

Nonchemical Weed Management at NDSU

22nd Annual Wide World of Weeds Workshop

January 20th, 2020

New Projects



- ‘CREEP STOP’ On-farm research
- USDA-NIFA-OREI Funded
- Collaborating with MSU&WSU
- Comparing eight cropping sequences for ability to suppress creeping perennial weeds
- First season, baseline data only
- Weather made timing tricky, weeds got upper hand quickly

Table 2. Eight weed integrated management systems compared across four years.

	2019	2020	2021	2022	Rationale
1	Forage Barley+alfalfa (ALF) Awnless barley planted as nurse crop with alfalfa. Reduced-tillage: barley grazed; Standard-tillage: barley hayed	ALF Reduced-tillage: Alf grazed; Standard-tillage: Alf grazed	ALF	Spring wheat (HRSW) Harvest HRSW for grain in Aug.	3-yr graze/hay check; widely used to suppress/control creeping perennials on organic farms
2	HRSW/Winter triticale (trit) Reduced-tillage: Undercut with a blade plow after harvest and subsequently at 21 to 28 d intervals until mid-Sep. then plant trit in late Sep. ; Standard-tillage: Field cultivator with narrow duck-foot sweeps is used in place of a blade plow	trit/till/millet Reduced-tillage: trit grazed in May after broadcast seeding millet; rely on 'hoof seeding' by sheep to plant millet; graze millet in Aug. then undercut until late Sep. Standard-tillage: hayed (vs. grazed); deep tillage before drill planting millet and after millet is hayed	trit/till/millet Repeat of 2020 procedure except trit not planted in fall	HRSW	2-yr grazing/haying check; grazing effective in 'eradication' of creeping perennials in MN; has not been attempted in semiarid regions
3	HRSW/trit Same management as in 2	trit/till/millet Same management as in 2	Flax+chickpea Reduced-tillage: Undercut with a blade plow after harvest and subsequently at 21 to 28 d intervals; Standard-tillage: Field cultivator with narrow duck-foot sweeps	HRSW	Single year of grazing; includes high-value flax-chickpea intercrop being grown by organic farmers
4	Lentil Harvest lentil for grain in Aug.. Reduced-tillage: undercut at 21-d intervals with blade plow; Standard-tillage: till every 14- to 21-d using a field cultivator with narrow duck-foot sweeps	HRSW+sweet clover (Clover) Clover seeded at same time in grass box with safflower (nurse crop), as is standard practice; Reduced-tillage: single pass with wide blade prior to planting; Standard-tillage: Inversion followed by leveling tillage prior to planting	Clover Reduced-tillage: Clover grazed in May, then undercut with a blade plow app. at ~30-d intervals; Standard-tillage: Clover disked under in May, followed with tilling with a field cultivator with narrow duck-foot sweeps	HRSW	"Business as usual" 3 grain crops in 4 yr along with a clover soil-building crop and a high-value lentil crop

5	<p>Lentil</p>	<p>Safflower+Clover Similar to 5 but deep-rooted safflower substituted for HRSW</p>	<p>Clover Reduced-tillage: Clover grazed in May, then undercut with a blade plow app. every 30 d; Standard-tillage: Clover disked under in May, followed with tilling with a field cultivator with narrow duck-foot sweeps every 30 d</p>	<p>HRSW</p>	<p>Includes two years of deep-rooted crops (safflower and second year of safflower)</p>
6	<p>Cover Crop (CC)/Winter wheat 9-species, cool-season polyculture; Reduced-tillage: CC grazed in early June, then undercut and every 21-28 d thereafter until winter wheat planting in late Sep.; Standard-tillage: No grazing; field cultivator with narrow duck-foot sweeps used to terminate and then till plots until wheat planting</p>	<p>Winter wheat Reduced-tillage: undercut every 21-28 days after July wheat harvest; Standard-tillage: tilled using a field cultivator every 14 to 21 d after harvest</p>	<p>CC Same management as in 2019 but tilled until fall freeze up</p>	<p>HRSW</p>	<p>Includes deep-rooted annual (winter wheat) and a 9-species cover crop polyculture, reflecting farmer use of cover crop mixtures</p>
7	<p>CC Tillage continued until fall freeze up</p>	<p>HRSW</p>	<p>CC</p>	<p>HRSW</p>	<p>Substitutes less-competitive HRSW for winter wheat; provides opportunities for tillage in alternate years</p>
8	<p>HRSW</p>	<p>Summer Fallow (SF) wide sweep intensive tillage - sweep every 14 to 20 days</p>	<p>SF wide sweep intensive tillage - sweep every 14 to 20 days</p>	<p>HRSW</p>	<p>Intensive tillage check Effective for suppression/control but not allowed under NOP (would be permitted for purposes of this study at a research center)</p>

Perennial Flax Agronomics

USDA-NIFA NCR-SARE (Johnson, Hulke, Gramig)



- Wild perennial flax, *Linum lewisii*
- Key benefits: eliminates need to plant every year, reduces tillage, enhances carbon storage, increased habitat, healthy food
- Unknowns: when to plant, spatial arrangement, weed management
- Weed management treatments based on variable plant diversity and tillage intensity/frequency

An aerial photograph of a carrot field. The field is divided into several rectangular plots by black plastic mulch. The plots contain rows of young carrot plants. The surrounding area is a lush green field, and the background features a line of trees under a cloudy sky.

Combining Cover Crops and Novel Mulches to Manage Weeds in Carrot

Jesse Puka-Beals and Dr. Greta Gramig
North Dakota State University

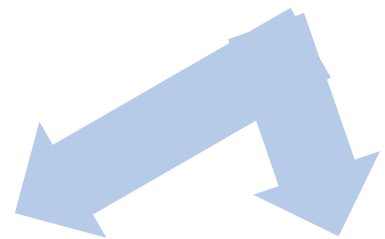
Demand for organic and local food



Entrepreneurs starting small-scale farms



Challenges with soil fertility and weed management

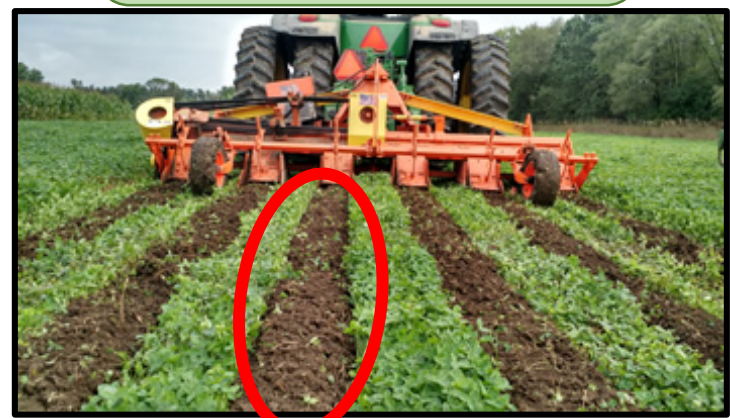
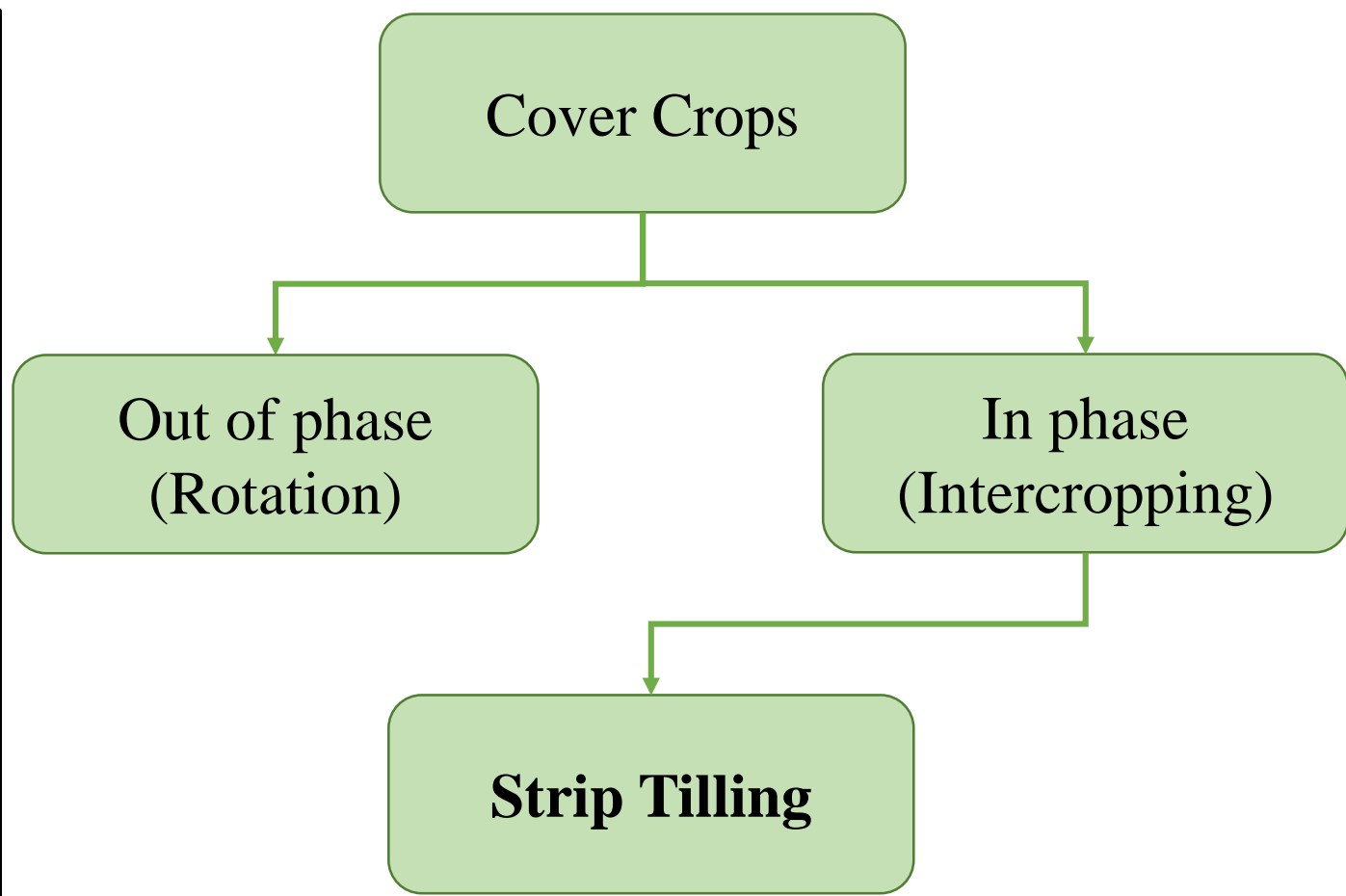


Off-farm

On-farm

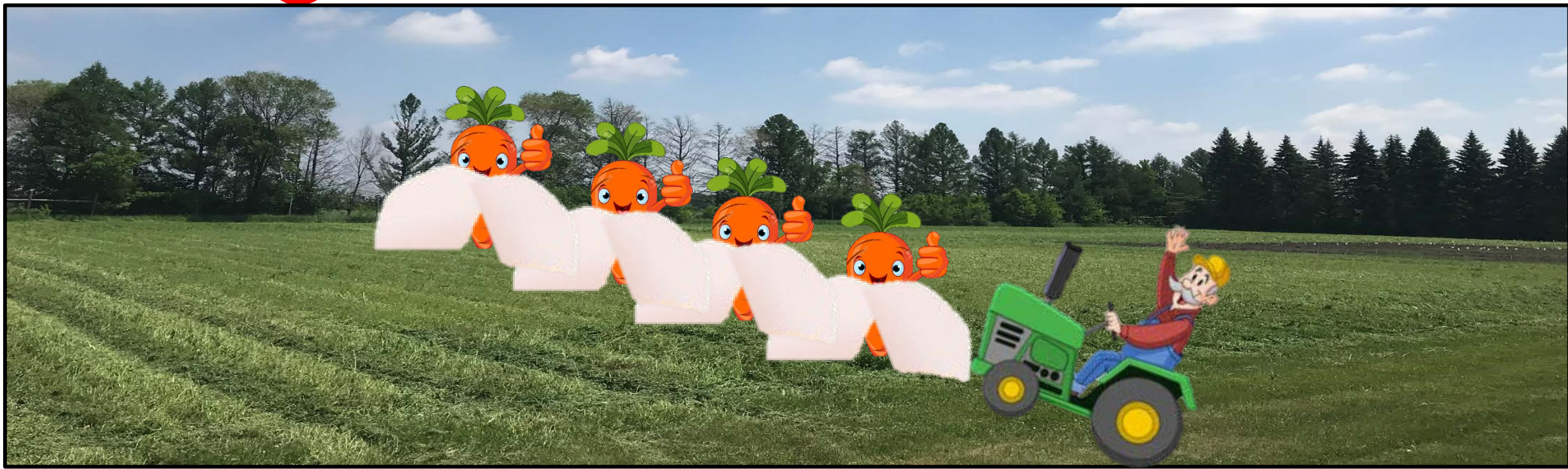
Roxbury Farm
Jean-Paul Courtens, N.Y.

Y1	Winter	Clover	
	Spring	Clover	
	Summer	Fallow – July	
	Fall	Oats – Field Peas	
Y2	Winter	White Clover between crop rows	Pepper / Eggplant on plastic
	Spring		Pepper / Eggplant on plastic
	Summer	Interseeded Rye	Pepper / Eggplant on plastic
	Fall		Pepper / Eggplant on plastic
Y3	Winter	Broccoli	
	Spring	Broccoli	
	Summer	Broccoli	
	Fall	Broccoli	
Y4	Winter	Fallow	
	Spring	Fallow	
	Summer	Sweet Corn (overseeded with clover)	
	Fall	Sweet Corn (overseeded with clover)	
Y5	Winter	Clover (mowed two or three times)	
	Spring	Clover (mowed two or three times)	
	Summer	Clover (mowed two or three times)	
	Fall	Clover (mowed two or three times)	



Purpose

- Can we manage weeds in the strip till zones so we can integrate cover cropping and carrot production?



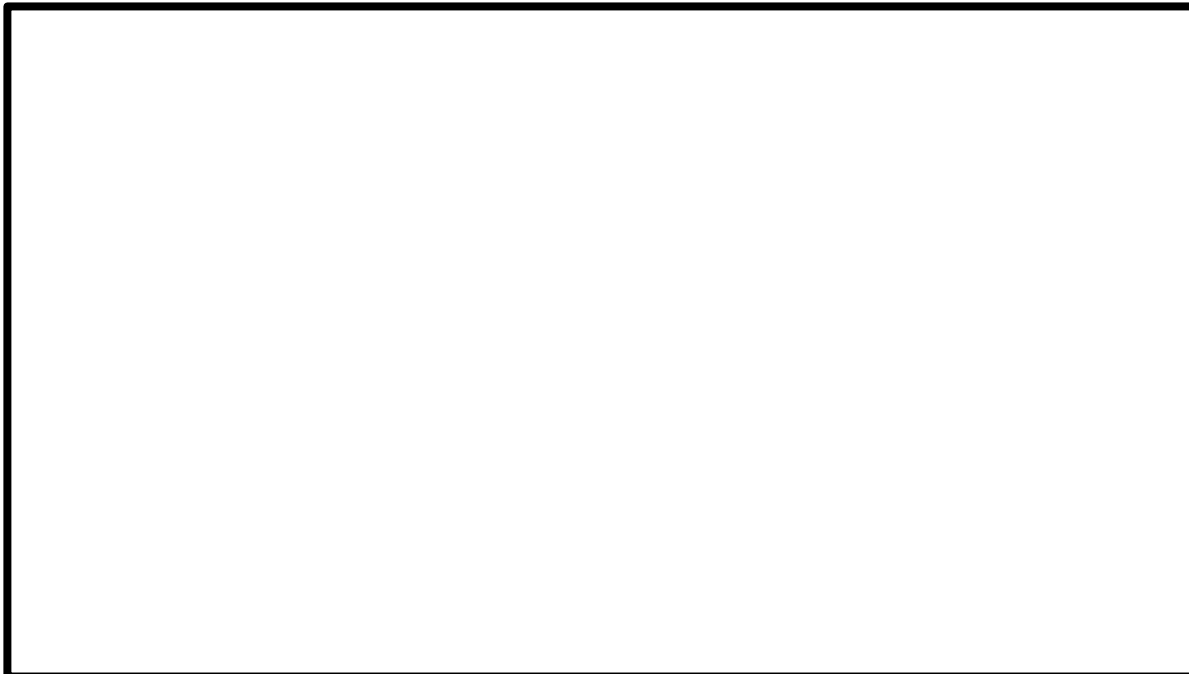
Vegetation and soil quality effects from hydroseed and compost blankets used for erosion control in construction activities

L.B. Faucette, L.M. Risse, C.F. Jordan, M.L. Cabrera, D.C. Coleman, and L.T. West

Published in *Journal of Soil and Water Conservation*, 2006

Hydromulch

- Step 1: Shred newspaper (1 kg)
- Step 2: Add water (35 L)
- Step 3: Pulverize
- Step 4: Apply in strip till zone (12.7 L m⁻²)



Compost Blanket

Step 1: Mix hemp hurd and composted cow manure at 1:2 ratio respectively

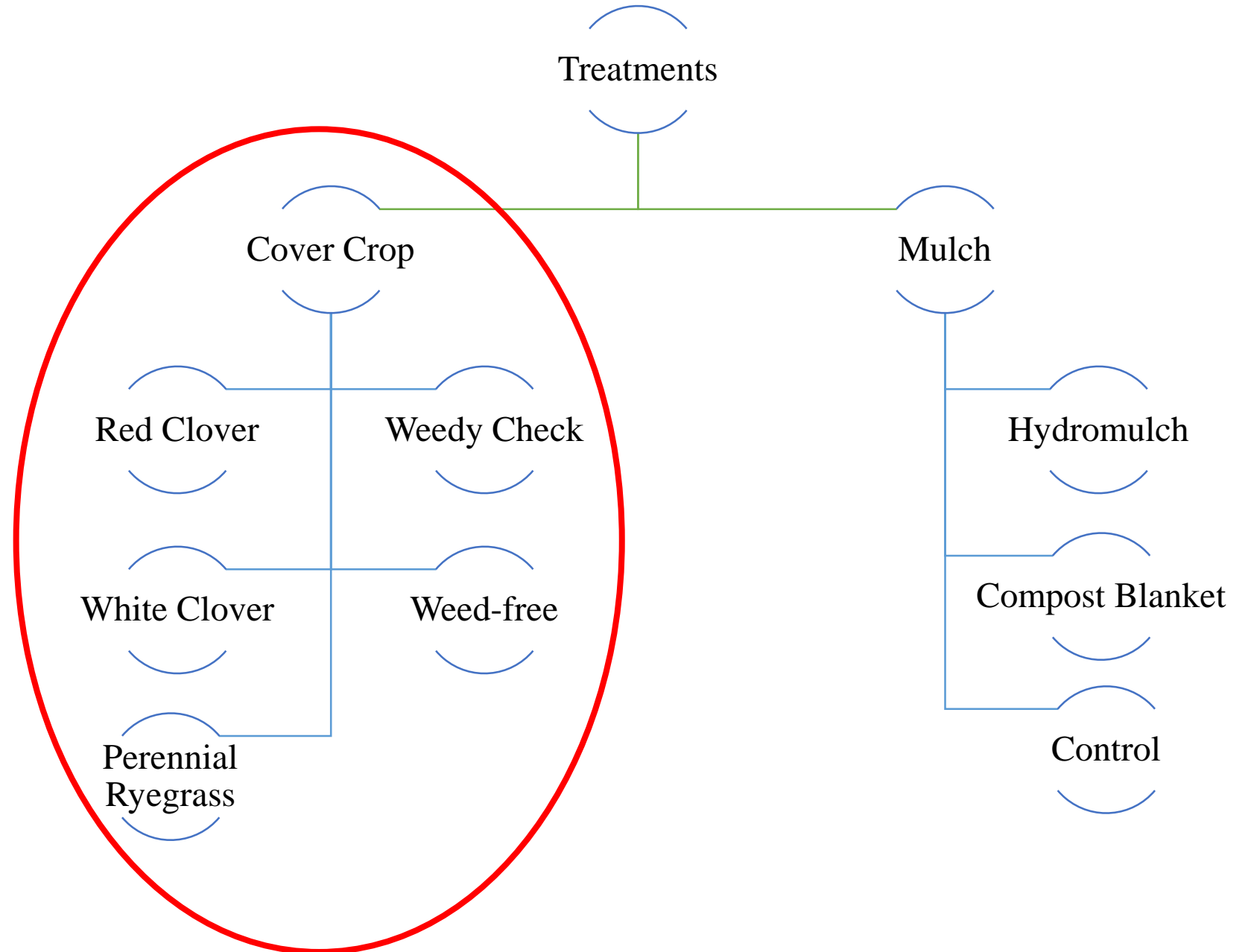
Step 2: Apply in strip till zone (108 L m^{-2})

Step 3: Compress

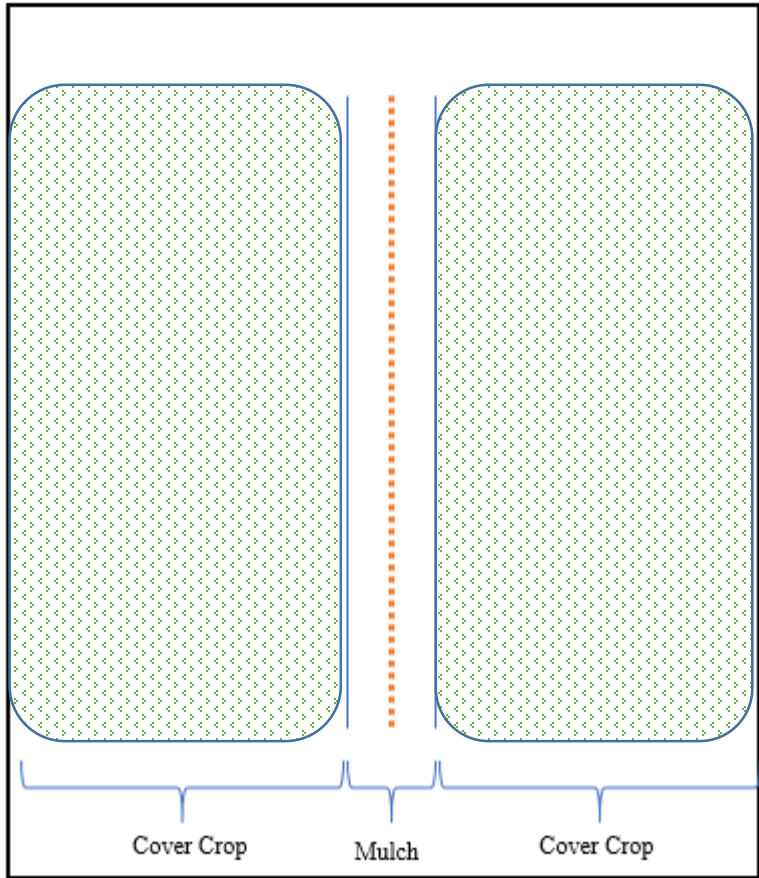


Methods

- Two locations
 - Absaraka ND, Fargo ND
- Two years
 - 2018, 2019
- Fertilized sites before establishment
 - Poultry manure (4-3-2) at a rate of 67 kg ha⁻¹
- Napoli carrot seed
 - Johnny's Seeds (Winslow, ME)
- Direct seeded
 - JP-Jang seeder
- Irrigation with drip tape until robust carrot establishment
- Harvest in September



4.6m

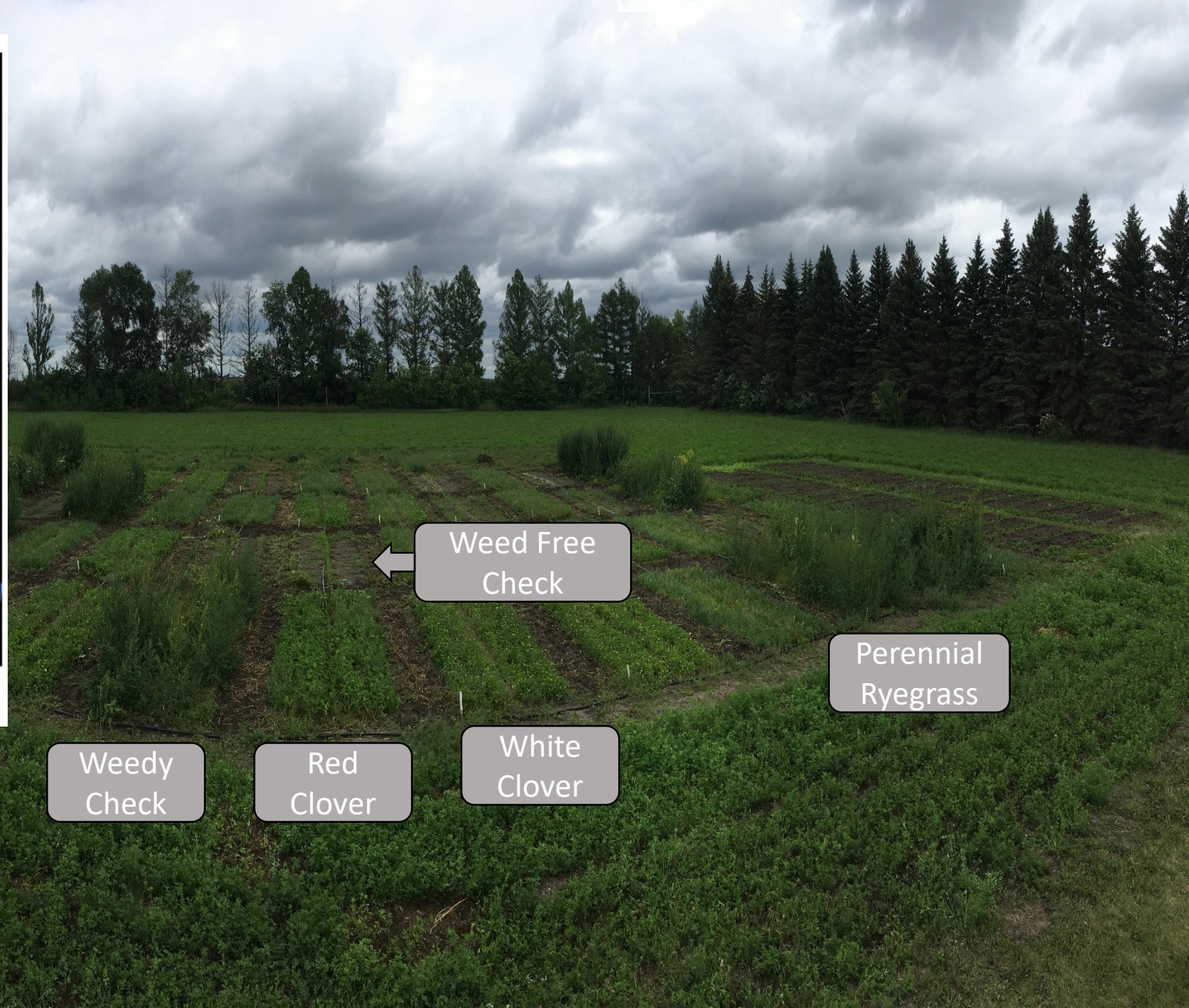


Cover Crop

Mulch

Cover Crop

1.5m



Weed Free Check

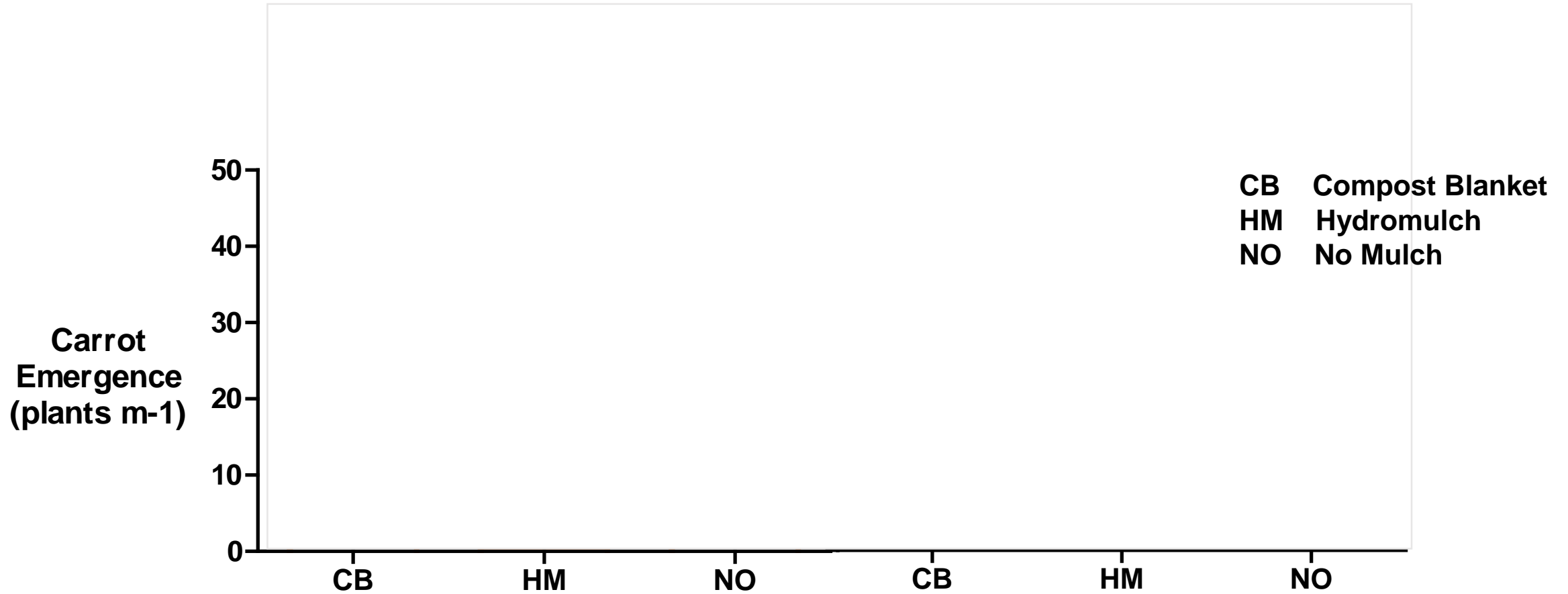
Perennial Ryegrass

Weedy Check

Red Clover

White Clover

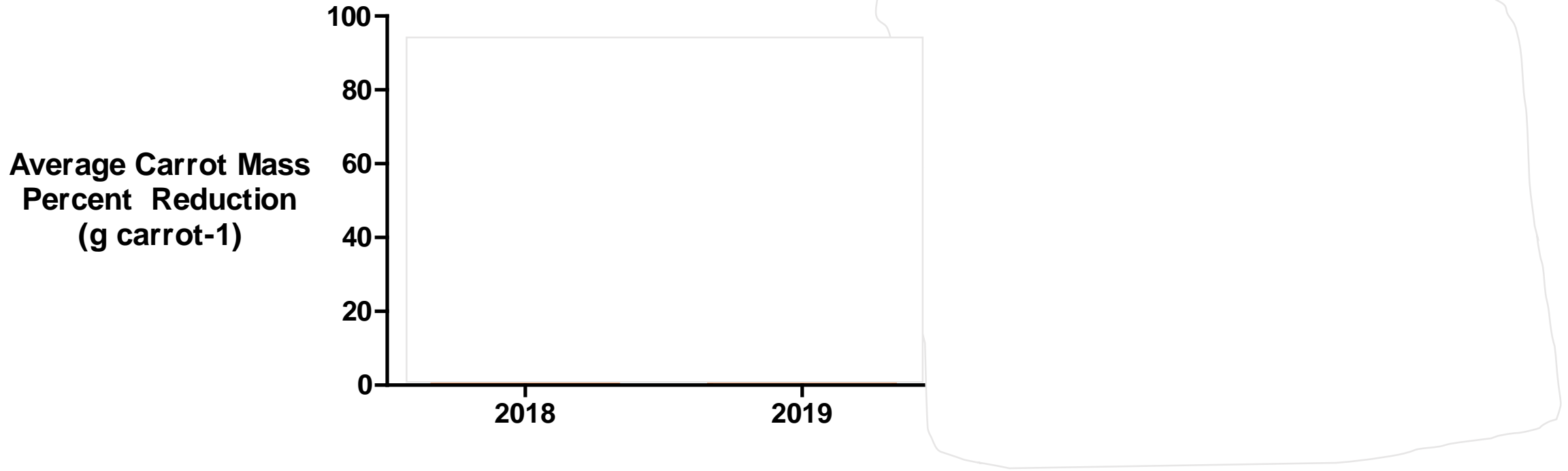
Mulches Can Reduce Emergence



Carrot emergence estimates were combined by years. Significant differences within sites are denoted by different letters using Tukey's honest significant difference ($\alpha=0.05$)

Cover Crops Reduce Yield

PR Perennial Ryegrass
RC Red Clover
WC White Clover
WF Weed Free Check



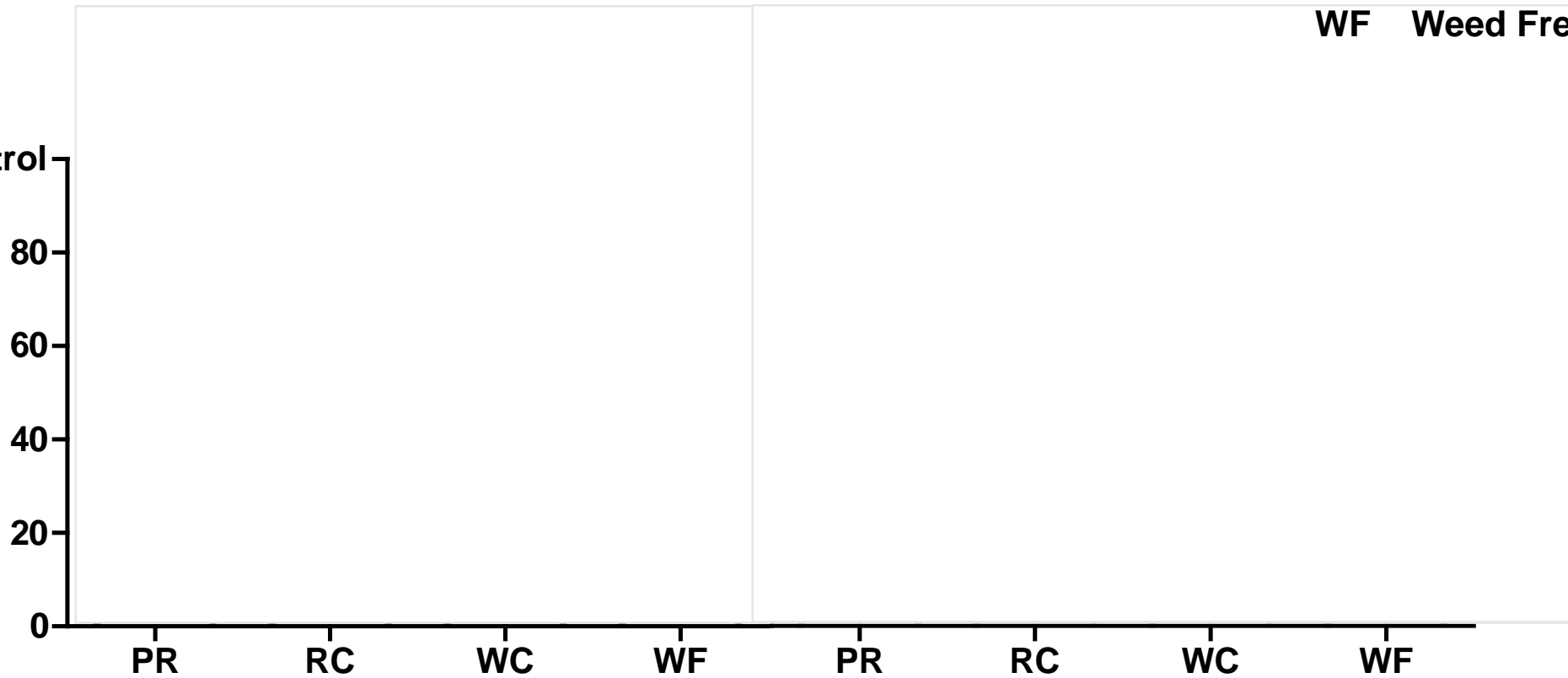
Average carrot mass percent reduction was determined by taking average root biomass per treatment and calculating the difference from the weed free check. A t-test was used to determine difference by year and an ANOVA was used to determine difference by cover crop. Significant differences among treatments are denoted with different letters ($\alpha=0.05$).

Cover Crops Reduce Weed Pressure

PR Perennial Ryegrass
RC Red Clover
WC White Clover
WF Weed Free Check

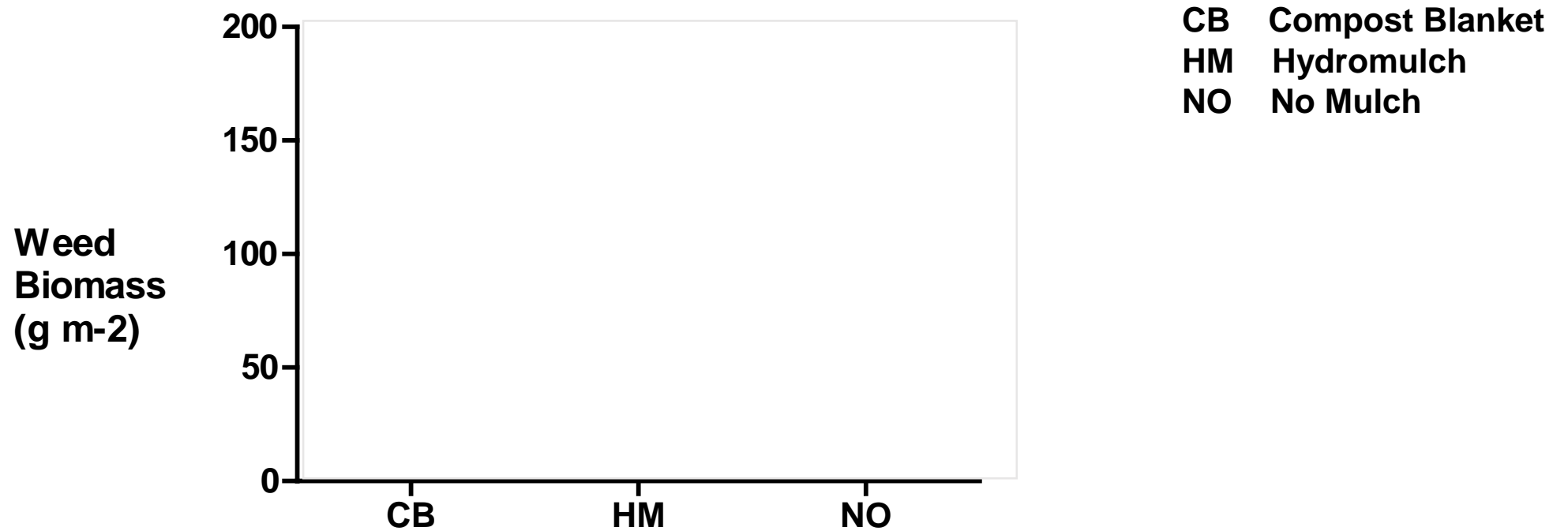
Perfect Weed Control

Weed
Biomass
Percent
Reduction
(g m⁻²)



Weed biomass percent reduction determined 1 week prior to carrot harvest. Weed biomass reduction was calculated by comparison with weedy check by site. Generalized Linear Model with Poisson distribution was used for statistical analysis. Significant differences among treatments are denoted with different letters ($\alpha=0.05$).

Surface Mulches Reduce Weed Pressure



Weed biomass determined 1 week prior to carrot harvest. Weed biomass represents aboveground biomass dried to constant mass. A oneway ANOVA was used for statistical analysis. Significant differences among treatments were determined using Tukey HSD and are denoted with different letters ($\alpha=0.05$).

Key Takeaways

- Carrot yield was substantially reduced when grown in a strip till zone by cover crops
- Mulches and cover crop treatments provided excellent weed control



White clover encroaches on the strip till zone during carrot emergence just before mowing.

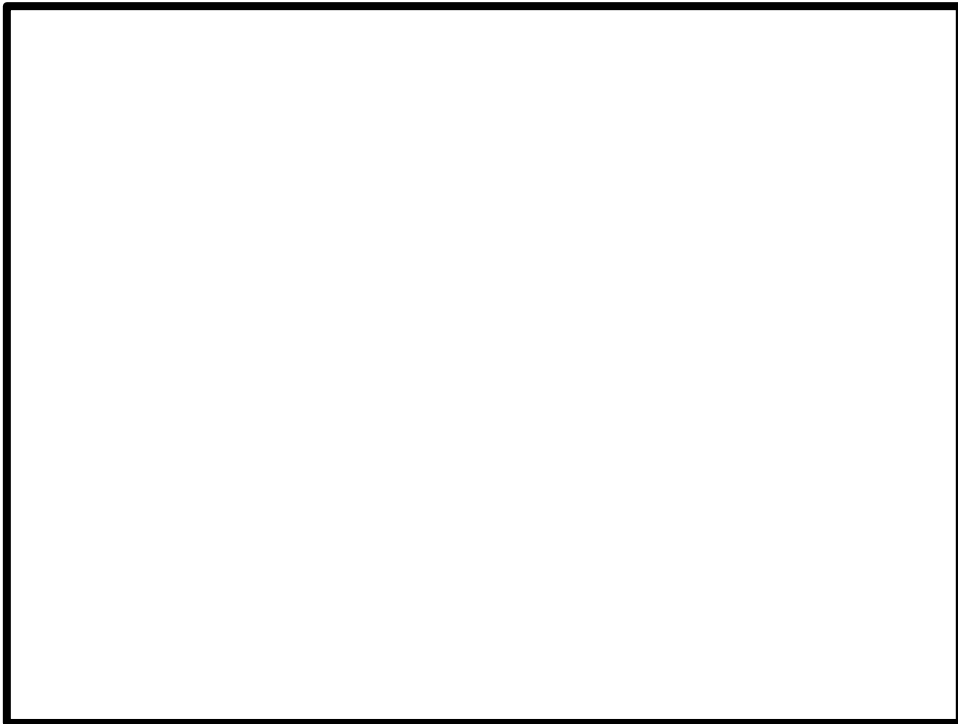
Further Development

- Application rate
- Application methods
- Novel mixtures



Special Thanks

- USDA-Hatch Project # ND01583
- North Dakota Specialty Crop Block Grant # 17-372
- North Dakota EPSCoR
- Heart and Soil Farm, Ross and Amber Lockhart



2018



2019

Questions?

