Case study:

IPM and biodiversity in lettuce, Winter 2024

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Summary:

This case study shares the crop protection approach taken in successfully harvesting a marketable winter lettuce crop using integrated pest management and biodiversity as key strategies.

Introduction

This report details the Winter 2024 lettuce crop, utilising Integrated Pest Management (IPM) and biodiversity as key strategies. Our primary objective is to effectively manage pest populations through natural means by enhancing on-farm biodiversity, reducing reliance on chemical sprays, and fostering more resilient pest control using natural enemies.

This approach aims to demonstrate a sustainable pest control model while maintaining crop health and productivity.

Crop overview

This section provides an overview of the lettuce crop's growth and the environmental challenges it faced during the season.

The crop experienced generally favourable conditions; however a series of frosts at the start of harvest posed challenges for disease control. This season was marked by significant caterpillar and vegetable weevil pressure, presenting an opportunity to test IPM strategies under cool-season conditions.

Weekly informal IPM workshops with growers and industry members were held, showcasing the practical application of IPM in the field during winter. It was difficult to determine whether biodiversity plantings influenced crop insect dynamics during the cooler period. Despite these challenges, the crop was successfully harvested, meeting quality and yield expectations, though frost damage did negatively impact the overall harvest.

The lettuce crop alongside an annual flower strip still in bloom, providing natural enemy support during winter (16 May 2024).

Lettuce at the start of harvest, prior to frost damage (9 July 2024).

Crop details

The lettuce variety 'Icequeen' (Intermediate Resistance: Bl.1-36) was transplanted on April 18th 2024, with two additional plantings following at two-week intervals. This case study focuses on all three plantings in detail. Harvesting of the first planting began on July 8th, 2024.

Monitoring details

Crop monitoring was conducted on a 7-day cycle, with adjustments made in response to rain. During each session, 10 plants were systematically scouted in a diagonal pattern across the cultivation block, following basic industry guidelines. Spray thresholds were set based on these guidelines and further refined using field experience to inform and improve decision-making processes.

Pest overview

The late April to early May planting slot was designed to assess how biodiversity plantings could influence pest dynamics under cooler conditions. While aphids were not an issue, the primary challenges came from juvenile vegetable weevils and caterpillars. These pest pressures, although not severe, persisted for a prolonged period throughout the crop cycle.

Towards the end of the crop, a spray was required for both caterpillars and vegetable weevils as their numbers increased closer to harvest.

Spray decisions were made collaboratively with growers attending the informal IPM workshops. Early on, the spray was delayed to assess the extent of damage caused by vegetable weevils and explore potential natural control. Significant damage only became evident late in the crop, as holes appeared in the leaf tissue. At that point, the group opted for a softer spray option to manage both the caterpillars and vegetable weevils effectively.

The caterpillars observed included a unidentified species (present in low numbers), soybean looper, and tomato fruitworm, none of which caused significant issues in isolation. Slugs, however, posed an additional challenge, exacerbated by wet conditions. Despite the application of slug bait, their population remained difficult to control.

Native plantings within the mobile insectaries placed among the lettuce crop (18 June 2024).

While aphids were not an issue, the primary challenges came from juvenile vegetable weevils and caterpillars.

A dead caterpillar with unidentified parasitoids developing inside and eggs visible on the surface (11 June 2024).

Natural enemies overview

As expected during the cooler winter months, the number of beneficial insects observed in the crop was relatively low. The primary natural enemies present in the lettuce during this period were spiders, which were consistently found throughout the crop. Additionally, small numbers of lacewing eggs were detected, indicating some level of activity despite the cooler and wetter conditions.

Several dead caterpillars, including one parasitized by natural enemies, were found toward the end of the crop as the effects of the drench began to wear off. This suggests that parasitism may have played a role in pest control. These occurrences were not attributed to spraying, as no insecticides had been applied at that time.

Disease update

The crop experienced minimal disease issues overall. Despite several foggy days during the season, only a small amount of botrytis was observed. After harvesting began, frost damage led to secondary bacterial infections developing in the affected areas.

Workshop attendees inspecting the crop in foggy conditions.

Thresholds

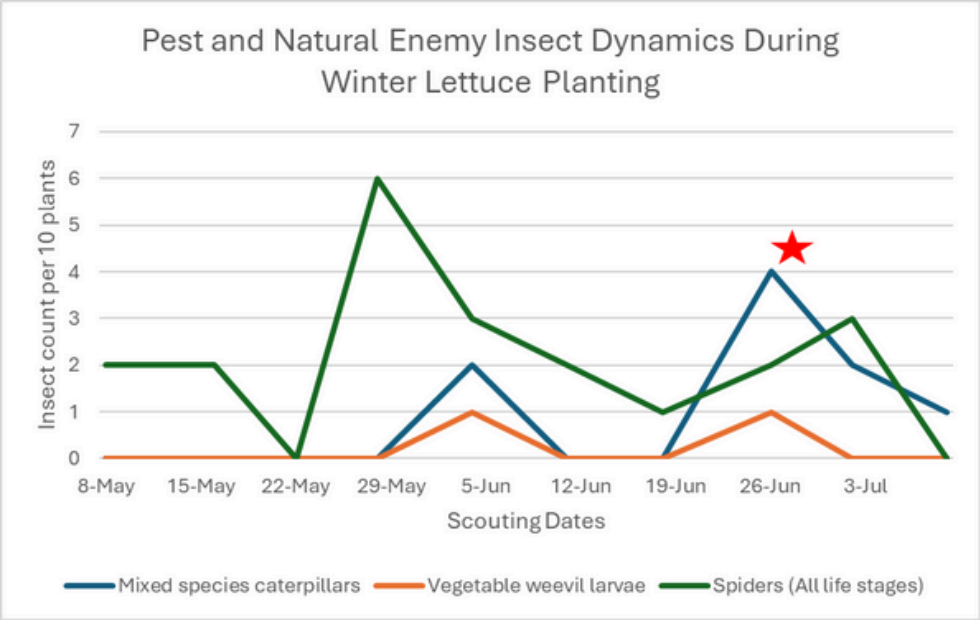
During this crop cycle, we followed threshold guidelines from the Information Guide for IPM in Outdoor Lettuce (August 2007), focusing primarily on caterpillar thresholds. The specific thresholds monitored were:

- **Soybean looper**: Action threshold set at 0.5 caterpillars (10mm or longer) per plant. This threshold requires further validation.
- **Tomato fruitworm**: No defined action threshold is set, though economic action thresholds are considered very low.

In our biodiverse system, we ultimately decided to spray, primarily due to the presence of tomato fruitworm, which posed the greatest threat. Soybean loopers and an unidentified caterpillar species were also found, along with vegetable weevil larvae. The decision to spray was made collectively, taking into account the combination of these pest pressures and their potential to cause significant crop damage and issues at harvest.

Monitoring results

Throughout the growing season, pest and natural enemy populations were closely monitored to evaluate the effectiveness of our IPM strategies and biodiversity enhancements. The graph below illustrates the main pest populations, with caterpillar species combined, alongside the most commonly observed natural enemy during the three primary planting periods. Key moments when spray was applied are indicated with a red star.



Additionally, the accompanying table provides details on the diversity of species encountered in the crop. This includes both pests and natural enemies that were not routinely monitored but were observed sporadically, offering valuable insight into the broader ecological impact of our biodiversity efforts. The table categorizes these sightings into two groups: those systematically recorded during monitoring and those noted incidentally, providing a comprehensive overview of the pest and beneficial insect dynamics within the lettuce crop.

Diversity of insect species observed in the lettuce crop

Pest		Beneficial	
Monitoring	Aphid	Monitoring	Lacewing – eggs
	Soybean looper -caterpillar		Spiders
	Tomato fruitworm -caterpillar	Observed	Hoverfly - adults
	Unidentified - caterpillar		Lacewing - adults
	Vegetable weevil - larvae		Parasitised caterpillar
	Whitefly - adults		Pacific damsel bug
	Thrips		
	Slugs		
	Snails		

Biodiversity planting impact

The diverse plantings within our farm ecosystem appear to have contributed to pest management during the winter season by supporting natural enemies and influencing pest dynamics. For this crop, on-farm biodiversity included several complementary measures.

An annual floral strip flanked both sides of the block, sown on September 18, 2023, with a mix of alyssum, buckwheat, calendula, cornflower, and marigolds. By winter, marigolds were the primary species still flowering, with some calendula and self-sown alyssum providing additional floral resources.

Permanent native plantings along the front and one side of the block also provided resources, with species such as *Coprosma 'Flat Freddy'*, *Lobelia angulata*, *Muehlenbeckia axillaris*, *Pratia puberula*, *Pimelea 'Blue Peter',* and *Ozothamnus leptophyllus* flowering in small numbers.

On June 6, 2024, six movable insectaries were placed within the crop, containing native plants such as *Muehlenbeckia axillaris*, *Parahebe catarractae 'Snowcap'*, *Pimelea 'Blue Peter'*, and *Pimelea prostrata 'Silver Ghost'*. These plantings offered crucial habitats and resources for beneficial insects, including Tasmanian brown lacewings, parasitoids, and spiders, which are key contributors to pest control.

While the crop experienced typical pests such as vegetable weevils and a range of caterpillar species, an unidentified caterpillar was also observed. Although this species did not cause any noticeable damage due to numbers, its presence, along with similar occurrences in previous lettuce crops, suggests that the native plantings may be influencing pest dynamics. These plantings could also be fostering natural enemies by hosting pests that serve as prey such as these unidentified caterpillars.

Additionally, the discovery of possible caterpillar parasitoids within the crop provides further evidence of the biodiversity plantings' role in supporting natural pest control. This is particularly significant given the challenges of winter conditions, where pest pressures can persist, but natural enemy activity is often reduced.

To quantify the impact of our biodiversity efforts, we summarised the total insect counts and species diversity observed within the lettuce crop:

Pests: 130 individuals across 10 species
Natural enemies: 30 individuals across 6 species

Spider webs glistening in the early morning mist on the native plant Muehlenbeckia axillaris (18 June 2024)

The discovery of possible caterpillar parasitoids within the crop provides further evidence of the biodiversity plantings' role in supporting natural pest control.

Spider webs woven on the ground around the lettuce crop (11 June 2024).

These data underscores the persistent pest pressure in Pukekohe during late autumn and winter, while also highlighting the presence of natural enemies within the crop, contributing to pest control despite the cooler conditions.

Harvest

The crop was successfully harvested, with frost posing the primary challenge. Despite these challenges, the crop was well-received at market, with no reported issues.

Reducing insecticides

We successfully produced a lettuce crop by utilising a combination of drenching, Integrated Pest Management (IPM) strategies, and biodiversity plantings.

This integrated approach enhanced the resilience of the system by minimising disruption to natural enemies living in the biodiversity plantings through reduced foliar spraying.

By decreasing the frequency of insecticide applications, we allowed beneficial insects to thrive and contribute to pest control, even under the cooler winter conditions. This resilience was evident in the presence of natural enemies such as spiders and parasitized caterpillars, which were observed during the crop cycle.

The choice of foliar spray was made strategically to target both caterpillars and vegetable weevils, which posed the most significant threats to the crop. This targeted approach minimised broader impacts on beneficial species, further reinforcing the resilience of the system.

The table below outlines the schedule of fungicide and insecticide applications made during the crop cycle, comparing our biodiverse crop with a similar conventional crop nearby. This comparison highlights how integrated pest management and biodiversity strategies effectively reduced chemical reliance while maintaining pest control.

Spider webs glistening in the early morning mist on the native plant Muehlenbeckia axillaris (18 June 2024)

This integrated approach enhanced the resilience of the system by minimising disruption to natural enemies living in the biodiversity plantings through reduced foliar spraying

Native plantings within the mobile insectaries placed among the lettuce crop (18 June 2024).

Our Crop Treatment			Nearby Crop Treatment		
Date	Fungicide	Insecticide	Date	Fungicide	Insecticide
		Durivo drench @ transplant			
			Week 16	copper	Uphold
25/04/24	Intuity + Bravo WeatherStik		Week 17	copper	Coragen
16/05/24	Intuity + Integralis + Incursus + Incursus Field		Week 18	TripleX	Coragen
30/05/24	Bravo WeatherStik + Integralis + Incursus + Incursus Field		Week 19	Captan 600 Flo	Coragen
12/06/24	Bravo WeatherStik + Kelpak		Week 20	Captan 600 Flo	Biobit
27/06/24	Integralis + Incursus Field + Kocide Opti	Steward	Week 21	TripleX + copper	
4/07/24	Integralis + Incursus Field + Kocide Opti		Week 22	Captan 600 Flo + copper	
			Week 23	TripleX + copper	

This schedule offers a detailed overview of the treatments applied, emphasising the differences in chemical usage between biodiverse and conventional farming practices.

Conclusion

This winter presented a season of relatively high lepidopteran pressure, yet effective pest control was maintained throughout the crop with minimal disruption to natural enemies. Biodiversity plantings once again appeared to support the presence of unidentified caterpillars, and this season, we also found caterpillar parasitoids within the crop.

These findings highlight the dual impact of biodiversity strategies; while they may introduce pest species not commonly seen, they also bolster natural enemies capable of controlling those pests. As the native plantings mature and develop fully, they are expected to further enhance ecological balance, supporting more natural enemies and fostering robust ecosystems within the farming system.

Acknowledgements:

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Other crop case studies

Case study: IPM and biodiversity in lettuce, Spring 2023 - here

This case study shares the crop protection approach taken in successfully harvesting a marketable spring lettuce crop using integrated pest management and biodiversity as key strategies.

Other related resources

Biodiverse planting on vegetables farms project - here

This project is designed to show manipulation of plant diversity on a farm can increase beneficial insect numbers and reduce the pests in a crop, meaning less use of insecticides is required.

Linked on this page are many grower resources relating to this biodiversity project, including how to guides and monitoring sheet templates.