

ASSESSING THE ALLELOPATHIC EFFECT OF COVER CROPS ON A CROP ROTATION

Highlights

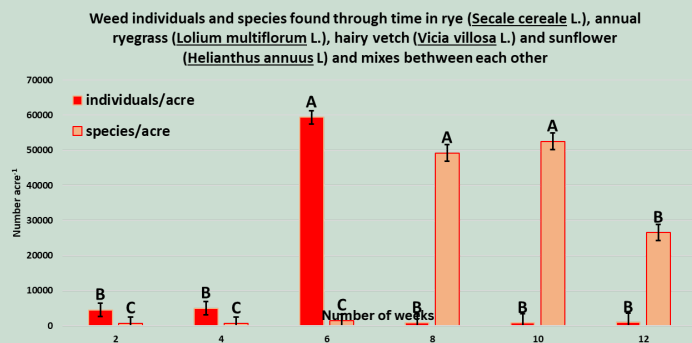
- Number of weed individuals was reduced from the eighth week and on as weed species increased.
- Cover crop species had no effect on either weed species and number of individuals per species
- Less weed species in canola and unseeded plots sown previously to
 - Annual ryegrass
 - Annual ryegrass + hairy vetch
- Less number of individuals in
 - Rye
- Cover crop termination had no effect on weed species and number of individuals per species
- Yield
 - Canola
 - More yield in
 - Annual ryegrass
 - Annual ryegrass + Hairy vetch
 - Annual ryegrass + sunflower
 - Less yield in
 - Sunflower + hairy vetch
 - Pea and wheat
 - More yield in roller crimped that in incorporated plots previously sown to cover crops
 - Regardless of cover crop species

Allelopathy is the direct or indirect impact on plant individuals, whether they belong or not to the same species. Established as substances composed of secondary metabolites, allelopathy can a) affect growth and yield of another plant and b) develop autotoxicity, where plant individuals' secrete chemicals that prevent propagation and development of seedlings of same species growth. Allelopathy can be used as a strategic tool to mitigate chemical weed management. Residues of allelopathic cover crops not only provide benefits to the soil but also help to reduce weed populations during their growth and likely for the cash crops seeded in the season thereafter.

This project was divided into two years. The first year, four crops were chosen based on their allelopathic properties, availability and popularity among growers. Crops such as rye (*Secale cereale* L.), annual ryegrass (*Lolium multiflorum* L.), hairy vetch (*Vicia villosa* L.) and sunflower (*Helianthus annuus* L.) have been shown to limit or reduce the growth of other plant species. In this experiment weeds were surveyed every two weeks (sixteen weeks total) after cover crop mix seeding to observe if allelopathic effects changed according to cover crop species or cover crop mixes. At the end of the season, plots were either roller-crimped or incorporated. The following growing season (second year), canola, field pea, wheat were sown perpendicular to the direction of these plots to observe if weed populations are still suppressed by the allelopathic effects of the cover crops and their mixes. A control plot is included where no crop is sown. Further, it was also assessed whether roller-crimping and incorporation impact weed suppression along with allelopathy.

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Cover crop seeding, roller crimping and incorporation (First year)



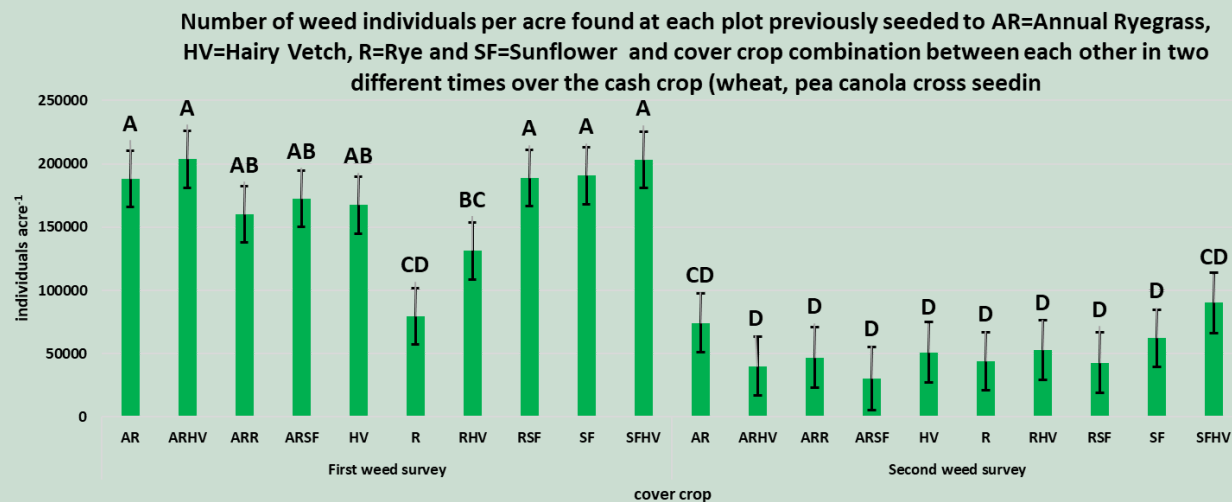
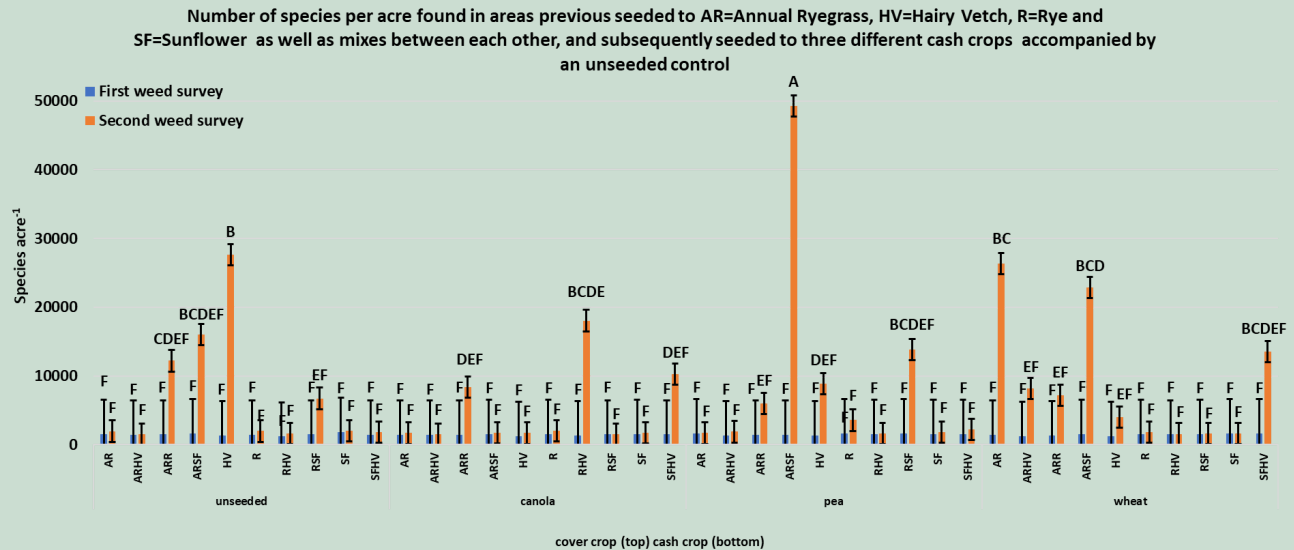
Weed individuals ($P < 0.0001$) and weed species ($P < 0.0001$) changed through the repeated measured conducted at each plot every two weeks. Number of individuals was significantly reduced after the eighth week and further. Number of species on the other hand increased in the same period dropping close to cover crop kill (roller crimping or incorporation). Cover crop species and cover crop mixes evaluated had no effect ($P = 0.9773$ and $P = 0.9038$ for either weed individuals and weed species respectively).

Cash crop seeding and harvest (Second year)

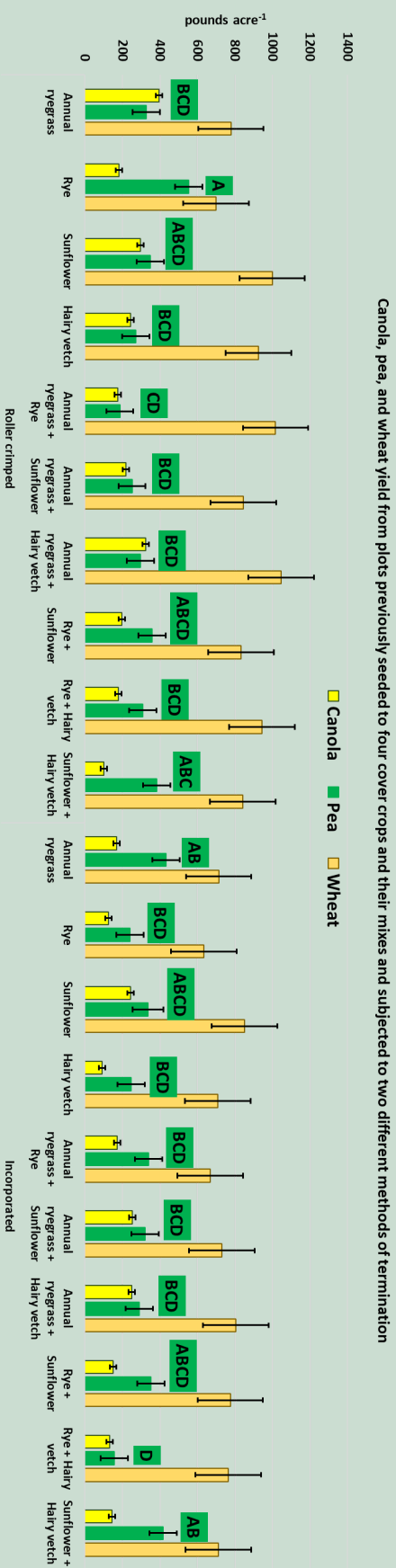
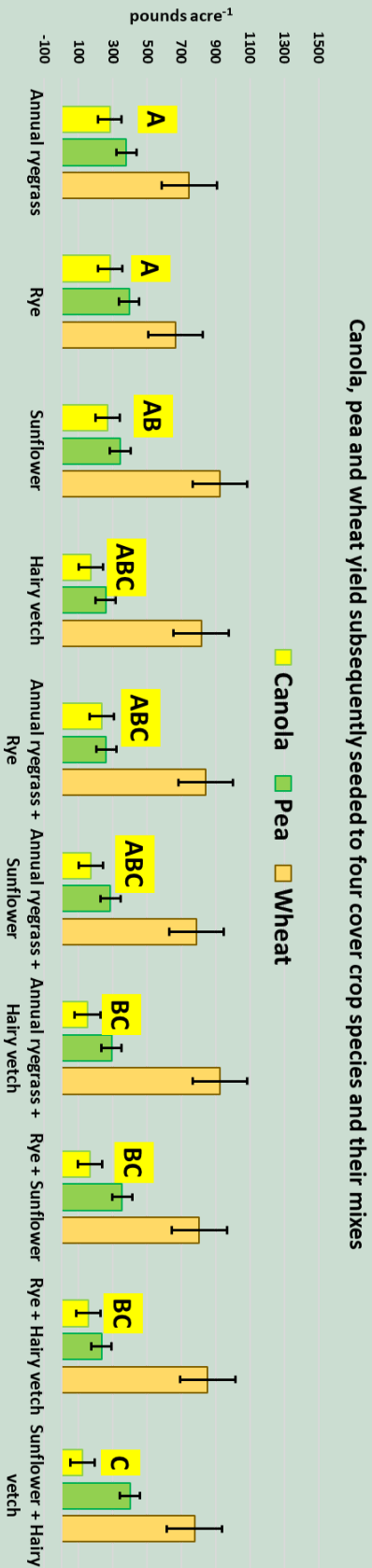
Only two weed surveys were conducted. This was because the trial was sown later in the growing season. Weeds in the second weed survey were very mature and outcompeting the cash crops. Differences however were found among these two readings. An interaction between crop and cover crop over time impacts weed species ($P = 0.0297$). Number of species increased six times more in the second weed survey compared to the first. Number of species was lowered in the first survey in plots sown to rye and hairy vetch and unseeded the consequent year compared to plots seeded to sunflower, followed by unseeded split-plots. Number of species is lower in the second weed survey is lower in several plots and split plots. Thus, canola and unseeded split plots previously sown to annual ryegrass and plots seeded to combinations of annual ryegrass with hairy vetch, wheat previously seeded to rye, sunflower and its combination, and pea split plots previously seeded to sunflower and mixes of rye with hairy vetch reported the lowest number of species compared to pea split plots previously seeded to mixes of annual ryegrass and sunflower. Number of individuals also decreased in the second weed survey compared to the first ($P = 0.0014$) and numbers were different according to cover crop species ($P = 0.0142$). As such, less individuals were found in areas seeded to rye compared to areas sown to mixes of sunflower with hairy vetch.

Cover crop termination method as no impact on weed species and number ($P = 0.4493$). Most of the impact on weeds can be attributed to the cover crop and subsequently to the cash crop seeded the following year. Rye has been shown to be extremely powerful in deterring other plant species. Previous literature does indicate that rye can reduce the presence of other weeds and even encourage the growth of some crops such as sunflower. This explains why sunflower with rye mixes reported some of the lowest numbers of species and number of individuals. Likewise, annual ryegrass produces copious biomass smother other weeds seedlings and prevent them from gathering sunlight. Moreover, presence of mixes rather than single cover crops was more effective in decreasing weed species and number. However, this was dependant on the species involved in the cover crop mix. This is congruent with results found in mixes of rye with sunflower and annual ryegrass with hairy vetch compared to mixes of sunflower with either annual ryegrass or hairy vetch.

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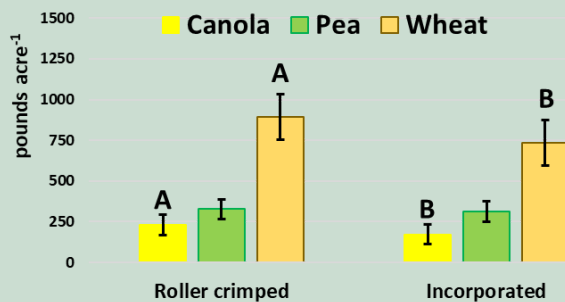


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Canola, pea and wheat yield sown after cover crops subjected to two methods of termination the year prior



Among all cash crops, canola ($P=0.0436$) was affected by the presence of cover crop species previously seeded. Results showed that yield was greater from canola subsequently seeded to annual ryegrass, mixes of annual ryegrass and hairy vetch and sunflower compared to mixes of sunflower and hairy vetch. It is possible there might be an antagonistic effect from these three species when sown in the same area. Numbers indicated that either hairy vetch or sunflower can be seeded previously, but not in the same cover crop mixture. Cover crops terminated through roller crimping favoured wheat ($P=0.0012$) and canola ($P=0.0147$) yield more than cover crop incorporation. A cover crop residue mat left from the previous season may have contributed to greater carbon and nitrogen availability and hence allowed these cash crops to get a head start over their individual counter parts seeded on incorporated plots.

Overall, when cover crops were seeded, there was an overall decline in weeds populations from all treatments and mixtures but no significant effects from either cover crop species. When cash crops were seeded, cover crop species seeded the year prior affected weeds species and number and cash crop species only affected weed species, this was regardless of cover crop termination method. Our show that allelopathy can be used as another tool for weed management. Both cover crops and cash crops seeding rates may need refinement in order to improve more weed management and increase crop yield.

