FIELD LAB: Controlling Leatherjackets
Final Summary

Leatherjackets (crane-fly larvae) can devastate emerging cereals and grassland. Threshold problem Leatherjacket population for cereal fields is >1million/ha, and a 2017 survey of 94 fields in Ayrshire and Bute[1] found 90% of fields had a leatherjacket population above this threshold. However chlorpyrifos, the only chemical control for leatherjackets, was banned in Spring 2016. There is very little guidance available for non-chemical alternatives for the control of leatherjacket populations.

The field lab is currently focusing on:

- *Alternative sprays based on plant extracts*
- *Considering the leatherjacket's lifecycle as part of a control strategy*
- *Minimizing damage to grass and crops*

The story so far

This field lab has experimented with the spraying of 'Rigel G' at a concentration of 1l Rigel G to 20L of water, per hectare. Rigel G releases a sulfoxide called alliin, a natural constituent of fresh garlic which is toxic to leatherjacket larvae. Larger grubs are more resistant to sulfoxides, so this treatment will be most effective at controlling leatherjacket larvae in their first few months of life. Leatherjacket eggs hatch in September/October, so an Autumn treatment of Rigel G will be most effective. Our early trials in Mid Bishopton in 2016-17 revealed a significant difference between fields treated with garlic and the control plot, with the sprayed field returning 64% less leatherjacket larvae after six months.

Chlorpyrifos can kill grubs much later in their lifecycle. This means land managers are accustomed to spraying chlorpyrifos in response to infestations, which are usually identified in the spring. Leatherjackets eat the roots, so farmers might not know they have an infestation until they notice stunted crop growth. A survey of leatherjacket grub numbers can expensive to perform, so Autumn garlic treatment is proposed as a preventative strategy.[2] This presents an economic issue: it requires farmers to spray before they know the leatherjacket population will be problematic, which won't be feasible in all cases due to the considerable expense of Rigel G (£80 per hectare).

Goals

This field lab aims to answer the following questions:

- *Is spraying of garlic compounds effective at managing Leatherjacket populations?*
- *Is a spring treatment as effective as an Autumn spraying in managing Leatherjackets?*

Methodology

This field lab takes place over five test plots on five separate farms. Two plots were sprayed in the autumn, and three were sprayed in the spring. Each field was partitioned into two equal sections. One was sprayed

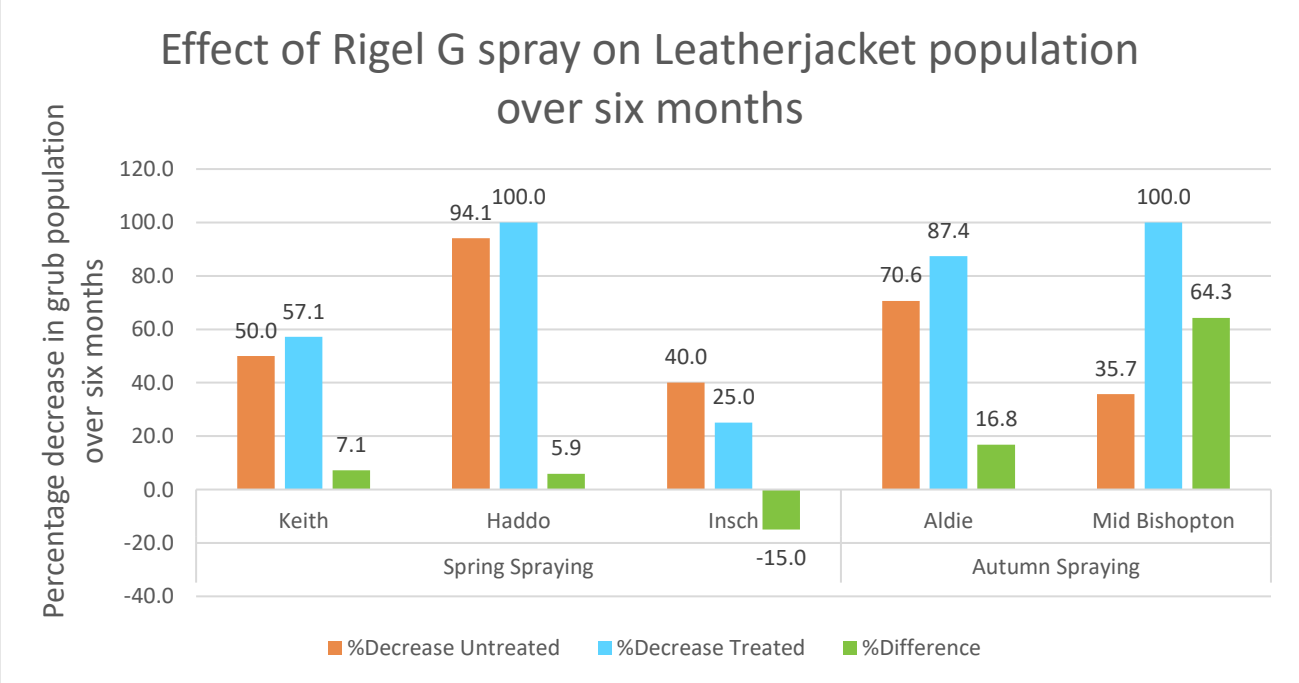
[1] Dr. Andy Evans, SRUC.
[2] DIY leatherjacket population measurements do exist, see 'Testing for Leatherjackets' in Field lab note 2: https://www.soilassociation.org/media/14421/leatherjackets-field-lab-report-drumcarro-farm-2017-dm.pdf

with Rigel G, the other served as a control. 25 core samples were taken in a diagonal fashion from each partition. This was done in before application, and again in the late Spring. The grubs in the samples were counted, and the population change in each segment extrapolated from the number of grubs found.


From left to right: The diagonal sampling method, a soil core, a leatherjacket grub.

Results

	Spring Spraying			Autumn Spraying	
	Keith	Haddo	Insch	Aldie	Mid Bishopton
Untreated before	849257	283333	166667	1445639	1980328
Untreated after	424628	16667	100000	424356	707260
Treated before	990800	266667	133333	1124543	1555972
Treated after	424628	0	100000	141452	0



Both sections of all fields saw a decrease in leatherjacket populations due to predators and other environmental factors.[3] Four of the five fields experienced a greater reduction in the treated section compared to the control. The two fields which were treated in Autumn saw a greater %difference between treated and untreated fields than those treated in the spring.

NB: Parks of Aldie received an incorrect concentration of Rigel G, and was sprayed at half the dose of the others. (1/2l Rigel G in 20l of water per hectare). In spite of this, Parks of Aldie still saw a significant population decrease. Even when sprayed at half concentration, the Autumn treatment is twice as effective as the most effective spring treatment.

Discussion

The 94% reduction of grubs in the Haddo control suggests that there was an external environmental reason for the population collapse in this field. This study is limited by its small sample size. The 25 core samples combined only cover an area of 0.009ha. The number of grubs found in this area is multiplied greatly to determine the population across the field. This explains some of the statistical anomalies: It's extremely unlikely that Haddo and Mid Bishopton saw a complete eradication of leatherjackets after treatment, rather it happened that no grubs were found in the 25 sample cores. This also serves to explain how Keith and Insch have identical summer populations. Insch's control appears to have outperformed the treated section, but this could be due to the control area containing a larger leatherjacket population to begin with, as both had a comparable population at the end. The only result outwith the margin for error is Mid Bishopton. None of these results have been replicated, so it's impossible to know how environmental factors have contributed to population change in each field.

Conclusion

This field lab tentatively concludes that Autumn spraying of garlic compounds could be an effective strategy for Leatherjacket population control. The effect of Spring spraying is indeterminable, which suggests a reduced efficacy of Rigel G on older larvae.

This means that garlic spraying could be suitable for farmers who identify a high number of leatherjackets in Autumn surveys, or as a preventative measure on high-value crops. This isn't a perfect replacement for chlorpyrifos, as treatment with Rigel G would be a highly expensive preventative measure, and might not be effective when used on a mature Leatherjacket infestation. However it could be particularly effective when combined with other cultural controls for Leatherjackets, such as earlier ploughing and cultivating a finer seedbed.[4]

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[3] See: Field Lab Note on Leatherjacket Lifecycle, https://www.soilassociation.org/media/10113/leatherjackets-field-lab-note-lifecycle-2.pdf

[4] See: 'Cultural Control Methods' in Field lab note 2: https://www.soilassociation.org/media/14421/leatherjackets-field-lab-report-drumcarro-farm-2017-dm.pdf