

Evaluating Cover Crop Mixes Best Suited to Provide a Habitat for Predatory Ground Beetles

On-Farm Demonstration Research Manual

Prepared for:
Virasat Agri Inc.

Prepared by:
Shannon Venturini, A.Ag. and Marjolaine Dessureault, P.Ag.,
E.S. Cropconsult Ltd.
Drew Bondar, P.Ag. and Conley Keyes, P.Ag.,
British Columbia Ministry of Agriculture and Food

March 10, 2023



Disclaimer:

Opinions expressed in this document are those of the author and not necessarily those of Agriculture and Agri-Food Canada or the BC Ministry of Agriculture and Food. The Government of Canada, the BC Ministry of Agriculture and Food and their director agents, employees or contractors will not be liable for any claims, damages or losses of any kind whatsoever arising out of the use of, or reliance upon, this information. The research principles shared in this manual are for demonstration purposes only.

Acknowledgement:

Funding is provided by the Canadian Agricultural Partnership a five-year, \$3 billion investment to strengthen the agriculture, agri-food and agri-based products sector, ensuring continued innovation, growth and prosperity.



Contents

Background	3
Objective & Research Question	3
Trial Design	4
Methodology	4
Materials and Equipment	4
Potential Funding Opportunities	4
Data Collection and Evaluation	5
Trial Schedule	6
Budget	6
Labour	6
Datasheet Template	7
Carabid Identification Guide	8
List of Local Seed Sources	9
References	10

Background

Ground beetles, or carabids (*Carabidae*), are generalist predators that target several blueberry pests, including spotted wing drosophila (SWD) pupae and weevils (Ballman *et al.* 2017). Multiple studies have observed that floral strips and cover crops provide habitat and increase abundance of beneficial insects, including ground beetles. In 1994, Lys *et al.* found that carabid species were significantly more abundant in cereal crops adjacent to strips of flowering herbs and weeds. The diversity of carabid species also increased significantly in crops near flowering strips. A 2013 study done by Ditner *et al.* observed an average of 40 different species of ground beetle in sites where a seed mixture of four plants, including *Fagopyrum esculentum* (buckwheat) and *Centaurea cyanus* (corn flower), were planted in strips adjacent to cabbage fields. One of the most frequent species of ground beetle caught in this study was *Bembidion quadrimaculatum*, which is commonly found in wild blueberry fields (Ballman *et al.* 2017). Carmona and Landis (1999) planted strips of three perennial plants, including *Agastache foeniculum* (hissop), and they observed that ground beetle activity-density tended to be higher in the refuge strips.

There are many parameters that can affect the effectiveness of using cover crops as beneficial insect habitats. On-farm demonstration research is a valuable approach that producers can use to objectively evaluate what works best for their operation. Demonstration research can be replicated over a few years to gain confidence in the results.

Objective & Research Question

The objective of this research is to evaluate the efficacy of different cover crop mixes at providing habitats for predatory ground beetles in blueberries.

The research questions this trial will address are:

- 1) Will cover crops planted in-between rows in blueberry fields increase predatory ground beetle populations?
- 2) Which cover crop mixes provide the best habitat for ground beetles?

Trial Design

In order to evaluate cover crop efficacy as ground beetle habitats, three different cover crop mixes will be tested in a 60-row Liberty blueberry field (Fig. 1). Each cover crop plot will be 18 rows wide with the cover crop planted between the rows in approximately 5 ft by 540 ft strips. A 6-row wide plot that will be farmed using normal grower practices will be used as a control.



Figure 1. Plot areas for each of the three cover crop mixes. The red box indicates the plot for mix 1, green is mix 2, and blue is mix 3. The grey box is the control area, which will have no cover crop established.

Methodology

- 1) Using Terralink's Oats, Peas, and Vetch (OPV) Spring Mix as a base (SARE 2018). A list of potential sources for each seed type is provided on page 9.
 - Mix 1: 48% OPV, 20% white clover, 27% barley, 8% chicory, 4% turnip
 - Mix 2: 47% OPV, 23% crimson clover, 11% phacelia, 3% radish, 16% annual ryegrass
 - Mix 3: 29% OPV, 10% millet, 38% faba bean, 19% buckwheat, 4% mustard
- 2) Plant each mix by drilling in at the following rates: Mix 1 – 74 lbs/ac, Mix 2 – 64 lbs/ac, Mix 3 – 104 lbs/ac. Lightly cultivate to a depth of ½ to 1 inch.
- 3) Manage the control area as per normal farm practices (mowed grass).

Materials List

- Base mix seeds: 100 lbs oats, peas, and vetch spring mix
- Variable seeds for each 1.12 acre plot:
 - 20 lbs white clover
 - 25 lbs barley
 - 10 lbs chicory
 - 5 lbs turnip
 - 20 lbs crimson clover
 - 10 lbs phacelia
 - 5 lbs radish
 - 15 lbs annual ryegrass
 - 20 lbs millet
 - 75 lbs faba bean
 - 45 lbs buckwheat
 - 10 lbs mustard
- 48 small plastic cups, with lid, 6 cm diameter
- 48 funnels, minimum 6 cm diameter
- 1L 99% isopropyl alcohol
- 48 pin flags
- Permanent marker
- Datasheet
- Carabid ID sheet

Potential Funding Options

1. BC Climate Action Fund – Cover Cropping.
2. Environmental Farm Plan/Beneficial Management Practices (EFP/BMP) funding- Cover Cropping (Practice Code 1304).

Data Collection and Evaluation

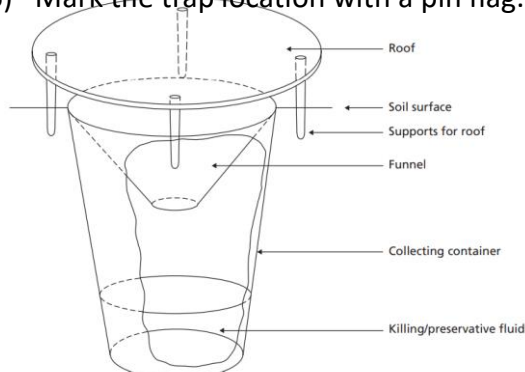
Ground beetle levels will be evaluated once every three to four weeks using pitfall traps for a total of three collections.

Trap spacing

- 1) In rows 3, 7, 11, and 15 place three traps (Fig. 2); $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ of the way in for each row.
 - a) In the control plot, place three traps each in rows 2, 3, 4, and 5.
- 2) Traps should be placed near the center of the row, within the cover crop foliage.

Placing the traps

- 1) Ensure traps are placed when no rain is forecasted for the next 72 hours.
 - If there are no upcoming rain-free periods, you may build small roofs for each trap using a small sheet of plastic or other waterproof material held up by rocks or pegs at each corner.
- 2) Dig a small hole where the trap will be placed.
- 3) Place the plastic cup in the hole.
- 4) Pour isopropyl alcohol into the cup, about 1 inch deep, then put the funnel into the cup.
- 5) Ensure the cup and funnel are **completely level with the ground**. Even a 1 mm lip may discourage insects from being trapped (Woodcock 2005).
- 6) Mark the trap location with a pin flag.



Trap collection

- 1) Three days later, collect traps by removing the cup from the ground and placing a lid on it. **Label the cup** with the cover crop mix number, row number, and position in the row (N, mid, or S).
- 2) Leave pin flags so the trap location can be found when the next round of traps is placed. Collect the funnels so they don't get misplaced.
- 3) Using the ID sheet provided, count the number of carabids and record the count on the datasheet.

Cover crop observations

- 1) While collecting traps, make observational notes on each cover crop mix, including information such as stand height, percent coverage, percent bloom, etc.

Evaluation

- 1) The number of carabids counted will be compared against:
 - a) The control strip
 - b) Relative numbers between each cover crop mix
- 2) Did the cover crops increase carabids compared to the control?
- 3) Which mix had the highest population of carabids?

Record-keeping

- Data collected: carabid counts, cover crop mix observations.
- Photos: seed mixing, planting, pitfall trap set-up, cover crops at each of the three collections.

Figure 2. Example pitfall trap set up. The roof is an optional addition if rain is forecast (Woodcock 2005).

Trial Schedule	
Date	Description of Activities
May/June 2023	Mix and plant cover crop seed
Early/mid June 2023	First pitfall trap collection, cover crop assessments
Late June/early July 2023	Second pitfall trap collection, cover crop assessments
Mid/late July 2023	Third pitfall trap collection, cover crop assessments (before mow)
July 2023	Host a field day before mowing the cover crop
Fall 2023	Analyse data and prepare a trial summary

Budget for Supplies (new)		
Item	Description	Cost (CAD\$)
Cover crop seed	Approximate cost of seeds in quantities listed in the materials list on page 4 from Green Cover Seeds	800
Plastic cups	For pitfall traps (x 48)	30
Funnels	For pitfall traps (x 48)	50
Pin flags	For locating pitfall traps (x 48)	20
99% isopropyl alcohol	Killing agent used in pitfall traps	20

Labour (outside of normal farm practices)		
Item	Description	Hours
Seed mixing	Mixing seeds at ratios as listed in methods on page 4	2
Planting	Working soil, planting, cultivating, and irrigation	6
Trap set-up/collection	Monthly set-up and collection of pitfall traps in each plot	8
Carabid ID	Identifying and counting carabids from pitfall traps	6
Field day	Promo and hosting	6
Summary	Analyse data and prepare a trial summary	4

Datasheet Template

Ground Beetle Cover Cropping Trial Datasheet

Date:

Weather:

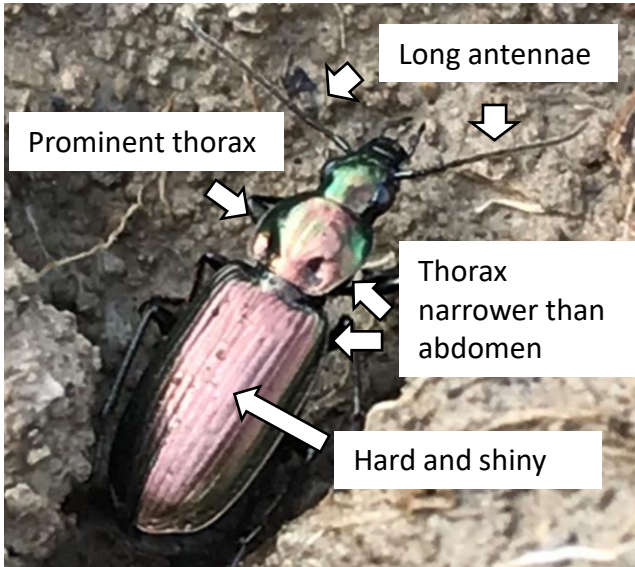
Mix 1				Mix 2			
Pitfall #	Row #	Count of Carabids	Cover crop observation notes	Pitfall #	Row #	Count of Carabids	Cover crop observation notes
1				1			
2				2			
3				3			
4				4			
5				5			
6				6			
7				7			
8				8			
9				9			
10				10			
11				11			
12				12			

Mix 3				Control			
Pitfall #	Row #	Count of Carabids	Cover crop observation notes	Pitfall #	Row #	Count of Carabids	Cover crop observation notes
1				1			
2				2			
3				3			
4				4			
5				5			
6				6			
7				7			
8				8			
9				9			
10				10			
11				11			
12				12			

Carabid Identification Guide

Basic identifying features:

- Long, hard, and shiny
- Long legs and antennae
- Range from 1/8 to 1 inch in size
- Enlarged thorax that is narrower than abdomen
- Enlarged segments at the base of rear legs
- 11 antennal segments (only visible with a microscope)



Common look-alike: click beetles



Carabids come in many shapes, sizes, and colours. See examples:



Local Seed Sources (as of spring 2023)

Mix	Seed type	Where to purchase
ALL	Oats, Peas, and Vetch Spring Mix	Terralink Horticultural
1	White Clover	Premier Pacific Seeds West Coast Seeds General Seed Company Speare Seeds
	Annual Ryegrass	Premier Pacific Seeds West Coast Seeds General Seed Company
	Chicory	Premier Pacific Seeds
	Turnip	Premier Pacific Seeds General Seed Company Speare Seeds
2	Crimson Clover	Premier Pacific Seeds West Coast Seeds General Seed Company Speare Seeds
	Phacelia	Premier Pacific Seeds General Seed Company
	Radish	Premier Pacific Seeds General Seed Company Speare Seeds
	Barley	Premier Pacific Seeds West Coast Seeds
3	Millet	General Seed Company Speare Seeds
	Faba Bean	General Seed Company West Coast Seeds
	Buckwheat	General Seed Company Premier Pacific Seeds West Coast Seeds Speare Seeds
	Mustard	General Seed Company Speare Seeds

References

Ballman, E. S., Collins, J. A., and Drummond, F. A. 2017. Pupation behavior and predation on *Drosophila suzukii* (Diptera: Drosophilidae) pupae in Maine wild blueberry fields. *Journal of Economic Entomology*. 110 (6): 2308-2317.

Carmona, D. M., and Landis, D. A. 1999. Influence of refuge habitats and cover crops on seasonal activity-density of ground beetles (Coleoptera: Carabidae) in field crops. *Biological Control*. 28(6): 1145-1153.

Ditner, N., Balmer, O., Beck, J., Blick, T., Nagel, P., and Luka, H. 2013. Effects of experimentally planting non-crop flowers into cabbage fields on the abundance and diversity of predators. *Biodiversity and Conservation*. 22: 1049-1061.

Lys, J.-A., Zimmermann, M., & Nentwig, W. 1994. Increase in activity density and species number of carabid beetles in cereals as a result of strip-management. *Entomologia Experimentalis Et Applicata*, 73(1), 1–9. <https://doi.org/10.1111/j.1570-7458.1994.tb01833.x>

(SARE) Sustainable Agriculture Research & Education. 2018. *Cover Cropping for Pollinators and Beneficial Insects*. Retrieved from: https://xerces.org/sites/default/files/2018-05/15-054_01_SARE_Cover-Cropping-for-Pollinators%2BBeneficial-Insects_web.pdf

Woodcock, B. A. 2005. Pitfall trapping in ecological studies. *Insect Sampling in Forest Ecosystems*, 37–57. <https://doi.org/10.1002/9780470750513.ch3>