Cover Crops, Crop Nutrition

Dave Franzen NDSU Extension Soil Specialist Nutritional benefits of cover crops-

-Can trap nitrate – reduce fall/winter/spring losses

-legumes might produce N if they have time

Carbon/Nitrogen ration

All plants and parts of plants have a characteristic range of carbon (C) to nitrogen (N)

this C/N ration is important in predicting whether N will be trapped, released or neither after a crop is harvested, or when a cover crop or any organic-based nutrient amendment is applied to a soil. Soil organic matter ranges from 9/1 to 11/1 Averages about 10/1

Plant residues?

Sawdust-200/1

What happens when you apply sawdust to soil. There is N in the sawdust, will it be released?

Sawdust- 200/1

An average value for the C content of dry plant residues is about 45%

If we apply 2000 dry sawdust to soil, we are applying 2000 lb sawdust X 0.45 = 900 lb C Since sawdust is 200 C/1 N, there is 900 / 200, or about 4.5 lb N in the sawdust

Sawdust- 200/1

We have 900 lb C and 4.5 lb N

In a typical biological decomposition, about 1/3 of the C goes into the soil eventually, and 600 lb C goes into the air as CO2

At the end of decomposition the C from the sawdust will have the same ratio of N as the soil.

Sawdust- 200/1

At the end of decomposition, when the C in the sawdust becomes soil organic matter the 300 lb C will be a ratio of 10/1 with N.

300 lb C needs 30 lb N for a 10/1 ratio. The sawdust only had 4.5

The other 25.5 came from the soil.

Sawdust with a ratio of 200 C/ 1 N ties up N.

Now how about a cover crop?

Wheat comes off in early August, the field is seeded to rye, comes up after a rain in about a week, and by the end of October when the temperatures get to 0, you figure there is a ton of dry matter/acre.

The rye was yellow-green the middle of October. You should assume about 2.5% N on a dry matter basis.

2,000 lb rye has 2,000 X 0.45 C, or 900 lbs/acre

At 2.5 %, the amount of N in the rye is 2,000 X 0.025, or 50 lb /acre

The C/N ratio of the rye cover crop is 900/50 = 18

After the rye decomposes, we have 300 lb C with 30 lb N Since we had 50 lb/acre to begin, we might expect about 20 lb N/acre to be release sometime in the season. Generally, residues with a C/N ratio of over 30 will tie-up N and not release it.

Residues with a C/N ratio from 20-30 will not affect the N status for crops shortterm.

Residues with C/N ratio under 20 tend to release N. Those residues with really low C/N ratios (Very green residues) will release the most the quickest.





From a measured area (1 foot by 1 foot)

Collect above ground plant material Dry Weigh

2000 lb/acre dry matter will weigh 20.8 grams

1 gram/sq ft = ~96 lb dry matter/acre

Green dry matter is about 4 % N

Each 100 lb dry matter would contain about 4 lb N/acre

For the next crop, figure about 1/3 available if conventional till

About 20% if no-till or one-pass seeded.

100% groundcover, annual legumes, 6 inch height is about 2,000 lb dry matter.

Each additional inch in height is about 150 additional lb dm.

Rye 8 inches high is about 2,000 DM.

(Sustainable Agriculture Network, Beltsville, MD)

Rutland fall cover crop grazed, spring 2010



Imagery Date: Jun 23, 2009 45'58'52.94" N 97'26'58.50" W elev 1202 ft Eye alt 2930 ft O

Rutland site (long-term no-till, cover crop grazed)

N rate, lb/acre	Corn Yield, bu/acre
0	172
40	187* Most productive N rate LSD 10%
80	189
120	189
160	188
200	198
LSD 5%	NS

Most efficient use of N- 128 lb N for about 190 bushels corn per acre

Oats biomass and yield for the treatments with and without a Berseem clover cover crop in the 2005 growing season at the Ian N. Morrison Research Farm (Carman, Manitoba).

Date	Above Ground Biomass Yield (lb/acre)					
	Crop Specific Biomass			Total Biomass		
	Oats Alone	Oats In Cover Crop	Berseem Clover Cover Crop	Oats Alone	Oats Plus Berseem Clover	
26 May	10 a	10 a	0	10	10	
17 June	834a	848a	58	959	1052	
12 July	5180a	4610a	58	5180	4670	
5 Aug	6370a	5290b	58	6370	5347	
6 Sept	0	0	210	0	210	
30 Sept	0	0	347	0	347	
25 Oct	0	0	560	0	560	

Kahimba, 2008; Applied Engineering in Agriculture Vol. 24:321-333

Cover crop legumes will only make N when soil N is used up. If significant soil N exists when they are seeded, no net increase in soil N will result.

Both non-legumes and legumes have similar above-ground N content if they are green. Yellow-leaved non-legumes will have little N benefit the following year. Cornell (Ketterings et al., 2008) Hairy vetch may have nitrogen fertilizer replacement value from 50-70 lb/acre.

Rye cover crops prior to planting and killed directly ahead of seeding have a negative N replacement value from 20-30 lb N/acre. This can be modified by killing rye a couple weeks before seeding.

Mycorrhiza is not inhibited by oil-seed radish cover crop.

White and Weil, Plant and Soil, 2009.

Rye enhances.

How about studies that looked at subsequent crop yields?

Using Kura clover, Iowa State study (AJ 2010, Sawyer et al.) showed that use of Kura clover did not influence soil nitrate before, during or after the growing season.

Excessive Kura clover growth reduced corn yield. Suppression of Kura clover during corn growth resulted in similar corn yields in Kura, non-Kura systems.

Interseeding resulted in significant challenges to Kura clover suppression and corn establishment and yield, and no perceived benefits to the crop. Studies on intercropping sunflower with legumes-Kandel et al., 1997 Crop Science, 5 site years in North Dakota (Prosper, Carrington) black lentil, hairy vetch, yellow-blossom sweet clover and snail medic.

Seeding at time of sunflower seeding reduced yields except with black lentil.

Yield of sunflower was not suppressed when seeded at V-4 or V-10.

Biomass of legumes at later seeding dates ranged from about 1500 lb/a for V-4 seeding to about 800 lb/a for V-10 seeding.

Sweetclover seeded at V-4 could act as a cover crop for the next growing season.

In a companion study (Kandel et al., 2000, Crop Science),

spring wheat seeded the year following the sunflower interseeding experiment was not enhanced by intercropped legumes. (1993-1994)





Soybean with 0 pounds N per acre application, without and with a cover crop.





Soybean with 100 pounds N per acre application, without and with a cover crop. Lamb and Rehm, from Franzen et al., final North Central Soybean Research Report, 2007. When evaluating information about cover crops remember-

Data without replication is not data. It cannot be evaluated critically. It is of no more use than coffee shop talk.

Grower data is data when there are replicated field strips, yield monitor data to go along with it, and an oversight partner as a collaborator.