Cover Crop Research at North Dakota State University

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Opportunities for cover crops in North Dakota

- Diverse climate, soil, and cropping systems of North Dakota provide a range of cover crop uses and management requirements
- Farmers are driving current interest in using cover crops within North Dakota
- Researchers in North Dakota are beginning to address the range of needs and uses for cover crops

Windows for cover crops in North Dakota

- Following early harvested small grains and pulse crops
- Protecting sugarbeet seedlings from spring wind damage
- Inter-seeded with corn or soybean row crops
- Following or inter-seeded with forage and silage crops
- Replace fallow when conditions prevent cash crop planting

Reasons farmers give for using cover crops

- Keeping the soil covered and live roots growing
- Increase soil organic matter
- Fixing nitrogen or scavenging leftover nutrients
- Providing food and habitat for soil microorganisms
- Residue management
- Late-season grazing for cattle

Rye Varietal Differences when Terminating with the Roller-crimper

Research Questions

- Which rye varieties are most easily terminated using the roller-crimper in North Dakota?
- Which rye varieties are the first to reach heading and anthesis?
- Does increased rye biomass production improve the effectiveness of the roller-crimper?

Materials and Methods

This study was conducted in central North Dakota at the Carrington Research Extension Center on loam soils in 2008 and 2009. The study was designed as an RCBD with four replications. Rye cover crops were terminated during anthesis using a roller-crimper on June 19 and 23 in 2008 and 2009. The 2009 trial was subject to seven days of early spring flooding and rye plants displayed signs of nitrogen deficiency.

Preliminary Results

- Relative differences in termination effectiveness occurred between rye varieties in both years (Table 1).
- Heading and anthesis date differences were observed between varieties. The range in heading dates was greater in 2009 than in 2008 (Table 1).
- Spring aboveground dry matter differed between varieties in 2009 only. Dry matter production was greater for all varieties in 2008 than in 2009 (Table 1).
- In 2008, rye termination using the roller-crimper was more effective for varieties with higher spring dry matter production (Figure 1).

Table 1: Evaluating rye variety susceptibility to termination using the roller-crimper in central North Dakota.

Variety	Heading	Anthesis	Plant Height	Spring shoot Dry Matter	Termination Rating
	(Day of year)	(Day of year)	(inch)	(lb/ac)	(1-10)*
2008					
DR0207	156	-	53.0	7190	1.5
DRO2	156	-	54.2	7232	2.8
Dacold	156	-	52.6	6420	3.5
Remington	155	-	53.2	5888	6.8
Rymin	154	-	53.2	6805	4.3
LSD (P<0.05)	**1**	**-**	**NS**	**NS**	**3.4**
2009					
Aroostok	160.8	167.3	48.8	2036.8	4.5
DR02	165.8	171.8	45.7	3073.0	4.5
Dacold	171.8	174.0	39.8	2083.4	9.3
Hancock	165.3	170.8	47.9	2053.9	5.0
Rymin	164.8	171.3	46.5	2528.8	4.3
Spooner	164.3	170.3	47.9	2073.8	6.0
Wheeler	169.5	173.5	46.3	2750.9	4.5
LSD (P<0.05)	**0.8**	**0.8**	**3.2**	**882.1**	**4**

*Termination rating: a relative rating of the effectiveness of the roller-crimper; 1 = best while 10 = worst

LSD values indicate the least significant statistical difference between treatments.

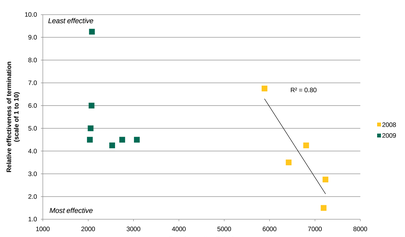
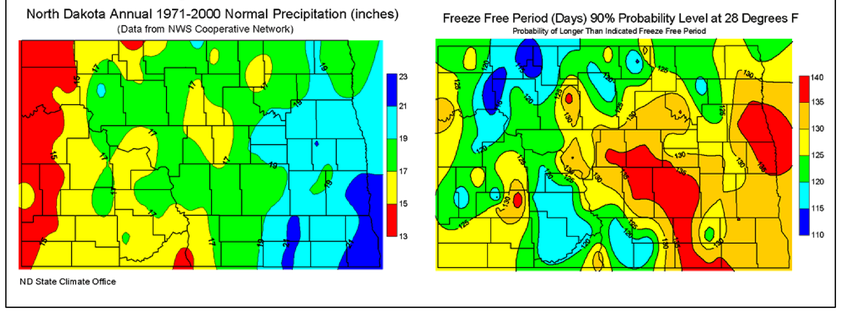


Figure 1: Relationship between rye biomass and relative effectiveness of roller-crimper termination

Cover Crop Use and Management Influenced by the Range of Environmental Conditions in North Dakota.



Field Pea Relay Cover Crops

Research Questions:

- Can fall flushes of volunteer field peas be used as cover crops after grain harvest?
- Will fall tillage foster more field pea volunteers?
- How much harvest loss is acceptable to achieve a good seeding rate for field pea relay cover crops?

Materials and Methods:

This study was initiated at the Carrington Research Extension Center on loam soils in 2008. After field pea grain was harvested in 2008, volunteers were fostered using tillage from seed spread in the field with a combine (harvest lost). This treatment was compared to a control plot were no management was used to foster pea volunteers. The seeding rate of 6 seeds/ft^2 (standard harvest lost) was compared to a double rate of 12 seeds/ft^2. The study was designed as an RCBD with four replications. Field pea biomass was measured in late October prior to a killing frost. Spring wheat was planted as a test crop in 2009. A GreenSeeker® was used to evaluate wheat canopy color.

Preliminary Results

- Fostering volunteer re-growth and increasing field pea seeding rate significantly increased cover crop biomass, nitrogen accumulation, and wheat test crop canopy cover (higher NDVI = darker green color).
- Enhanced cover crop production increased wheat test crop yield when seeding at 12 seeds/ft^2 but had not effect on wheat protein levels.

Table 2: Influence of fostering method and seeding rate on field pea relay cover crop and wheat test crop performance in 2008-2009 at the Carrington Research Extension Center in central North Dakota.

Fostering Method	Seeding Rate	Pea Cover Crop Biomass	Total Nitrogen in Cover Crop Biomass	Wheat Test Crop Canopy Color	Wheat Test Crop Yield
	(seeds/ft^2)	(lb/ac)	(lb/ac)	(NDVI)	(bu/ac)
None	6	334c	12.9b	0.695b	53.9b
Disk with harrows	6	1844b	71.7a	0.713b	56.4b
Disk with harrows	12	2215a	88.5a	0.758a	59.6a

Means followed by the same letter are not significantly different (P<0.05).

Cover Crops in Sugarbeet Production Systems

Research Questions:

- Can cover crops be integrated into sugarbeet rotations to reduce wind erosion?
- Will cover crops or strip tillage protect sugarbeet seedlings from wind damage?

Materials and Methods:

The study was established at three locations in the Red River Valley of North Dakota and Minnesota on loam and silty clay loam soils that varied from highly susceptible to moderately susceptible to wind erosion. The study was designed as a randomized complete split plot with four replications at each location. Fall cover crops were established the week of Sept. 8, 2008. The wet fall 2008 and spring of 2009 delayed planting of cover crops to May 20 and 29. Due to excessively wet soils in fall 2008, strip tillage plots were established in the spring and created an uneven, cloddy seedbed.

Preliminary Results

- No major wind events occurred in 2009, so there was minimal demonstration of cover crop wind protection for sugarbeet seedlings.
- Spring-seeded barley improved seedling emergence and final sugarbeet stand.
- Rye+Barley and Rye+Pea were effective fall-seeded cover crops.
- Strip tillage lowered final sugarbeet stand and root tonnage as a result of the poor seedbed. These results confirm recommendations that strip tillage be performed in the fall in the Red River Valley.

Table 3: Effect of cover crops and strip tillage on sugarbeet yield and quality compared to conventional chisel plow tillage at Casselton, ND, in 2009.

Treatment	Root Yield	Sugar	SLM	Net Sugar	RSA	RST	Sugarbeet Stand
	(ton/a)	(%)	(%)	(%)	(lb/a)	(lb/ton)	(beets/100 ft)
Conventional	36.4	16.19	1.1659	15.03	10937	300.53	155
Strip Tillage	36	14.87	1.2471	13.62	9799	272.41	134
Rye	36	16.03	1.1674	14.86	10695	297.25	150
Rye + Barley	35.8	16.09	1.1905	14.9	10664	297.99	162
Rye + Pea	38.8	16.05	1.2429	14.8	11499	296.09	164
Spring Barley	37.5	16.28	1.0802	15.2	11387	304	178
Spring Oats	34.8	15.86	1.0955	14.76	10289	295.24	170
LSD (P<0.10)	**2.09**	**0.363**	**0.1093**	**0.445**	**647**	**8.896**	**12**

LSD values indicate the least significant statistical difference between treatments.

SLM = sugar loss to molasses; RSA = recoverable sugar per acre; RST = recoverable sugar per ton.