Renegerative Agriculture

Impact of allelopathic cover crops and its termination method in subsequently planted cash crops

More than 60% of weed management is through recurring herbicide applications, leading increased instances of weed resistance. Allelopathy is the influence, usually detrimental, of one plant on another, where toxic substances are released when a plant dies, or produced through decaying tissue (Zimdahl R.L., 2018). These secondary metabolites may establish direct or indirect harmful or beneficial effects (Reigosa et al., 2006). Allelopathy can affect the growth and yield of another crop (Batish et al., 2001), b) develop autotoxicity, meaning chemicals expelled from plant residues of a species can hinder the growth of seedlings of the same species (Yu and Matsui, 1997). Thus, if managed properly, allelopathy can be a great alternative in weed management.

This study is preliminary and novel, because a) weed species and number of individuals per species will be evaluated within the allelopathic cover crop as well as the subsequent cash crops such as wheat, canola and peas and b) it aims to evaluate if allelopathy is affected if cover crops as well as cover crop mixtures are roller-crimped or incorporated in the soil before the cash crop is seeded. This research is unique because allelopathy is still an untouched subject for many growers. Extending knowledge through this project might increase grower interest in using allelopathic crops as another way to induce more weed suppression.

In the following growing season, cash crops such as canola, wheat and peas will be seeded as monocrop at each site respectively. Much like the first study year, soil samples will be collected for chemical analysis, a burndown herbicide application will be broadcasted before seeding and fertilization will be adjusted to target yields such as 40, and 50, for canola and wheat respectively (Government of Alberta 2024), as peas will not be fertilized. Harvest per plot will be weighed and recorded.

Objectives

This study aims to explore in further detail the allelopathic effects of Rye, ryegrass, Hairy vetch and Sunflower and mixtures between these cover crops (Rye + ryegrass, Rye + Hairy vetch, Rye + Sunflower, ryegrass + Hairy vetch, ryegrass + Sunflower and Hairy vetch + Sunflower). This study is preliminary, because a) weed species and number of individuals per species will be evaluated within the allelopathic cover crop as well as the subsequent cash crops such as wheat, canola and peas and b) it aims to evaluate if allelopathy is affected if cover crops as well as cover crop mixtures are roller-crimped or incorporated in the soil before the cash crop is seeded.

Materials & Methods:

The experiment was located at two sites in Lakeland Agricultural Research Association. These sites are St Paul (54°5'N, 110°15'W), and Fort Kent (54°18'N, 110°37'W). In 2024, aside from the herbicide burndown treatments there were no further applications of herbicide for the rest of the growing season. Rye (Secale cereal L), Annual ryegrass (Lolium multiflorum L.), Hairy vetch (Vicia villosa L.), Sunflower (Helianthus annus L.) were sown at 4.9, 4.5, 20.2 and 1.3 g m2 and mixtures of these crops (Rye + ryegrass, Rye + Hairy vetch, Rye + Sunflower) were also sown. Except for Sunflower, the seeding rate of all other cover crop species was doubled. The experiment was set up as a four replicate, complete random design.

The split plot factor is the cover crop termination style: roller crimped or incorporated. An untreated control, where no cash crop is seeded will also be included. In 2025, canola was sown on both sites. For future reference, 2024 will be named cover crop season whereas 2025 will be stated as cash crop season.

For both study years, a quadrat of 25X25 cm was situated randomly across the plot. Every second week of the months of June, July, and August, weed species and number of weeds per species were counted in one of these quadrats (species richness). Quadrat selection was random. For both cover crop and cash crop season, biomass was taken out of this one quadrat and separated at the end of the growing season (end of August, early September).

In the cover crop season, biomass was separated as cover crop, and weeds. For the cash crop season, biomass will be taken before the cash crop harvest and separated as weeds, cash crops and if present, cover crop plants. In 2024, hand weeding was conducted to remove Canada thistle (Cirsium arvense L. Scop.) and wild oat (Avena fatua L.) in the plots. This was because (a) Canada thistle has a thick and sturdy root system that may bend the blades of the mower used for roller crimped plots and (b) Wild oat spread quickly across fields; since we are not using maintenance herbicides during the growing season, wild oat becomes a threat for the outcomes of the experiment. In 2025, hand weeding was only conducted for wild oat. In both seasons, hand weeding was conducted, either by a stirrup hoe and/or a wheel stirrup hoe in aisles between seed plots around the first week of June.

At the end of the cover crop season, half of the plots were incorporated with a rototiller, and the other hand were mowed. Both Farm king C4560 rototiller for incorporation and Farm king mower for roller crimping were attached to a John Deere tractor (2010). In the absence of a roller crimper, a Farm king 528 mower was used to cut down the upper biomass of the cover crops and spread with a rake across the plot.

The experiment was set up as a four replicate, split-block plot analysis. Main factor was the cover crop species/ mixes, and the split block factor is the termination method at the end of the season. A cover crop season and a cash crop season factor is included as fixed because it is intentionally rotated every season as to mimic what producers would likely do in the field. Random effects considered will be replicate (i.e., block), as well as repeated measures (sample periods) at each plot for weed counts occurring every month after cover crop seeding. Interactions between fixed effects and random effects were considered random. Table 5-1 provides a breakdown of the effects studied in this experiment.

Table 5-1. Effects studied in the impact of allelopathic cover crop and its termination method in subsequently planted cash crops

Fixed	Random
Crop season	Site
• Cover crop season	• St. Paul
• Cash crop season	• Fort Kent
Termination method	
• Incorporated	Replicates (block)
• Roller-crimped	
Cover crop species/mixes	
• Annual ryegrass	
• Annual ryegrass + Hairy vetch	
• Annual ryegrass + Rye	
• Annual ryegrass + Sunflower	
• Hairy vetch	
• Hairy vetch + Rye	
• Hairy vetch + Sunflower	
• Rye	
• Rye + Sunflower	
• Sunflower	
Sampling period	
• June	
• July	
• August	

Interaction	
Fixed	Random
Crop season X Termination method	Replicates X Crop season
Crop season X Cover crop species/mixes	Replicates X Termination method
	Replicated X Cover crop species/ mixes
Cover crop species mixes X Termination method	Replicates X Crop Season X Cover crop species/mixes X Termination method

Repeated measurement
Crop season X Cover crop species/mixes X Termination method X Sampling Period

The variables were: cover crop biomass, weed biomass, number of weed individuals in general and per species as well as total number of weed species. In the cover crop season, competition indexes were evaluated such as relative neighbour effect (RNE), land equivalent and actual yield loss (AYL) index. In the cash crop year, yield, cash crop biomass and RNE for weeds was evaluated.

The relative neighbour effect (RNE) is the ratio used to compare competency of a plant in a community. It is computed by taking the biomass of a weed or a group of weeds in a treatment and subtracting the weed biomass obtained in the control treatment. Followed by this, the difference is divided by either the weed biomass from either the treatment or the control, whichever one is greater.

I adapted this concept to see if there was a difference in grain yield in canola among incorporated and among roller-crimped treatments. Thus, I used canola grain yield from a treatment, subtracted the canola grain yield from the control (either unseeded roller crimped or unseeded incorporated) and divided by the grain yield of either the treatment or the control, whichever value was greater. I did the same for canola biomass.

All analysis were performed in Statistical Analysis Systems SAS Institute Inc (2008) using PROC MIXED. If the interactions between site and treatment were not significant (i.e., Z-test>0.05), data for both sites were combined. Significance was assessed at a confidence level of 0.05. Moreover, LSD analysis was used to compare means for each parameter among control treatments to observe their impact on variables from fixed effects. In 2024 transformations were used for certain response as stated in tables. Transformed data was then back transformed for table display.

Results

Canola yield, canola biomass, and weed biomass

Table 5-2. P-values obtained compiling yield, biomass of canola and weed as well as number of weeds and weed species from data obtained in 2024 and 2025 in Fort Kent and St. Paul (N=176). Trials in 2024 were sown to Annual ryegrass (*Lolium multiflorum* L), Hairy vetch (*Vicia villosa* L.), Rye (*Secale cereale* L.) and Sunflower (*Helianthus annus* L.) and mixtures between these cover crop species. In 2025, same trial was sown uniformly to canola (*Brassica spp.*).

		Biomass		Relative neighbour effect			Weed	
Effect	Canola yield[a]	Canola	Weed[a]	Canola oilseed RNEc	Canola biomass RNEb	Weed RNEw	Number[b]	Species[c]
Crop season							0.01	0.04
Cover crop species/mixes	0.80	0.96	0.02	0.20	0.99	0.36	4.00×10^{-4}	0.08
Termination method	0.79	0.80	0.50	0.65	0.32	0.34	0.13	0.78
Crop season X Cover crop							0.68	0.60
Crop season X Termination period							0.01	0.30
Cover crop species/mixes X Termination period	0.67	0.90	0.57	0.98	0.97	0.77	0.67	0.66
Crop season X Cover crop species/mixes X Termination method X Sample period							$\leq 1.00 \times 10^{-4}$	$\leq 1.00 \times 10^{-4}$

[a]Inverse transformation
[b]Inverse transformation
[c]Logarithminc transformation

Data showed no difference between St. Paul and Fort Kent sites (P=0.24). This means data could be pooled and analysed as a single set. As such, yield was the same across cover crop species and mixes, termination methods (roller crimped vs incorporated) and interaction between cover crop and termination method effects (Table 5-2). A miscalculation in the seeding rate of canola may have caused this. Canola was sown ten times more than the recommended seeding rate. This overseeding incident may have acted as a blanketing effect, hindering potential differences among main and split block effect treatments.

Although there was no difference among sites, separate analyses showed that in Fort Kent cover crop species/ mixes, termination method and interaction between these treatments had no effect in canola yield (P=0.92,0.11 and 0.32 respectively). In contrast, in St. Paul, cover crop species/mixes effect influenced canola yield ($P=2.0 \times 10^{-4}$), as well as termination of the cover crop treatment (P=0.04). Interaction among these effects however had no impact on canola yield (P=0.30). Indeed, yield was 16 bu acre^{-1} in control plots (plots that were unseeded in the cover crop season).

Plots previously sown to Annual ryegrass yield 12 bu acre. This yield was 25% greater than mixtures of Annual ryegrass + Sunflower and Hairy vetch and 33% more compared to plots sown to Sunflower and mixtures of Rye + Sunflower. Moreover, canola yield obtained from plots previously sown to Annual ryegrass was statistically the same as yield from canola sown in plots planted to Annual ryegrass + Hairy vetch, Annual ryegrass + Rye, Hairy vetch + Rye, Hairy vetch + Sunflower and Rye the year prior. Plots that were roller crimped in the cover crop season had 18% more yield than plots that were incorporated. It can be argued that in Fort Kent there were more weeds than in St. Paul. Thus, a combined effect of over seeding plus greater weed pressure in Fort Kent, may have caused for differences to be imperceptible through statistical analysis.

Weed biomass overall were impacted by cover crop species and mixes but neither by termination method nor cover crop X termination method interaction (Table 5-2). In general terms, plots sown to Annual ryegrass + Rye had the least amount of weed biomass compared to other cover mixes and cover crop treatments (Figure 5-1). In contrast, plots sown to Hairy vetch has more weed biomass and such biomass was as statistically as heavy as that collected from unseeded plots (control). Moreover, plots sown to Hairy vetch + Sunflower, Rye, and Annual ryegrass + Sunflower, had just as much weed biomass as that found in control plots and plots sown to Hairy vetch.

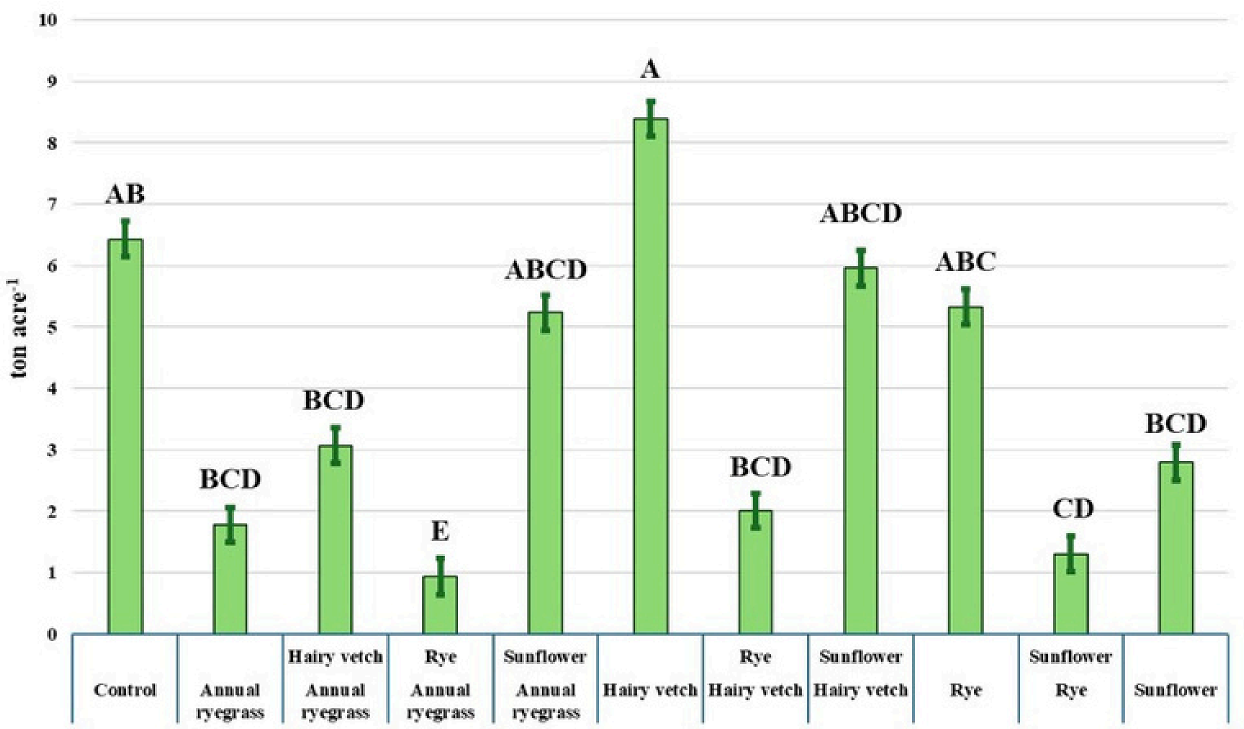

Figure 5-1. Weed biomass sampled in canola seeded plots in 2025 that were previously sown to cover crop species and cover crop mixes in 2024 in St. Paul and Fort Kent. N=176.

For canola yield, the relative neighbour effect for yield (RNEc), canola biomass (RNEb) and weed biomass (RNEw) were the same across cover crop species and mixes, termination method and interaction between these effects (Table 5-2).

Weed individuals and weed species

Weed individuals were analysed as per plot, per month, per year. Year here is regarded as the cover crop season in 2024, where cover crop treatments were sown and terminated and the cash crop season in 2025, where canola was sown in all plots. An all-inclusive analysis showed the growing season influenced number of weed individuals and number of weed species (Table 5-2). Our results show that the weed community is malleable depending on the cover crop and cash crop sown. As such, more weeds were found in the cover crop year compared to the cash crop year.

This is probably because (a) residues from allelochemicals from the previous cover crop season plus allelochemicals released from canola plants may be impacting weed number. In contrast to number of weed individuals, there were more weed species in the year where canola was sown that in the year when cover crops were planted. Probably, cover crops planted hindered the growth of certain weed species. These weed species thus thrived in the cash crop year because there were less or no cover crop plants in the plots, and potential cover crop residues were less effective to suppress weeds due to decomposition.

Moreover, cover crop species and cover crop mixtures among these species impacted number of weeds (P=4.00 x10-4) but not number of weed species (P=0.08). Plots with more weeds were those left unseeded (control). Statistically similar to the control, plots sown to Sunflower and mixtures of Sunflower + Hairy vetch had as many weed individuals as those counted in the control. On the other hand, weed individuals were scarce in plots sown to Rye + Sunflower, Rye and Annual ryegrass + Rye. In addition, weed individuals in plots sown to Annual ryegrass + Hairy vetch, and Hairy vetch +Rye were statistically the same as those found in plots sown from Rye and sown with Rye mixtures with either Sunflower or Annual ryegrass (Figure 5-2).

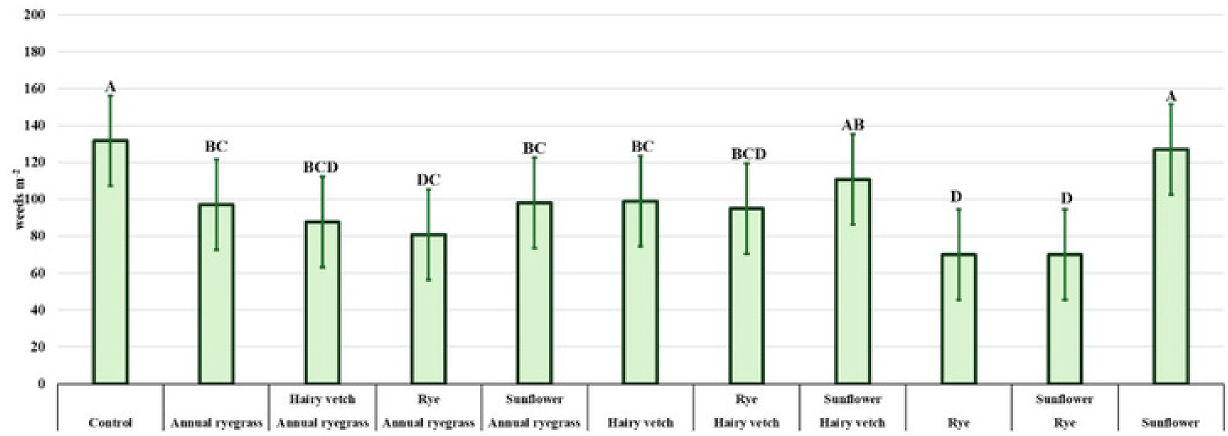

Figure 5.2. Number of weed individuals found at each cover crop species/mixes treatment effect N=528. Number of weeds were allotted were counted during three sample periods in the cover crop season (2024) and the cash crop season (2025). Different letters indicate significance across treatments.

The interaction between crop season and termination method influenced number of weeds (Table 5-3). Mean values show that there is no difference in termination method during the cover crop year, which makes sense because termination occurred at the end of the season. However, in the cash crop period, more weeds were found in plots that were roller crimped compared to plots that were terminated through incorporation. The possible explanation is likely that glyphosate had more soil contact in plots that were incorporated versus those that were roller crimped. Hence, more weed control may have occurred twofold, (a) by allelochemical residue from previous cover crops (b) by allelochemicals expelled from canola plant stands and (c) by glyphosate application at burndown. Since glyphosate tends to act on a short period of time and thus maintenance sprays in the middle of the season are necessary, it is likely that cover crop residue and canola plants may have increased weed suppression through allelopathy.

Moreover, number of weeds shifted through time. In the cover crop year, weed number was at its highest in June, then weed number significantly reduced by July and stays the same significantly by August, shortly before termination. In other words, cover crops are seeded after glyphosate burndown and fertilizer application, weed number increased due to nutrient application but eventually allelopathy and cover crop smothering played a role. In turn, weed number was reduced and plateaued by the end of the season. In the cash crop year, weed individuals seemed to increase in number from June to August, shortly before harvest. This is likely cover crop residue decomposition. Decomposition through out the year could potentially increase organic carbon and nitrogen in the soil. In turn, the availability of carbon and nitrogen may have provided enough nutrient availability for weeds and hence there is an increase in weed number in the cash crop at the end of the season before canola grain was collected. Number of weeds in August was significantly lower as that found in the beginning of the cover crop year in June. This is likely weed inter and intraspecific competition among each other as well as with canola plants.

Weed species also varied through time. However, in the cover crop year, weed species number was the same during the who cover crop season. In the cash crop year this was different. Weed species number in June was as statistically low as that found in the previous cover crop season. Then, it increased to a maximum in July to finally drop in August. All weed species unable to flourish in the cover crop season were able to do so in the cash crop season. Weed species number consequently dropped by August due to competition among weeds and with canola plant stands.

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Table 5-3. Weed number of individuals and weed species in the cover crop season (2024) sown to annual ryegrass (*Lolium multiflorum* L), hairy vetch (*Vicia villosa* L.), rye (*Secale cereale* L.) and sunflower (*Helianthus annus* L.) and mixtures between these cover crop species as well as the cash crop season (2025) which was sown uniformly to canola (*Brassica spp.*) N=176

Effect	Number of individuals			Species		
Crop season						
Cover crop season	114.21	23.3	**A**[a]	2	0.5	**B**
Incorporated	115.39	25.4	A[b]	2	0.5	A
Roller crimped	113.03	25.4	A	2	0.5	A
Cash crop season	79.85	23.3	**B**	3	0.5	**A**
Incorporated	67.57	25.4	C	3	0.5	A
Roller crimped	100.16	25.4	B	3	0.5	A

[a]Letters in bold different from each other represent significance between means
[b]Letters different from each other represent significance between means

Since both weed number and number of weed species were affected by an interaction of crop season X The following is a summary description of weed individuals and weed species changes occurring at each month in the cover crop season, the cash crop season and comparing cash crop with cover crop season.

Cover crop year

June

Each plot showed few weed species but there were many individuals counted per species. This is likely an early response to cover crop growth, where only a few weed species were able to grow along cover crop plants while others were deterred through allelopathy (Figure 5-3 a and b).

July

More weeds were found in the control plots incorporated compared to those sown in Annual ryegrass + Rye incorporated. It can be argued that by the middle of the cover crop season, Annual ryegrass and Rye mixes were the most effective in suppressing weed proliferation (Figure 5-3 a and b).

August

Control plots and plots sown to Sunflower that were terminated through incorporation had more weed individuals than mixes of Annual ryegrass + Rye terminated in the same way. By this time of the year, it is established that Annual ryegrass and Rye are the best cover crop mixture for weed suppression. No differences were found in roller crimped plots (Figure 5-3 a and b).

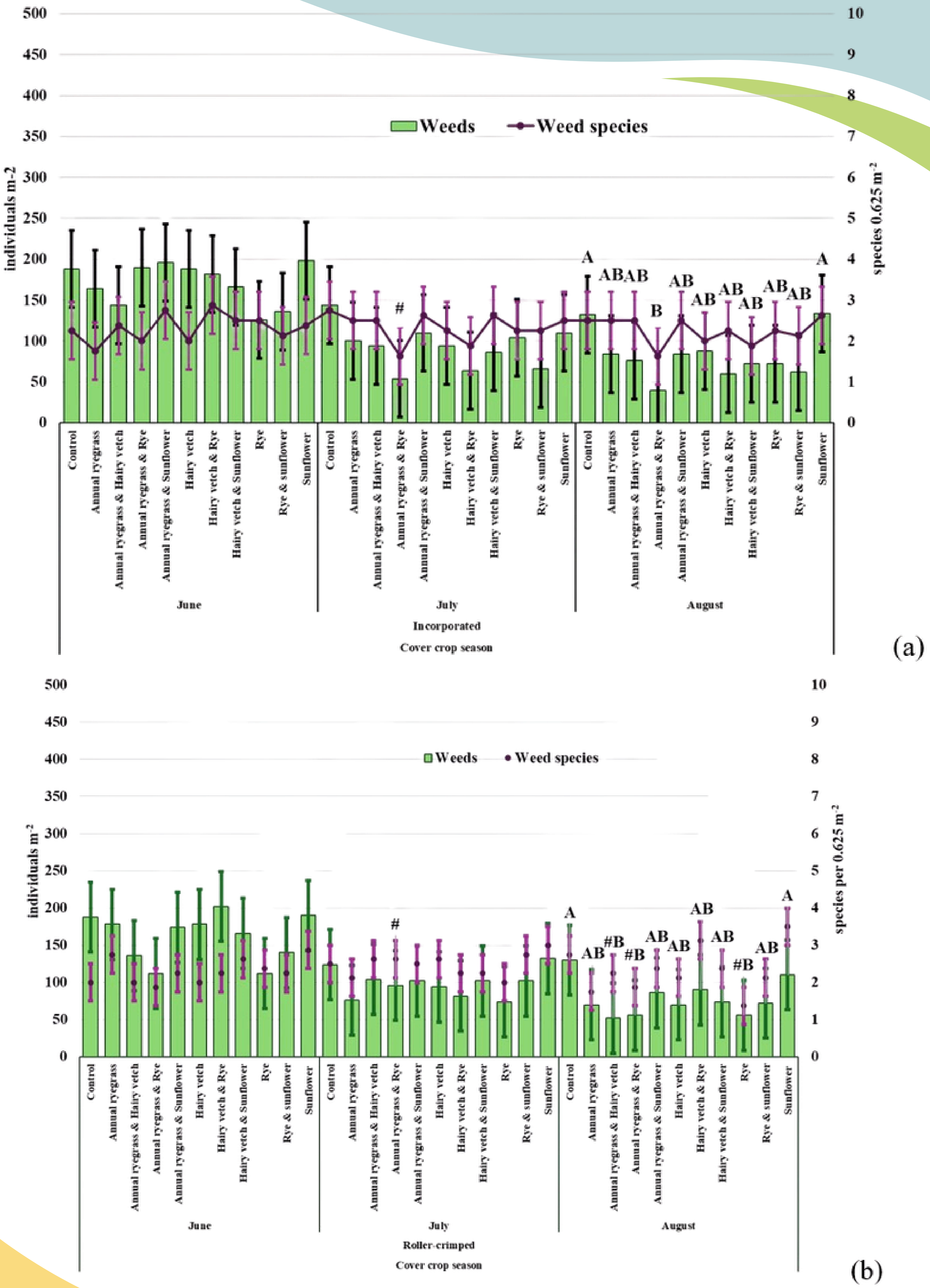


Figure 5-3a and b. Weed individuals and weed species counted in the cover crop season at three sample periods in 2024 in Fort Kent and St. Paul. (a) # =significantly different than control in the same sample period (b) letters different from each other denote significant difference among treatments within the same sample period. N=176.

Cash crop year

June

There were two more weed species in the cash crop year in plots previously sown to Annual ryegrass+ Sunflower and later incorporated compared to those sown to Rye and incorporated in the previous cover crop year. It is possible that Rye impeded the growth of certain weed species early in the cash crop year, while others were effectively managed with glyphosate. The allelopathic impact of Rye is thus greater compared to that from mixes of Annual ryegrass and Sunflower early in the cash crop season and it seems to be an appropriate choice to reduce weeds for subsequent cash crops (Figure 5-4 a and b).

July

Unseeded (control) plots and plots planted to Hairy vetch + Sunflower and roller crimped had more weeds in the following cash crop year than plots from the same treatments but instead, incorporated (Figure 5-4 a and b).

- Control>Hairy vetch + Sunflower

There were more weeds found in the cash crop year in plots previously sown to Annual ryegrass and incorporated compared to previously incorporated crops sown to Rye. Rye is thus a potent cultural strategy for weed suppression compared to Annual ryegrass IF BOTH ARE TERMINATED THROUGH INCORPORATION (Figure 5-5).

Moreover, in the cash crop year, previously roller crimped plots, the control (unseeded in the cover crop year) was significantly weedier compared to crops sown to canola in the cash crop year and sown the year prior to Rye +Sunflower, Rye, Hairy vetch, Hairy vetch + Rye and Sunflower and terminated by roller crimping (Figure 5-4 a and b).

Less weeds were found in previously roller crimped plots sown to Annual ryegrass and Annual ryegrass mixes compared to the control in the cash crop year. Roller crimped Annual ryegrass is less effective for weed suppression the following cash year than crops sown to Annual ryegrass+Sunflower, Rye and Rye+Sunflower (Figure 5-4 a and b).

Within canola plants sown in the cash crop year, plots sown to Hairy vetch+Sunflower and roller crimped in the cover crop year seemed to have a weaker suppression effect against weeds in contrast to roller crimped plots sown to Annual ryegrass mixes as well as those plots sown to Hairy vetch+Rye and Hairy vetch in the same year (Figure 5-4 a and b).

Canola does not benefit from roller crimped Sunflower. Plots sown to Rye+Sunflower, Rye and Annual ryegrass+Sunflower and roller crimped in the prior cover crop year, reduced more weeds in the cash crop year than roller crimped Sunflower plots in the same cover crop year. However, Rye+ Sunflower roller crimped plots seem to have lasting weed suppressing impact in the following cash crop year compared to those plots in the cover crop year, sown and roller crimped to Annual ryegrass and Hairy vetch+ Sunflower (Figure 5-5).

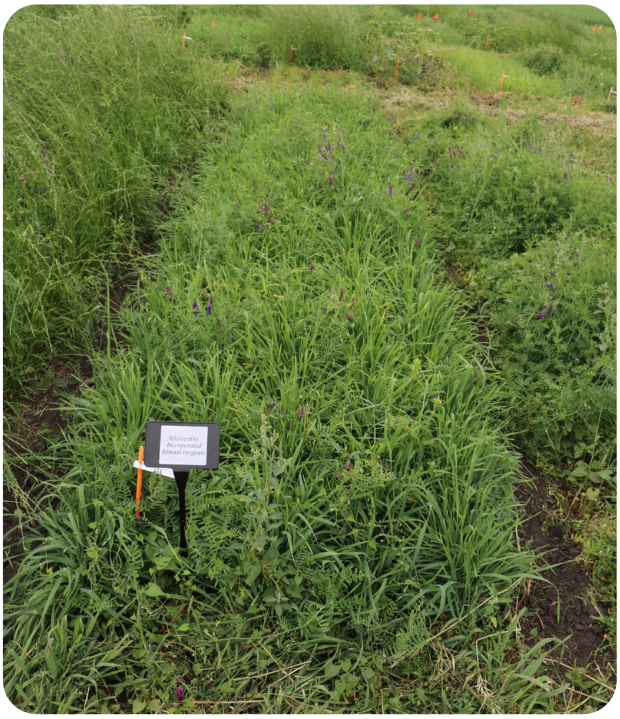
August
By August, plots that in the cover crop year were sown to Sunflower and incorporated suppressed less weeds than those plots which underwent the same termination but sown to Annual ryegrass + Hairy vetch, Annual ryegrass +Rye, Rye + Sunflower, Hairy vetch and Rye the following year, when all plots were sown to canola. Similarly, incorporated Annual ryegrass + Hairy vetch plots had a greater weed suppressing effect within canola stands compared to plots sown to Hairy vetch + Sunflower and eventually incorporated in the cover crop year (Figure 5-3).

Roller crimping of Annual ryegrass + Hairy vetch, Hairy vetch and Hairy vetch + Sunflower in the cover crop year negatively impacts weed suppression for the following in the cash crop year, compared to plots sown to the same cover crop treatments but rather incorporated. It is possible that residue left in the cover crop year due to roller crimping reduce burndown herbicide contact to the soil and in turn protected upcoming weed emergence in the cash crop year. Further, presence of weeds may have been accentuated by fertilizer input to the canola crop in the cash crop year (Figure 5-4 a and b).

Weeds in the cash crop year mere numerous in plots that were unseeded and roller crimped the previous cover crop year in contrast to roller crimped plots sown to Rye mixed with either Hairy vetch or Sunflower (Figure 5-4 a and b).

Hairy vetch + Sunflower plots that were roller crimped in the cover crop year had more weeds in the following cash crop year compared to plots, also roller crimped and sown to either Hairy vetch + Rye, Annual ryegrass, Annual ryegrass mixes, Hairy vetch, Rye + Sunflower, Sunflower and Rye (Figure 5-4 a and b).

Finally, previously roller crimped plots sown to Hairy vetch + Rye in the cover crop year had greater weed suppressing potential among canola plants in the following cash crop year compared to those plots likewise roller crimped and sown to Hairy vetch alone (Figure 5-4 a and b).



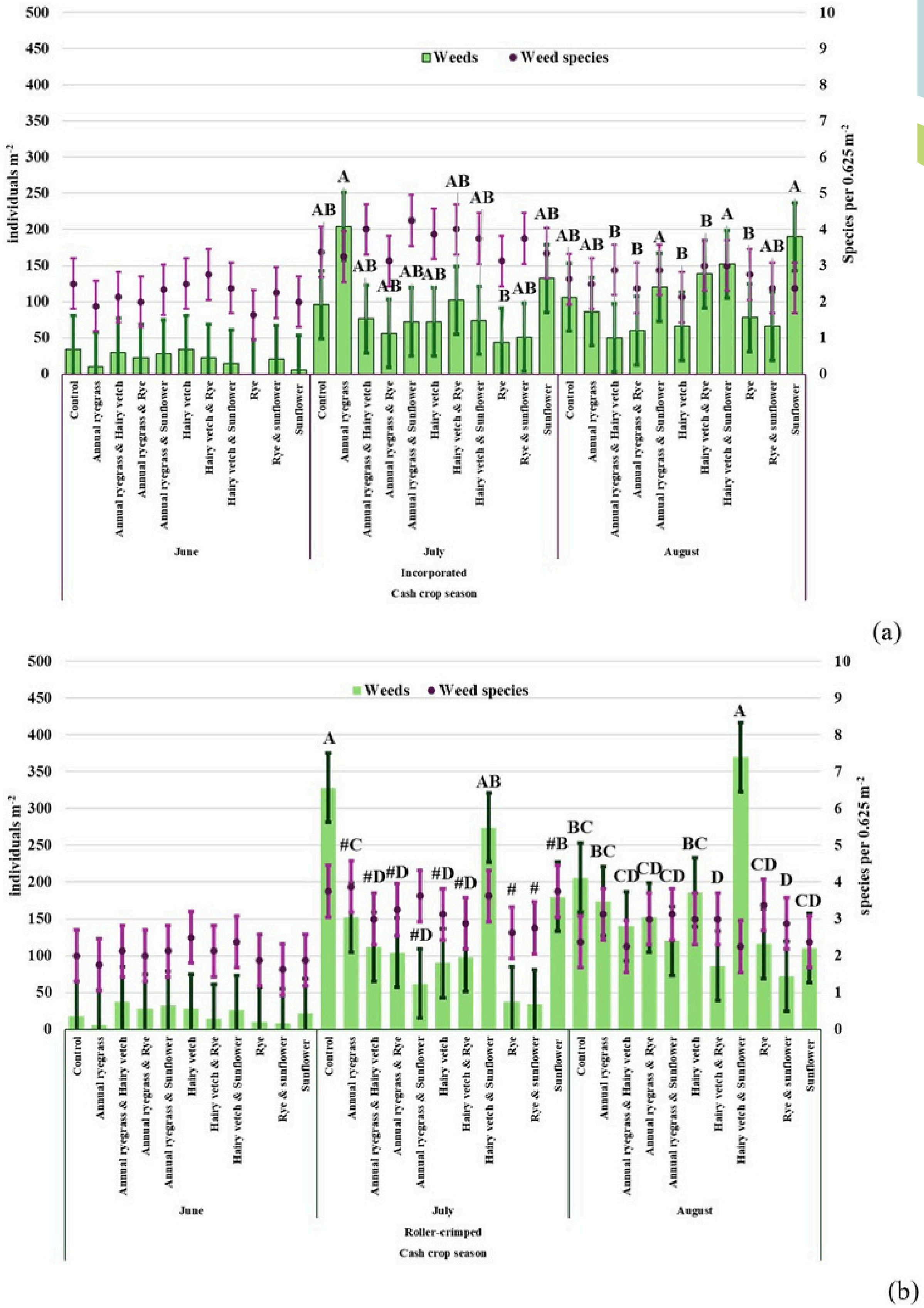


Figure 5-4 a and b. Weed individuals and weed species counted in the cash crop season at three sample periods in 2025 in Fort Kent and St. Paul. (a) letters different from each other denote significant difference among treatments within the same sample period. (b) # =significantly different than control in the same sample period. Letters different from each other denote significant difference among treatments within the same sample period. N=176.

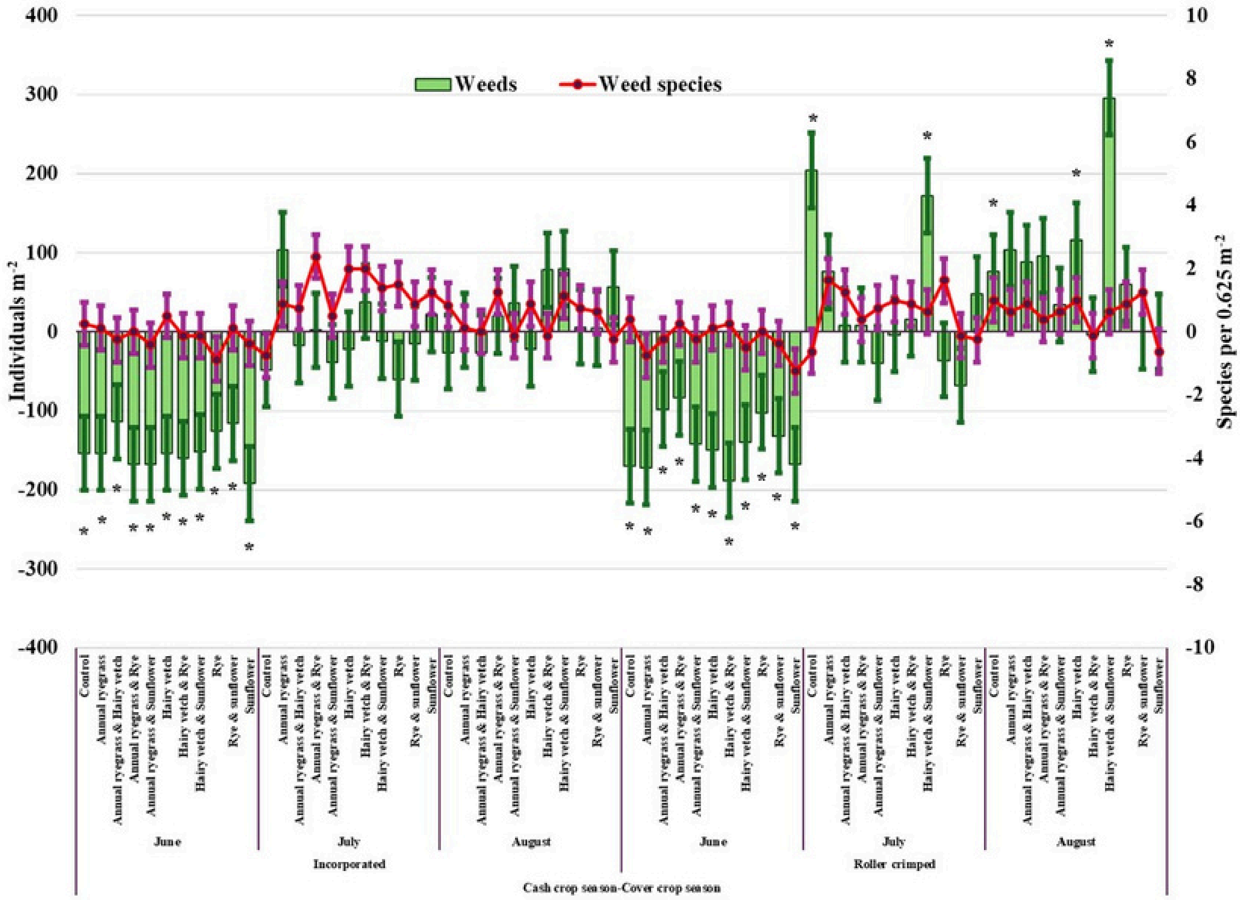


Figure 5-5. Differences (Roller crimped-incorporated) in Weed individuals and weed species computed from counts performed at three sample periods in 2025 in Fort Kent and St. Paul in the cash crop season. *=difference in weeds between cash crop season and cover crop season is significant within the same sample period. N=176.

Comparing the cash crop year to the cover crop year

June

Overall, all treatments had less weeds in the cash crop period than in the cover crop period. On incorporated plots, differences between cash crop year and cover crop year in treatments sown to Annual ryegrass+ hairy, Rye+ Sunflower and Rye+ vetch showed smallest differences in weeds, between the cash crop year and the cover crop year.

Weeds in plots sown to canola in the cash crop year and previously sown to Annual ryegrass + Rye, Annual ryegrass + Hairy vetch and Rye and incorporated, also reported smaller differences:

- There were less weeds in these plots during the cover crop year
- This is likely an offset caused by glyphosate application in the cash crop

July

Roller crimped control plots were weedier in the cover crop year compared to the cash crop year. This means cover crop residue was long lasting and it allowed for weed suppression to take place in the cash crop year.

Weeds in plots sown to Hairy vetch+ Sunflower and terminated through roller crimping were more numerous in the cash crop year (Figure 5-6), among canola plants than in the cover crop year among Hairy vetch and Sunflower stands (Figure 5-6). This shows that Hairy vetch and Sunflower are more effective in reducing weeds by smothering than by allelopathy. Moreover, it seems that allelopathy is not long lasting and other factors need to be acquired to procure weed suppression in cash crop years.

Compared to incorporated plots sown to mixes of Annual ryegrass as well as Hairy vetch and Hairy vetch + Rye in the cover crop year, these same plots in the cash crop year had more weed species. This means that likely weeds that were suppressed in the cover crop year were able to emerge in the absence of cover crops seeded. Moreover, it is possible that residues by this time during the growing season already decomposed and therefore was no more allelopathic effect from the cover crops sown the year prior canola seeding.

Like June in the cash crop year, plots that in the cover crop year were sown to Annual ryegrass + Sunflower and incorporated had more weed species than those in plots that were sown to Rye and incorporated. In July however, the same contrast rather occurred in plots sown to Rye + Sunflower and later incorporated.

August

In the cash crop year (Figure 5-6), crops previously sown first to Hairy vetch + Sunflower, Hairy vetch and Annual ryegrass, and subsequently roller crimped were weedier than these same plots the cover crop year (Figure 5-6). Thus, roller crimping of Hairy vetch + Sunflower as well as monocrops of Hairy vetch and Annual ryegrass does not improve weed suppression for the following cash crop year.

Weed species number counted in the cash crop period, among canola stands, was greater in roller crimped plots previously sown to Hairy vetch + Rye in contrast to plots previously planted to Rye and terminated likewise in the same cover crop year. Canola planted in plots previously sown to Sunflower and later roller crimped were surrounded by more weed species than canola planted in plots sown to Annual ryegrass, Rye and Annual ryegrass + Rye and terminated in the same manner in the cover crop year.

By the end of the cash crop year growing season, roller crimped plots sown to Rye in the previous cover crop year had more weed species in contrast to number of weed species counted when the cover crop was up before roller crimping. In roller crimped plots, residue decomposition is slower conversely to residues integrated into the upper soil layers (incorporation). It is likely that the allelopathic effect of Rye was waning as Rye residues were slowly decomposing.

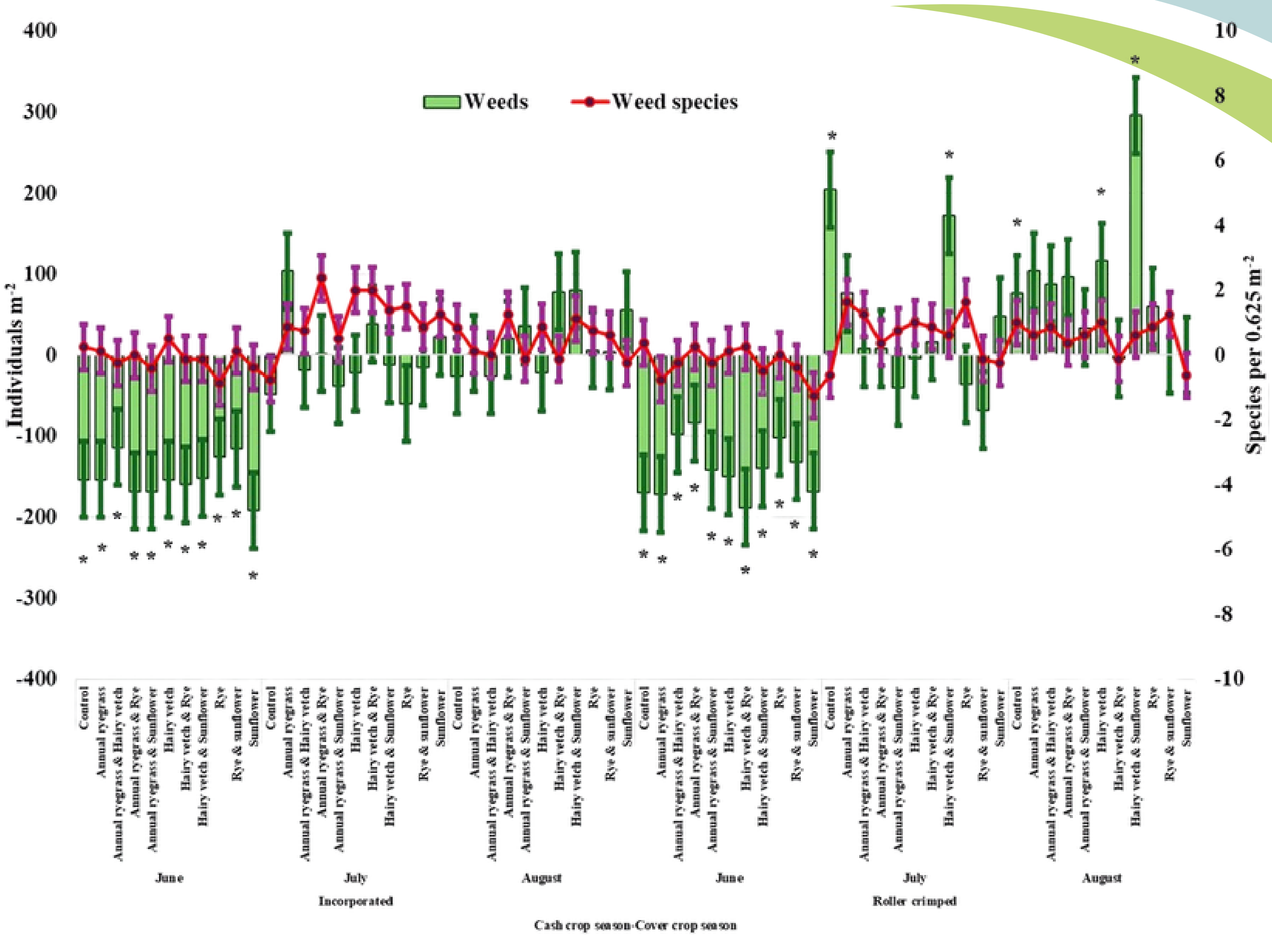


Figure 5-6. Differences (Cash crop season -Cover crop season) in Weed individuals and weed species computed from counts performed at three sample periods in 2025 in Fort Kent and St. Paul. *=difference in weeds between cash crop season and cover crop season is significant within the same sample period. N=176.

Conclusions

- No changes in yield across sites
  - However, St. Paul showed differences across cover crop spcies/mixes and termination method.
    - Canola yielded 35% more if sown in plots previously planted to annual ryegrass compared to yield from canola sown in plots previously planted to sunflower
    - Plots that were roller crimped had an overall 18% more yield than plots that were incorporated.
- Plots sown to Annual ryegrass + Rye in the cover crop season had 89.5% less weed biomass compared to that collected in plots sown to Hairy vetch + Sunflower.
- Weed individuals were suppressed as follows
  - In plots sown to Rye, Annual ryegrass + Rye and Rye + Sunflower
  - On plots terminated through incorporation
- In the cash crop season
  - All plots previously sown to annual ryegrass mixtures and incorporated were the least weedy compared to unseeded (control) plots and plots sown to sunflower and incorporated in the cover crop season
- Plots previously planted to hairy vetch + sunflower and roller crimped had 100% more weeds than plots terminated in the same fashion but previously sown to Rye + Sunflower, and Sunflower in the cover crop year

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