Are Intercropped Cover Crops Compatible with Canola Weed Management on the Canadian Prairies

Janelle Gawiak[1], Yvonne Lawley[1], Maryse Bourgault[2], and Linda Gorim[3]

University of Manitoba Department of Plant Science[1], University of Saskatchewan College of Agriculture and Bioresources[2], University of Alberta Faculty of Agricultural, Life, and Environmental Sciences[3]

Funding Provided By: RDAR Results Driven Agriculture Research; WGRF Advancing Agriculture through Research; Manitoba Crop Alliance

INTRODUCTION

Cover Cropping on the Canadian Prairies is within its infancy and is being driven by early adopters of the practice. Currently the success of fall shoulder season cover crops on the Prairies is hindered by the lack of moisture and limited window following fall harvest[1]. Interseeding cover crops into cash crops has been explored to extend the length of the growing season, improve establishment, and increase biomass accumulation.

Currently, there is limited information on how cover crops can fit into Prairie crop rotations, especially with canola, one of Western Canadas' most widely produced crops. Furthermore, there is little to no information on herbicide control strategies that could be compatible with cover crops. Therefore, it is necessary to screen common canola herbicide tolerance systems for their potential to support the intercropping of cover crop species.

OBJECTIVES

The objective of this study is to evaluate the effect of the three herbicide resistance strategies used with canola as well as common herbicide and desiccation application timings to identify strategies that may be compatible with a cover crop intercropping while maintaining a productive canola crop.

MATERIALS AND METHODS

Three small plot experiments were conducted in 2022. Each included four replicates. The experiments had a split plot design with herbicide resistance strategy as the main plot and application timing as the subplot. Experiments were conducted at three locations across the Canadian Prairies (Figure 1) including the U of Alberta St. Albert Research Station (GDD 1501), U of Saskatchewan Kernen Research Station (GDD 1804), and U of Manitoba Ian N. Morrison Research Station (GDD 1797)[2].

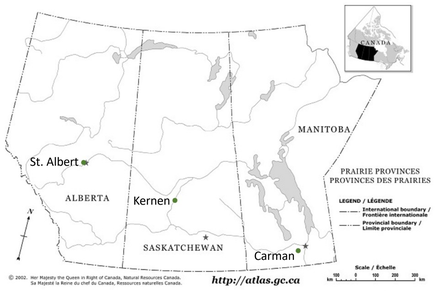

Figure 1. Map of the Canadian Prairie provinces[3].

Seeding rates: Three canola varieties (Clearfield P508MCL, Liberty Link DKC 82 SCLL, and Roundup Ready DK902TF) were seeded to achieve a stand of 110 plants/m^2 (445,000 plants/acre). A cover crop mixture was seeded to achieve a stand of 40 plants/m^2 at a rate of 3.6 lbs/acre (Table 1). The cover crop mixture and canola were seeded in alternate rows on 7.5" spacing.

Table 1. Seeding rates of species comprising the cover crop mixture.

Cover Crop Species	Seeding Rate (lbs/acre)	Target Stand (plants/m^2)
Red Clover	0.225	5
White Clover	0.100	5
Subterranean Clover	0.700	5
Persian Clover	1.875	5
Alfalfa	0.275	10
Italian Ryegrass	0.400	10
Mix Total	**3.6**	**40**

Herbicides: The pre-emergence (PE) treatment was Roundup (glyphosate) applied at a rate of 0.67 L/acre to all plots prior to crop emergence. The in season (IS) applications occurred in mid June for all three herbicide resistance systems. Clearfield Ares (imazamox/imazethapyr) was applied at 0.25 L/acre, Liberty (glufosinate) applied at 1.0 L/acre, and Roundup Weathermax (glyphosate) applied at 0.7 L/acre. The desiccant (D) treatment was Reglone Ion (diquat) applied at the end of August at a rate of 0.6 L/acre.

Statistical Analysis: All data was analyzed as a split-plot using the Proc Glimmex procedure of SAS 9.4. Location, canola herbicide resistance system, and herbicide application timing were included as fixed effects in the model. Replication was nested in location and was included as a random effect. The normal distribution was used for cover crop counts, cover crop biomass, and canola yield. Poisson distribution was used for weed counts and a log normal distribution was utilized for weed biomass. Differences between treatments were separated using Lsmeans at the 0.05 significance level.

RESULTS

Analysis of Variance (ANOVA)

Table 2. F-test probability from the ANOVA of location (Carman, Kernen, and St. Albert), canola herbicide resistance system (Clearfield, Liberty Link, and Roundup Ready) abbreviated as canola, and herbicide application timing (pre-emergence only, pre-emergence and in season, and pre-emergence in season and desiccant) abbreviated as timing, and their interactions for June cover crop counts, post harvest cover crop biomass, July weed counts and biomass, and canola yield.

	Cover Crop Count	Cover Crop Biomass	Weed Count	Weed Biomass	Canola Yield
Sources of Variation	P-values				
Location (L)	0.0106	0.0126	<0.0001	0.0181	0.0003
Canola (C)	0.7898	0.1207	0.0054	0.0001	<0.0001
Timing (T)	0.4839	0.0925	<0.0001	0.0130	<0.0001
L*C	0.8237	0.1561	0.0015	0.0218	<0.0001
L*T	0.4239	0.5130	0.0004	0.0048	<0.0001
C*T	0.6126	0.0722	0.1318	0.0505	0.7553
L*C*T	0.6263	0.2665	0.0729	0.0059	0.3166

Canola Yield

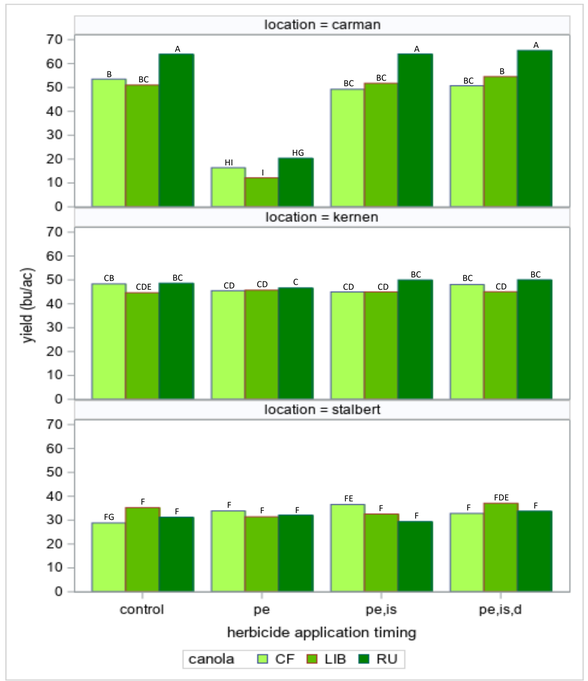

Figure 2. The effect of herbicide application timing (pre-emergence only (pe), pre-emergence and in season (pe,is), and pre-emergence in season and desiccant (pe,is,d)) on canola yield (bu/ac) for three herbicide resistance systems in canola (Clearfield (CF), Liberty Link (LIB), and Roundup Ready (RU)) seeded with a cover crop mixture at the locations Carman, Manitoba, Kernen, Saskatchewan, and St. Albert, Alberta in 2022. A control with no cover crops and pre-emergence, in season, and desiccant herbicide application timing was seeded for all canola herbicide resistance systems. Different letters indicate significant difference at P <0.05.

Weed and Cover Crop Biomass

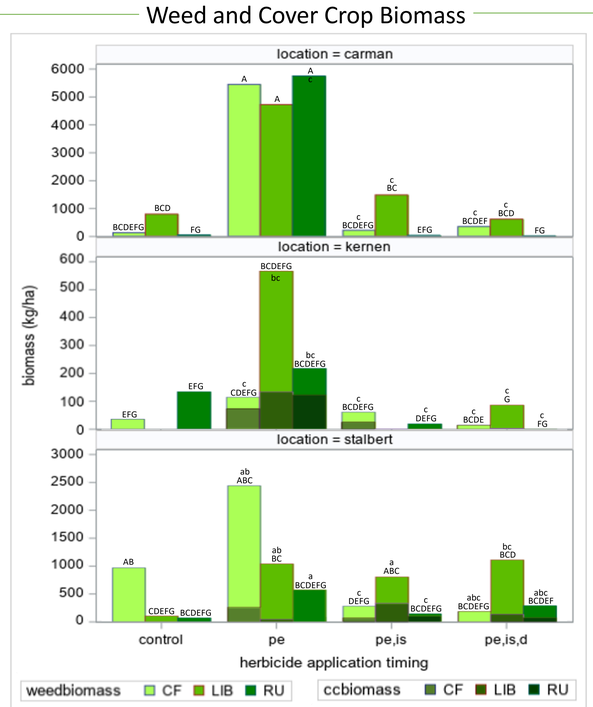

Figure 3. The effect of herbicide application timing (pre-emergence only (pe), pre-emergence and in season (pe, is), and pre-emergence in season and desiccant (pe,is,d)) on weed and cover crop biomass (kg/ha) for three herbicide resistance systems in canola (Clearfield (CF), Liberty Link (LIB), and Roundup Ready (RU)) seeded with a cover crop mixture at the locations Carman, Manitoba, Kernen, Saskatchewan, and St. Albert, Alberta in 2022. A control with no cover crops and pre-emergence, in season, and desiccant herbicide application timing was seeded for all canola herbicide resistance systems. Difference in letters indicate significant difference at P <0.05. Capitals are used for weed biomass, and lowercase for cover crop biomass.

HERBICIDE INJURY

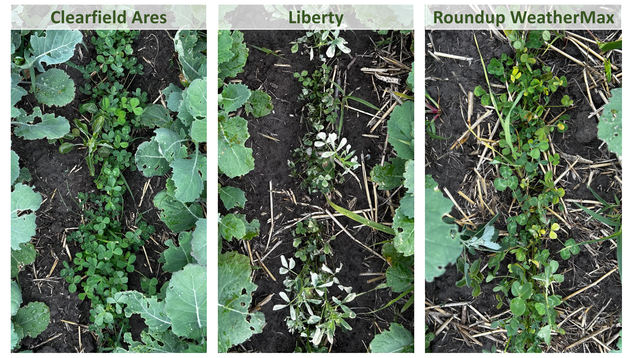

Figure 4. Herbicide injuries to the cover crop mixture of clovers, alfalfa, and Italian ryegrass 3 days after herbicide application. In season herbicides were selected based on the herbicide resistance system; Clearfield had Clearfield Ares applied, Liberty Link was treated with Liberty herbicide, and Roundup Ready was treated with Roundup WeatherMax.

Herbicide injury to cover crops under the canola canopy were prominent following the application of Liberty, followed by Roundup WeatherMax, and showed slight injury following Clearfield Ares. Injury symptoms in the cover crops following Clearfield Ares included slight chlorosis to clovers. Roundup WeatherMax application produced symptoms of chlorosis and wilting in clovers and a shepherd's crook in alfalfa. The most prominent injury to the cover crops occurred following the application of Liberty, where bleaching symptoms were visible in alfalfa and slightly in clovers. Also, wilting and cupping of clover leaves were observed. Cover crops treated with Clearfield Ares and Roundup WeatherMax were injured but still recovered, while cover crops treated with Liberty were injured beyond the point of recovery.

KEY FINDINGS

Did cover crops establish when intercropped with canola?
Cover crops successfully established at two of three sites in 2022. Cover crops successfully established at the Kernen site in Saskatchewan and St. Albert site in Alberta with an average understory of 67 plants/m^2 and 45 plants/m^2 respectively. The greatest amount of cover crop biomass at both sites occurred in the pre-emergence only treatments where the weed biomass was also the highest (Figure 3). Weed pressure from redroot pigweed, green foxtail, and lambsquarters at the Carman site in Manitoba outcompeted the cover crops that initially established.

Did in season herbicide application timing and desiccant treatments decrease cover crop biomass?
Cover crop biomass was not statistically different when in season herbicides or a desiccant was applied. Treatments consisting of only a pre-emergence herbicide application did see the greatest biomass accumulation, but there was moderate cover crop biomass in the pre-emergence and in season herbicide treatments. Limited results were due to poor cover crop persistence.

Did intercropped cover crops decrease canola yield?
Intercropping of cover crops did not decrease canola yield when weeds were controlled. Where weeds could not be controlled with in in season herbicide application, yields were reduced.

NEXT STEPS

- After documenting low cover crop establishment and growth in 2022, cover crop seeding rates were increased to achieve a target stand of 100 plants/m^2 when repeated in 2023 (data not shown as analysis is currently underway)
- Further testing is needed with a larger range of cover crop species, cover crop seeding methods, canola varieties, and locations.

REFERENCES

1. Morrison, C.L. and Lawley, Y. 2021. 2020 Prairie cover crop survey report. Department of Plant Science University of Manitoba. https://umanitoba.ca/agricultural-food-sciences/sites/agricultural-food-sciences/files/2021-10/2020-prairie-cover-crop-survey-report.pdf
2. Farmwest. 2022. Growing degree days. https://farmwest.com/climate/calculators/growing-degree-days/.
3. Natural Resources Canada. 2002. Reference maps. https://natural-resources.canada.ca/earth-sciences/geography/atlas-canada/explore-our-maps/reference-maps/16846#provincial-and-territorial.