Welcome to the webinar on Canada thistle and field bindweed!

- We will start at the top of the hour.
- For questions, use the Q and A box on your control panel. We'll be reading the questions aloud after the c. 45-minute presentation.
- A recording will be available on the eOrganic YouTube channel within 1-2 weeks.
- Learn more about the CREEPStop project at https://eorganic.info/creepstop
- Find all upcoming and archived eOrganic webinars at http://eorganic.org/node/4942

eOrganic

CREEP STOP

Integrating Biological, Cultural, and Mechanical/Physical Tools for Long-term Suppression of Creeping Perennial Weeds in Northern Great Plains and Pacific Northwest Cropping Systems

eOrganic Webinar

Pat Carr, Jed Eberly & Tim Seipel

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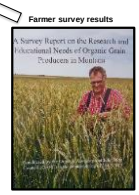
CREEP STOP

Farmer survey results



Closing the Economic and Yield Gap Between Tilled and Strategically Grazed Organic Cropping Systems
Perry Miller et al. (2017)

Integrated Management of Perennial Field Bindweed (*Convolvulus arvensis*) In Organic Production Systems in the Northern Great Plains: Evaluating Agronomic, Economic, and Environmental Outcomes.
Zach Miller et al. (2017)

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Intra- and Interstate Collaboration

Flathead Valley Community College
- Heather Estrada (agronomist)

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- Patrick Carr (agronomist)
- Jed Eberly (microbiologist)
- Kate Fuller (economist)
- Hayes Goosey(forage specialist)
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NDSU
- Greta Gramig (weed ecologist)

OSU Oregon State University
- Alice Formiga (eOrganic)

WASHINGTON STATE UNIVERSITY
- Ian Burke (weed ecologist)

USDA ARS Agricultural Research Service
- John Gaskin (geneticist)

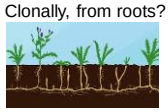
OBJECTIVES

- **Assess *diversity/ spread* of creeping perennials in the NGP and PNW.**
- **Identify *biological, cultural*, and *mechanical* practice *combinations* that provide suppression/control.**
- **Provide education opportunities.**

Assess *diversity/ spread* of creeping perennials

- What is the spreading mechanism?

Clonally, from roots?



Seed, from outcrossing?

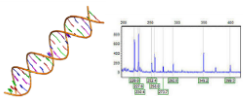
Both? If so, what is the ratio?

If we know how they spread, we can choose control methods that are most effective at lowering population numbers of these weeds.

Slide provided by John Gaskin, USDA ARS, Sidney, MT

How can we determine the method of reproduction?

- DNA fingerprinting
  - Identical plant genotypes = derived from clonal reproduction
  - Different plant genotypes = derived from seed



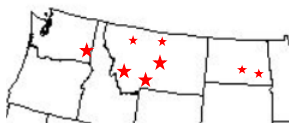
Amplified Fragment Length Polymorphisms

Slide provided by John Gaskin, USDA ARS, Sidney, MT

Identify *suppression/control* practices

Identify *suppression/control* practices

Farm & Research Center Locations - 2019



Slide prepared by Heather Fryer

CARC & Fort Ellis

	2019		2020		2021		2022
1	Barley + Alfalfa	-	Alfalfa	-	Alfalfa	-	HRSW
2	HRSW/Wtr triticale	-	WinterTriticale/Fxtl Millet/Wtr Triticale	-	WinterTriticale/Fxtl Millet/Wtr Triticale	-	HRSW
3	HRSW	-	Lentil + YF Sweetclover	-	YF Sweetclover	-	HRSW
4	Lentil	-	HRSW + YF Sweetclover	-	YF Sweetclover	-	HRSW
5	HRSW	-	Barley + AWP	-	AWP	-	HRSW
6	Lentil + YF Sweetclover	-	YF Sweetclover	-	Hemp	-	HRSW
7	9-Species CC Cocktail	-	HRSW	-	9-Species CC Cocktail	-	HRSW
8	HRSW	-	Fallow	-	Fallow	-	HRSW

Identify biological *suppression/control* tools

Slide provided Dan Chichinsky, MSU

Provide education opportunities

Funding for this project is provided through the USDA Organic Research & Extension Initiative (Award no. 2018-51300-28132; accession no. 1016580)

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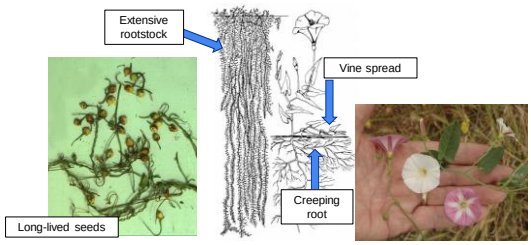
MONTANA STATE UNIVERSITY EXTENSION

Effects of Management on Field Bindweed Population Growth and Soil Properties

Kara Hettinger, Montana State University, LRES Master's Student
Tim Seipel, Montana State University
Zach Miller, MSU – Western Agricultural Research Center
Kyrstan Hubbel, MSU – Western Agricultural Research Center

Why is field bindweed difficult to manage?



Cropping System Treatments

On a spectrum from least to most soil disturbance

Treatment Description
1. Most intensive tillage
2. Intensive tillage
3. Tillage with a warm-season cover crop
4. Wheat-cover crop rotation with tillage
5. Rye-cover crop rotation with tillage
6. Wheat-cover crop rotation
7. Reduced tillage with a cover crop mixture
8. Cover crop with livestock grazing
9. Conventional perennial alfalfa
10. Organic perennial alfalfa

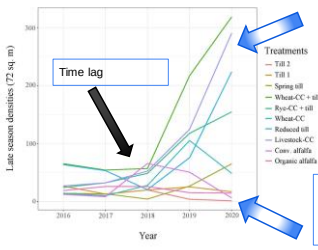
Methods for Soil Analyses

Slake stability test

Soil testing

Includes pH, OM, N, P, K, and other minerals

Results - Field Bindweed Density Over Time



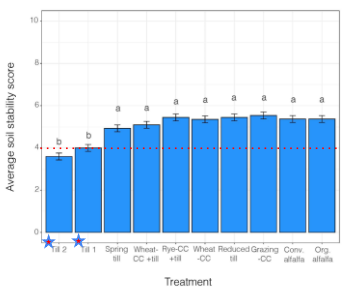
Time lag

Annual crop, cover crop, and grazing treatments had increases in bindweed abundance

Intensive till and alfalfa kept bindweed abundance low

Results - Field Bindweed Population Growth Rates

Treatment	Year 2017-18	2018-19	2019-20	2017-20
Till 2	0.34	-3.5	-0.36	**-3.6**
Till 1	0.45	-1.2	-0.28	**-1.1**
Spring till	-1.2	1.4	0.63	0.82
Wheat-CC + till	0.19	1.3	0.23	1.7
Rye-CC + till	0.37	0.91	0.0	1.3
Wheat-CC	0.70	1.7	-2.6	-0.22
Reduced till	-1.6	2.2	0.52	1.1
Grazing + CC	0.59	0.86	0.80	2.3
Conventional alfalfa	0.28	-0.09	-1.8	**-1.7**
Organic alfalfa	-0.01	-1.9	1.4	**-0.54**



Results – Soil Stability

Intensive tillage lowered soil stability

Increases the potential for erosion

Management of Field bindweed

- Perennial alfalfa or intensive tillage on opposite ends of the disturbance spectrum prevented bindweed populations from growing
- Though most soil properties were similar, there was greater soil instability in the tillage treatments

Effects of management on Canada thistle

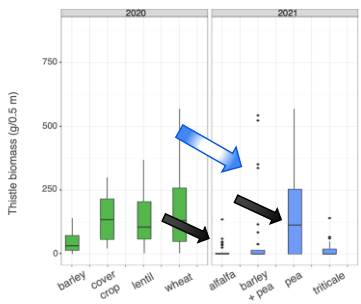
Integrated weed management of Canada/creeping thistle

	2019		2020		2021		2022
1	Barley + Alfalfa	-	Alfalfa	-	Alfalfa	-	HRSW
2	HRSW/Wtr triticale	-	Winter Triticale/Fxtl Millet/Wtr Triticale	-	Winter Triticale/Fxtl Millet/Wtr Triticale	-	HRSW
3	HRSW	-	Lentil + YF Sweetclover	-	YF Sweetclover	-	HRSW
4	Lentil	-	HRSW + YF Sweetclover	-	YF Sweetclover	-	HRSW
5	HRSW	-	Barley + AWP	-	AWP	-	HRSW
6	Lentil + YF Sweetclover	-	YF Sweetclover	-	Hemp	-	HRSW
7	9-Species CC Cocktail	-	HRSW	-	9-Species CC Cocktail	-	HRSW
8	HRSW	-	Fallow	-	Fallow	-	HRSW

Split plot reduced till:
cultivation grazing

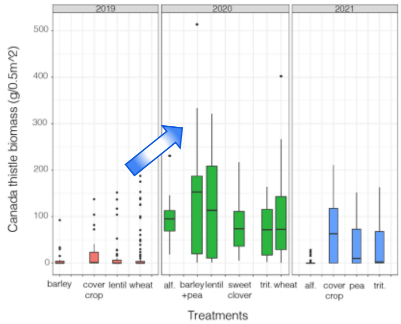
Ft Ellis Research Farm

- Decrease 2021 (extreme drought)
- Lowest weed biomass in alfalfa
- Peas alone in 2021 had high weed biomass



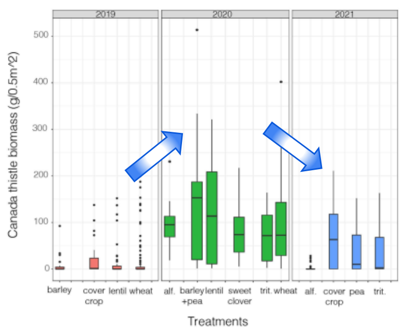
Central Ag
Research Center

- Increase in thistle
- Decrease 2021 (extreme drought)
- Interaction with alfalfa
- Lowest growth rate associated with alfalfa



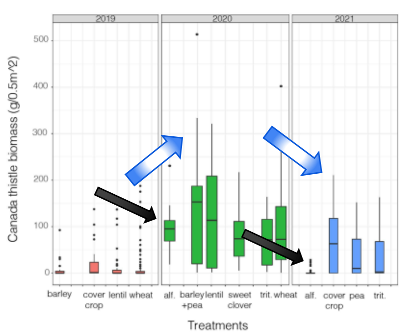
Central Ag
Research Center

- Increase in thistle
- Decrease 2021 (extreme drought)
- Interaction with alfalfa
- Lowest growth rate associated with alfalfa



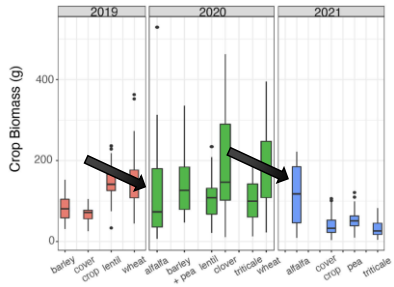
Central Ag
Research Center

- Increase in thistle
- Decrease 2021 (extreme drought)
- Interaction with alfalfa
- Lowest growth rate associated with alfalfa



Central Ag Research Center

- Crop biomass
- Decrease 2021 (extreme drought)
- Interaction with alfalfa
- Lowest growth rate associated with alfalfa



Alfalfa can prevent population growth of perennial weeds

There is still a need to incorporate more integrated management into managing perennial weeds

We are assessing if we can integrate biocontrol of thistle into organic cropping systems



Thistle Rust (*Pucinina punctiformis*) : A Potential Biocontrol Agent for Canada Thistle

Puccinia punctiformis (thistle rust)

- Occurs throughout range of Canada thistle
- Obligate biotrophic rust pathogen (only grows on living plants)
- Obligate parasite.
  - Exists in rhizome
  - Above ground vegetation
- Life Cycle: complex - 5 stages
- Restricted host-range (only Canada thistle as host in nature)
- Causes systemic root disease
- Infection
  - Spore: Teliospore
  - Host: thistle rosette
  - Inoculation season: fall

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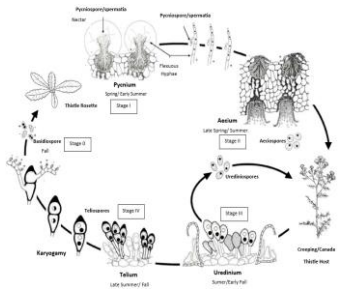
Thistle rust life cycle



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Stage 1: Spermatia

- Reproductive stage
- Signs/symptoms
  - Orange spores
  - Lower leaf surface
  - Sweet aroma
  - Malformed leaves
  - Bolting
- Season
  - Spring-summer

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Stage 4: Teliospores

- Dormancy stage
- Systematic transmission
- Signs/symptoms
  - Small black "freckles"
  - Leaves/stem
  - Premature leaf necrosis and abscission
- Season
  - Late summer-fall

****Inoculation source**

More info

[Thistle Rust: A Potential Biocontrol Agent to Help in the Management of Canada Thistle - MSU Extension IPM Program]

Thistle rust potential for reducing Canada thistle

Research Questions:

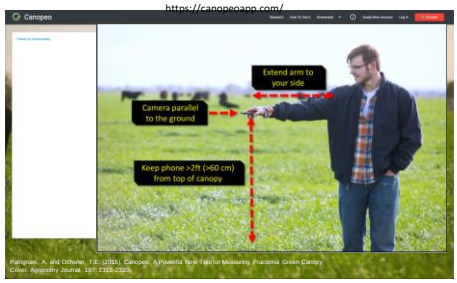
1. What is the rate of successful inoculation, and how widespread is infection?

2. Can thistle rust reduce Canada thistle patches Montana?

3. How do thistle genotypes and rust genotypes interact?

Thistle Surveys

https://canopeoapp.com/



#	Original	Classified	Vegetation	Filename	Cover
1			other	Plot 4 Frame 5.jpg	73.5
2			other	Plot 3 Frame 2.jpg	76.9
3			other	Plot 3 Frame 3.jpg	59.8
4			other	Plot 3 Frame 4.jpg	51.7

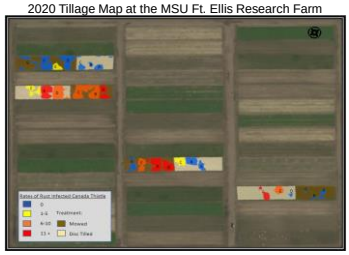
Andrew Patrignani. (2020, April 4). andrew-patrignani/fsiliage: Fsiliage (Version v1.0). Zenodo. http://doi.org/10.5281/zenodo.3740240

Thistle rust response to agronomic practices

1. Tillage
   a. Does tillage (conventional v. reduced) help, hurt or have no impact on the spread and establishment of thistle rust?
2. Cropping rotations
   a. Does thistle rust cause C. thistle patches to decline at higher rates when grown with competitive crops?
3. Extension
   a. Work with farmers and stakeholders to build functional integrated weed management systems.

Field Study

2020 Tillage Map at the MSU Ft. Ellis Research Farm



- Mapping
  - Discrete patches
  - Tillage splits
  - Infection rates
- Data
  - Symptomatic density
  - Asymptomatic density
- Competition
  - 2020: Forage barley
  - 2021: Winter triticale

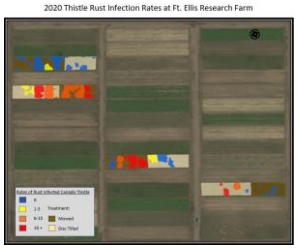
Randomly assigned tillage treatments

Reduced (mow)

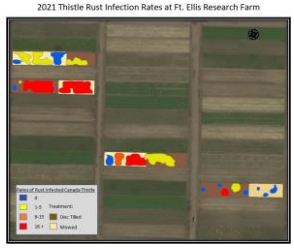
Conventional (disc)

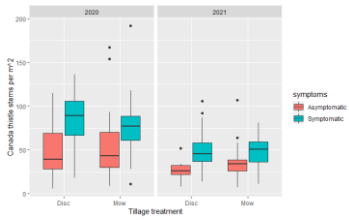
Fort Ellis Research Farm. Bozeman, Montana

2020 Thistle Rust Infection Rates at Ft. Ellis Research Farm

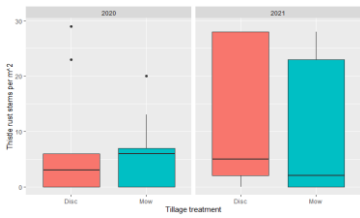


2021 Thistle Rust Infection Rates at Ft. Ellis Research Farm



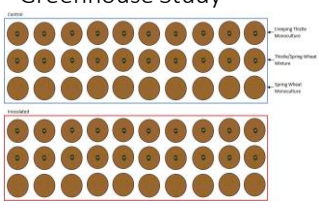


Canada thistle density was been reduced significantly ($p<0.0001$) between 2020 and 2021.
Canada thistle was reduced by 53% in the disc treatment and 55% in the mow treatment.



Thistle rust abundance has increased significantly ($p<0.0001$) between 2020 and 2021
Thistle rust was increased by 61% in the disc treatment and 51% in the mow treatment.

Greenhouse Study



Control (uninoculated)
- Monoculture thistle
- Thistle/spring wheat
- Spring wheat only

Inoculated
- Monoculture thistle
- Thistle/spring wheat
- Spring wheat only

Competition
- Rotation 1
  - Fallow
- Rotation 2
  - Spring wheat
- Rotation 3
  - Spring pea

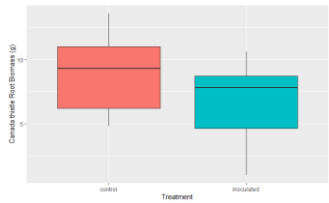
Data/Analysis
- Biomass/density
- Symptomatic/asymptomatic

Greenhouse Study

Thistle growth cycle	Treatment	Crop competition	% Thistle biomass loss in polyculture
1	Control	Monoculture C. thistle	NA
1	Inoculation	Monoculture C. thistle	NA
2	Control	Hard red spring wheat	53%
2	Inoculation	Hard red spring wheat	**62%**
3	Control	Arvika forage peas	61%
3	Inoculation	Arvika forage peas	**67%**

Greenhouse Study

Thistle root density



Summary

- Systemically infected thistle is less competitive than non-infected in greenhouse experiments
- After 1 year, 20% of inoculated plants in the field show symptoms of infection
- Biomass of infected plants is not significantly reduced after 1 season.

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- Please fill out our evaluation survey which you will receive by email!

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