO RESPONDED AND WHAT WE FOUND

Of the 54 respondents, 72 percent were farmers (Figure 2). The highest proportion of respondents (57 percent) identified as members of Riverine Plains, while the Irrigation Farmers Network (22 percent), Vic No Till (13 percent) and Birchip Cropping Group (8 percent) were also represented (Figure 3). A high number of respondents (17) skipped this question, possibly because they didn't belong to a farming system group, or were members of Farmlink or Southern Growers (not listed as options).

A large proportion of respondents (87 percent) reported slug issues over the last 5 years, however the survey also captured responses from those that did not, or who were unsure (13 percent) (Figure 4).

Livestock play a role in most of the enterprises surveyed, with only 31 percent of respondents having no livestock grazing crops or residues in their farming system (Figure 13). Nearly 69 percent of respondents indicated that they grazed crop residues, which is a practice that can help reduce the risk by removing slug refuges.

Over the last five years, 94 percent of respondents indicated that they had sown canola, 96 percent had sown wheat, 63 percent had sown barley, with faba beans (71 percent) the dominant pulse grown (Figure 16). There was a higher proportion of oats grown than expected, with 51 percent of respondents having sown them in the past five years. Overall the diversity of crops grown in the region is quite low, but comparably greater than some other areas.





The results also showed that over 75 percent of surveyed growers get their advice about slug management from agronomists, with GRDC, other farmers and experts also rating highly (Figure 10). Paddock history informed slug management strategies for 35 percent of respondents.

IMPACT OF SLUGS

On a scale of 0-100 (where 0 represented no problem and 100 represented their worst year in the past five years), respondents (45) rated the severity of their slug problem at an average of 70 (Figure 5). The slug problem has increased slowly over the past five years, with 25 percent of surveyed farmers reporting issues dating back five or more years, 42 percent indicating the problem arose three–four years ago and a further 33 percent reporting slugs becoming a problem one–two years ago (Figure 6). The region experienced several wet growing seasons in a row from 2020–2023 (and the first half of 2024), which correlates to the increase in slug numbers seen during this time.

This increase in slug problems is supported by the area over which molluscicides baits were applied in 2023. Only four percent of respondents indicated they did not apply bait (Figure 7) in 2023, while over 26 percent of respondents baited more than 800 ha. In terms of bait expenditure in 2023, 33 percent of respondents spent between \$1–50/ha, 56 percent spent \$50–100/ha, and four percent spent over \$100/ha (Figure 8). Concern at the cost was evident, with one respondent commenting that “constantly baiting isn’t sustainable”.

Where baits were applied, 60 percent of respondents had used the metaldehyde product Metarex Inov in the past five years, with eight percent using an iron product such as IRONMAX Pro (Figure 15).

In 2023, respondents also reported having to resow large areas due to slug damage, with 36 percent having to resow 1–50 ha, 16 percent having to resow 50–100 ha and one farmer having to resow more than 100 ha (Figure 9).

FARMING PRACTICES

When looking at farming practices that may contribute to slug threats, a large proportion of respondents had practiced some form of conservation agriculture in the past five years, with nearly 39 percent indicating they used no-tillage and 67 percent used minimum tillage (Figure 11). Kelly chaining (37 percent of respondents) and speed tillage (35 percent) were the two most popular tillage methods used, with a variety of deep and shallow cultivation techniques also practiced.

The survey confirmed that stubble retention is widely practiced by respondents, with over 77 percent retaining stubble in the past five years (Figure 12). Managing heavy stubble loads at sowing can be a problem and 69 percent indicated they had burnt stubble in the last five years, while 44 percent had baled straw and 33 percent had mulched. Only 10 percent rolled their stubble, despite this being an effective tool to prevent slug damage, while six percent used a biological stubble digester.

It's likely the widespread adoption of minimum till and stubble retention (conservation agriculture) has provided slugs with a more favourable habitat. However several comments made within the survey demonstrated a gap in knowledge regarding the effectiveness of stubble removal techniques, such as stubble burning for slug control, compared to burning for crop establishment (burning aids crop establishment in cold environments but is not always failsafe).

Soil acidity, sodicity and structural issues occur frequently across the Riverine Plains and this is reflected in the high percentage of respondents having applied ameliorants such as gypsum (83 percent) and lime (81 percent) in the survey (Figure 14). The survey did not provide information on whether soil ameliorants were incorporated post-application by participants and whether this reduced slug damage.

Over 75 percent of respondents reported using high amounts of nitrogen as urea, while 27 percent used lower rates of nitrogen and 25 percent pre-spread urea.

In trying to understand the likely disruption to natural enemies of slugs, the survey revealed a high reliance on three insecticide groups — 4A, 1B & 3A — which are all disruptive to carabid beetles (predators of slugs) (Figure 15). However, 15 percent of responses indicated the use of a softer insecticide option (Group 28) for control of lepidopteran larvae.

A comment from the survey highlighted the need for further extension of knowledge in the area of biological controls, referencing the use of neonicotinoids ("NeoNics") as seed dressings and sprays in broadacre crops and their negative impact on beneficial predators and parasitoids, such as carabid beetles.

DISCUSSION

Although this survey was focused on the Riverine Plains region, the number and extent of responses suggest that this survey covered a much wider area than anticipated.

The increase in slug problems reported in the last one–two years suggests that this pest is not only expanding in range, but that numbers have also increased in areas where they have existed for some time. Furthermore, the damage caused by slugs in 2023 saw large areas resown as a result of farmers being unaware of the extent of slug populations in their paddocks. The yield penalty for late (resown) canola crops was estimated at 1 t/ha in north east Victoria and this

should be considered an opportunity cost on top of the direct costs of molluscicides.

It's sometimes a difficult and risky decision as to whether to bait emerging crops for slugs. We've estimated that not baiting canola — and losing the crop — would incur additional cost in resowing and the subsequent yield loss due to later sowing (estimated at \$840/ha). This has to be weighed up against the cost of baiting, noting that 56 percent of respondents spent \$50–100/ha in slug control during 2023.

Variation in seasonal conditions means that extensive baiting programs, such as was needed in 2023, are not required every year. However, budgeting \$60–80/ha for slug control when growing canola in high-risk situations and seasons is likely to be prudent. In 2024 the cost of baiting was less due to drier seasonal condition, with no reports of resowing due to slug damage.

RISK

In this survey, growers identified key factors perceived to increase risk.

CROP ROTATION

A survey response referred to canola following faba beans, with the observation that "slug numbers are a lot higher after a wet spring and faba beans". While faba beans are a poor food source for slugs, it's likely that slug populations build up under faba beans due to favourable micro-habitats.

One of the biggest issues facing Australian broadacre farming systems is lack of diversity due to tight crop rotations, including cereal on cereal or wheat – canola – wheat rotations. Tight rotations can have a bearing on the buildup of damaging pest populations, such as slugs, however the responses suggest farming systems in the areas covered by this survey are not as tight as other regions.

Linseed is known to limit slug populations by drying out the soil, but the crop was only grown by a single respondent in this survey and its adaptation to the Riverine Plains region is unclear. Incorporating chickpeas into farming systems where slugs and snails threaten production is also known to limit population increases, however chickpeas have not been widely adopted in the Riverine Plains region, likely due to their susceptibility to waterlogging and the prevalence of acid soils. Only three respondents grew chickpeas in the past five years.

FUTURE RESEARCH

A potential future area of research would be the influence of crop rotation in limiting slug numbers, and therefore production loss.

DIRECT AND INDIRECT IMPACTS OF MODERN FARMING PRACTICES ON SLUGS

Written responses in this survey suggest there is some confusion between the direct impacts of modern farming practices, such as conservation agriculture on slug populations, and the indirect effects of burning and cultivation which can improve crop establishment, thus limiting slug damage. Cultural tools which can improve establishment, whilst also limiting slug activity, are discussed in greater detail in the GRDC publication [Strategies to limit slugs threats other than baits](#).

Some specific field demonstrations that could be assessed for their effectiveness in managing slug threats in the Riverine Plains region include:

1. Rolling after sowing to establish its impact on canola establishment, bait efficacy and slug activity, especially on dispersive soil types
2. Effects of gypsum and lime with shallow incorporation on slug activity and canola establishment
3. Impacts of predrilling urea prior to sowing on slug activity post sowing and speed of establishment; and
4. Monitoring slug predator and parasite communities and function in response to seed treatments and tillage

Building on previous research from other regions, it's likely that undertaking localised research in the Riverine Plains to investigate the interaction between cultural and baiting strategies, including the potential use of strategic tillage to incorporate lime or gypsum while simultaneously reducing slug habitats (by drying out the soil), would provide growers with an integrated approach to slug management.

NUTRITION

Another survey response drew a link between balanced plant nutrition and reduced slug and snail damage. This comment highlights how the role of soil health in providing a more resilient farming system, and the role plant nutrition plays in establishing crops, needs to be further explored.

INTEGRATED PEST MANAGEMENT

The concept of “bottom-up” integrated slug management involves leveraging current canola establishment investments by GRDC which are focused on physical and chemical constraints. This could incorporate a greater understanding of the biological factors that not only influence plant establishment but also enhance crop tolerance to herbivory.

The use of biological stubble digestors, used by six percent of respondents to this survey, is one such tool that could be further investigated.

Increasing crop diversity, enhancing natural enemies, decreasing urea usage by improving plant nutrition and strategic tillage are all part of an ecological approach to managing slug threats in wet years, and to also limiting losses caused by other intangible establishment pests.

ACKNOWLEDGEMENTS

This survey was delivered through funding from the Victoria Drought Resilience Adoption and Innovation Hub, funded by the Australian Government's Future Drought Fund. Thank you to collaborators including the Irrigation Farmers Network, Vic No Till and Birchip Cropping Group, as well as all the survey respondents.

For further information, please contact Sabita Duwal, Riverine Plains Project Support Officer by emailing sabita@riverineplains.org.au



APPENDIX 1 SURVEY RESULTS

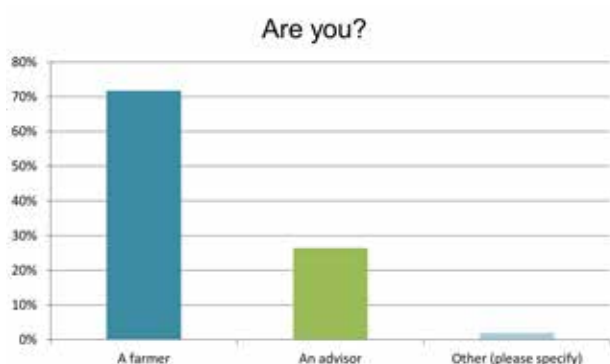


Figure 2 Riverine Plains' 2024 slug survey Question 2; demographics

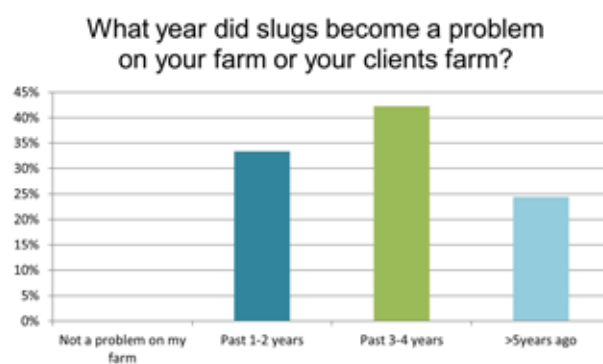


Figure 6 Riverine Plains' 2024 slug survey Question 5; year slug damage first detected

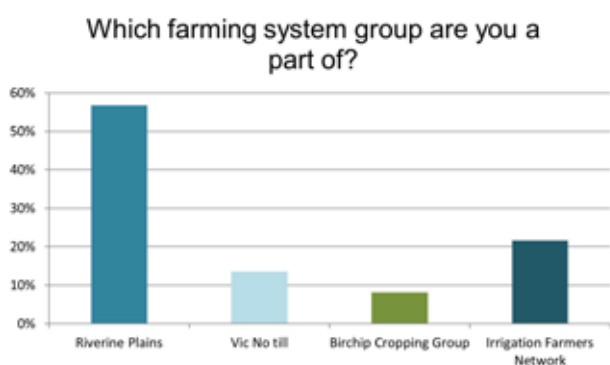


Figure 3 Riverine Plains' 2024 slug survey Question 2; Farming group membership

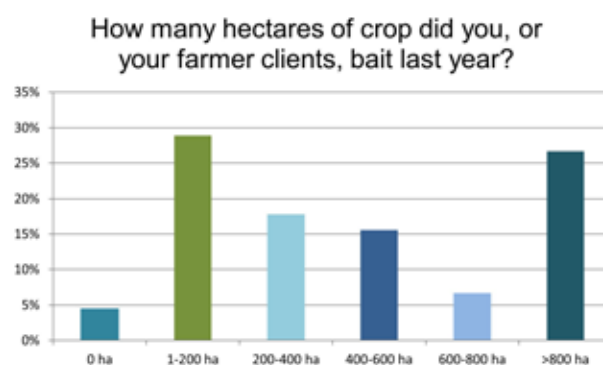


Figure 7 Riverine Plains' 2024 slug survey Question 6; area baited

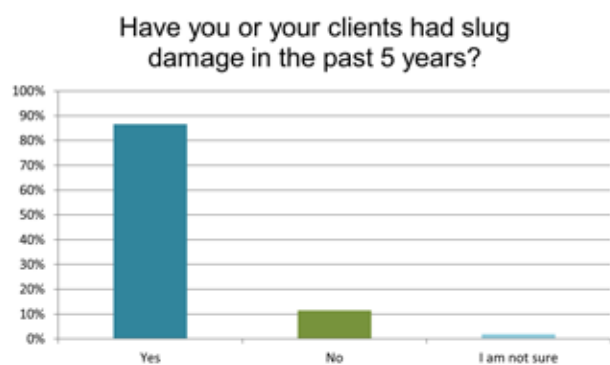


Figure 4 Riverine Plains' 2024 slug survey Question 3; slug damage occurrence

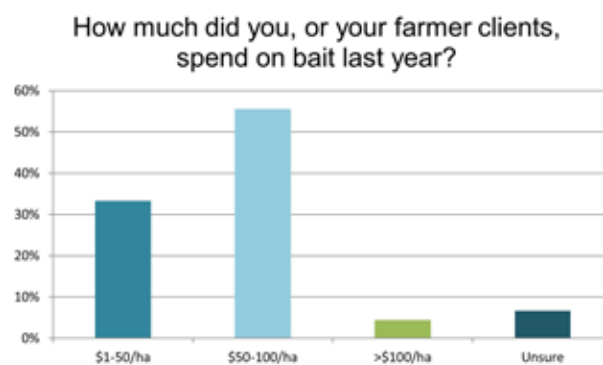


Figure 8 Riverine Plains' 2024 slug survey Question 7; cost of bait applied/ha

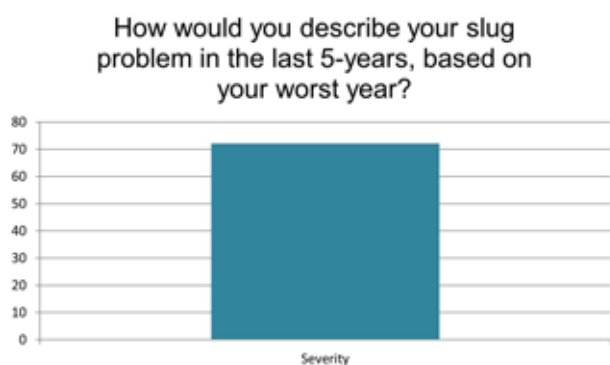


Figure 5 Riverine Plains' 2024 slug survey Question 4; severity of damage

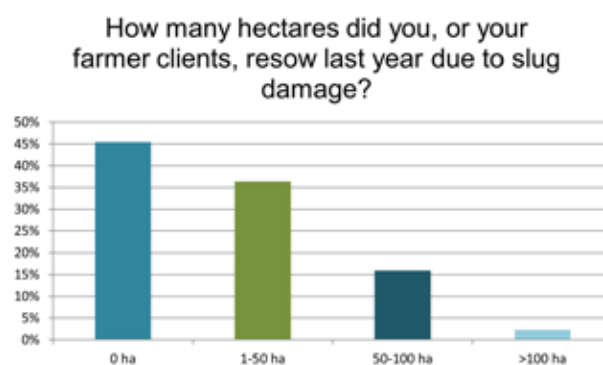


Figure 9 Riverine Plains' 2024 slug survey Question 8; area resown due to damage

Where do you, or your farmer clients, get information on slug management strategies? Choose one or more from the below.

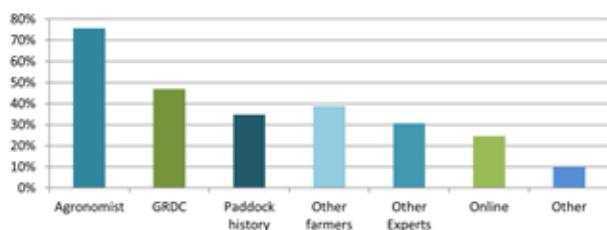


Figure 10 Riverine Plains' 2024 slug survey Question 9; source of management information

Which soil additives have you used over the past 5 years? Choose one or more.

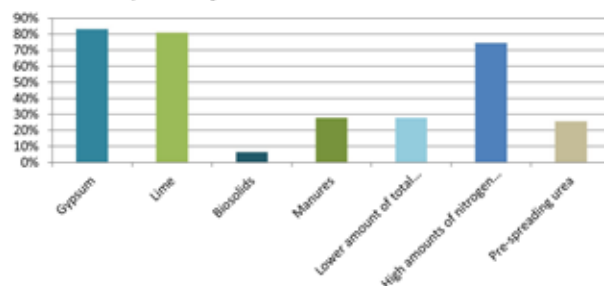


Figure 14 Riverine Plains' 2024 slug survey Question 13; soil additives

Which of the following tillage practices have you used in the last past 5 years? Choose one or more from the below.

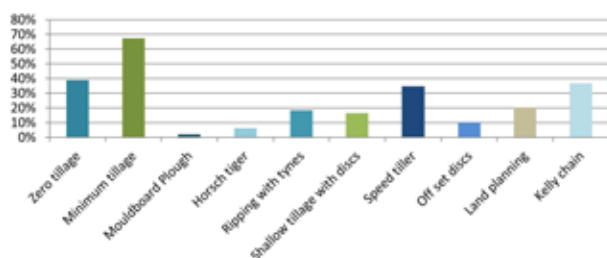


Figure 11 Riverine Plains' 2024 slug survey Question 10; tillage methods

Which of the following pesticides & molluscicides have you used in the last 5 years?

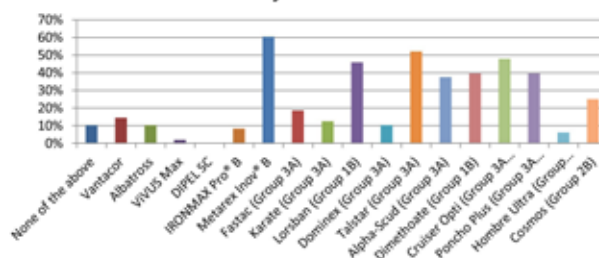


Figure 15 Riverine Plains' 2024 slug survey Question 14; pesticide use

Which of the following stubble management practices have you used in the last 5 years?

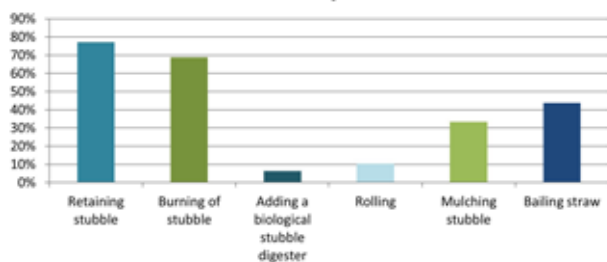


Figure 12 Riverine Plains' 2024 slug survey Question 11; stubble management

Which of the following crop species have you sown in the last 5 years?

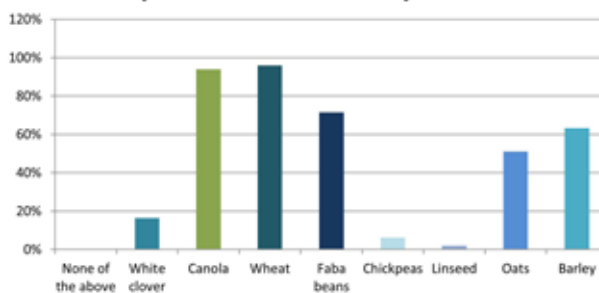


Figure 16 Riverine Plains' 2024 slug survey Question 15; crop rotation

Which livestock grazing strategies have you used in the last 5 years? Choose one or more.

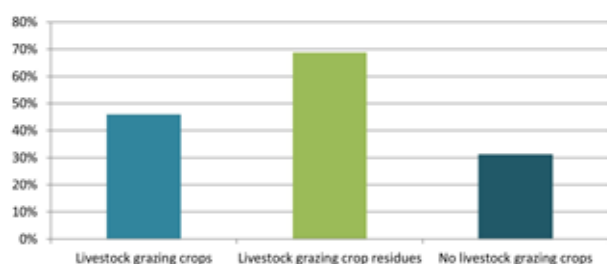


Figure 13 Riverine Plains' 2024 slug survey Question 12; livestock