

Integrating Cereals and Cover Crops into Corn and Soybean Cropping Systems: Improving Economic Return and Implications for Pest Management.

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Primary Objectives:

1. Document and quantify the insect control, weed management, disease management, and other agronomic benefits of including a winter annual forage, grain, or cover crop in a conventional corn and soybean cropping system.
2. Evaluate the potential impact on groundwater resources associated with several cropping systems by quantifying residual soil nitrate levels.

Results:

The utility of winter annual cover crops (Harus wheat and Wheeler rye) as a spring forage source was evaluated. Both harvest dates for wheat out yielded the rye in tons of dry matter harvested. Winter annual forage yield was comparable when the previous crop was either corn or soybean. The data suggests that planting the winter annual forage after corn silage harvest in the fall and following it with soybean in the spring is an effective way to increase production per unit of land base. Growers may be able to add an additional \$100 per acre value to their corn and soybean cropping system by utilizing a winter annual cover crop as a spring forage.

Table 1. Winter annual forage yield and quality. Values are averaged across year and replication. Means followed by the same letter are not significantly different at P =0.05.

| Forage | Yield | CP | NDF | ADF |
|----------|--------|-----------|--------|--------|
| | Ton/A | --- % --- | | |
| Rye | 1.73 b | 19.4 a | 48.6 b | 26.8 a |
| E. wheat | 2.60 a | 16.2 b | 59.1 a | 30.6 b |
| L. wheat | 2.69 a | 14.0 c | 59.8 a | 31.6 c |

Table 2, below, provides the yields for each of the cropping systems. Table 3, provides an economic summary of the multiple cropping systems. Input costs refer to the actual costs accrued for fertilizer, seed, etc. The equipment costs reflect 2001 prices as reported in Dartt, B. and G. D. Schwab. 2001. Custom Work Rates in Michigan. Michigan State University, Agricultural Economics Staff Paper #2001-42. In press. The cash receipts reflect the most recent five-year average commodity price as reported by the Michigan Agricultural Statistics Service. Land and management costs are not reflected in this draft summary. Prices received based on MASS 1999-2000 annual report, 5 yr. averages (except corn silage): Corn: \$2.13; Wheat: \$2.74; Soybean: \$5.59; Forage: \$82.40 dry ton; Corn silage: 25.00 wet ton;

| Winter ann | Rot. crop | Yield | | |
|------------|-------------|---------------------|----------------------|-----------------------------|
| | | Forage DTon/Acre | Wht grain Bu/Acre | Rotate crop Bu or Dton/A |
| LW-F | Corn grain | 2.69 | | 153.45 |
| EW-F | Corn grain | 2.60 | | 153.55 |
| R-F | Corn grain | 1.73 | | 179.30 |
| LW-G | Corn grain | | 76.00 | 0.00 |
| EW-G | Corn grain | | 68.70 | 0.00 |
| W-cc | Corn grain | | | 186.90 |
| R-cc | Corn grain | | | 189.35 |
| NC | Corn grain | | | 197.70 |
| | Isd | 0.2 | 5.88 | 25.07 |
| LW-F | Corn silage | 2.69 | | 4.95 |
| EW-F | Corn silage | 2.60 | | 5.25 |
| R-F | Corn silage | 1.73 | | 5.65 |
| LW-G | Corn silage | | 76.00 | 1.75 |
| EW-G | Corn silage | | 68.70 | 2.40 |
| W-cc | Corn silage | | | 6.65 |
| R-cc | Corn silage | | | 6.55 |
| NC | Corn silage | | | 6.45 |
| | Isd | 0.2 | 5.88 | 2.01 |
| LW-F | Soybean | 2.69 | | 52.40 |
| EW-F | Soybean | 2.60 | | 51.75 |
| R-F | Soybean | 1.73 | | 50.45 |
| LW-G | Soybean | | 76.00 | 0.00 |
| EW-G | Soybean | | 68.70 | 0.00 |
| W-cc | Soybean | | | 52.40 |
| R-cc | Soybean | | | 48.60 |
| NC | Soybean | | | 51.80 |
| | Isd | 0.2 | 5.88 | 2.46 |

Table 2. Cropping system yield as affected by the addition of a winter annual forage (LW-F, EW-F, or R-F) or wheat (EW-G, or LW-G) double crop.

LW-F = late wheat forage
EW-F = early wheat forage
R-F = rye forage

LW-G = late wheat grain (Harus var.)
EW-G = early wheat grain (Patterson var.)

W-cc = wheat cover-crop
R-cc = rye cover-crop
NC = no cover

Cropping systems using rye and wheat as a winter annual cover crop had comparable rotational corn grain, corn silage and soybean yields as systems without cover crops. When the winter annual cover crop was harvested as a forage, yields of the rotational corn grain and corn silage were decreased. This was due to the later planting date of the rotational corn to facilitate harvest

of the cover crop. However, rotational soybean yields were not compromised when the cover crop was harvested as a spring forage.

| Winter ann | Rot. crop | Forage \$/Acre | Wht grain \$/Acre | Rotate crop \$/Acre | System \$/Acre |
|------------|-------------|-------------------|----------------------|------------------------|-------------------|
| LW-F | Corn grain | 79.04 | | 148.09 | 227.12 |
| EW-F | Corn grain | 71.21 | | 148.30 | 219.51 |
| R-F | Corn grain | 9.15 | | 188.60 | 197.75 |
| LW-G | Corn grain | | 123.06 | -206.50 | -83.44 |
| EW-G | Corn grain | | 103.06 | -206.50 | -103.44 |
| W-cc | Corn grain | | | 174.32 | 174.32 |
| R-cc | Corn grain | | | 175.26 | 175.26 |
| NC | Corn grain | | | 225.59 | 225.59 |
| LW-F | Corn silage | 79.04 | | 127.61 | 206.65 |
| EW-F | Corn silage | 71.21 | | 149.04 | 220.25 |
| R-F | Corn silage | 9.15 | | 163.06 | 172.21 |
| LW-G | Corn silage | | 123.06 | -81.46 | 41.60 |
| EW-G | Corn silage | | 103.06 | -35.08 | 67.98 |
| W-cc | Corn silage | | | 193.52 | 193.52 |
| R-cc | Corn silage | | | 192.60 | 192.60 |
| NC | Corn silage | | | 218.00 | 218.00 |
| LW-F | Soybean | 79.04 | | 180.07 | 259.10 |
| EW-F | Soybean | 71.21 | | 161.87 | 233.08 |
| R-F | Soybean | 9.15 | | 154.62 | 163.77 |
| LW-G | Soybean | | 123.06 | -148.32 | -25.26 |
| EW-G | Soybean | | 103.06 | -136.92 | -33.86 |
| W-cc | Soybean | | | 122.14 | 122.14 |
| R-cc | Soybean | | | 109.52 | 109.52 |
| NC | Soybean | | | 159.68 | 159.68 |

Table 3. Net return to land and management as affected by the different cropping systems.

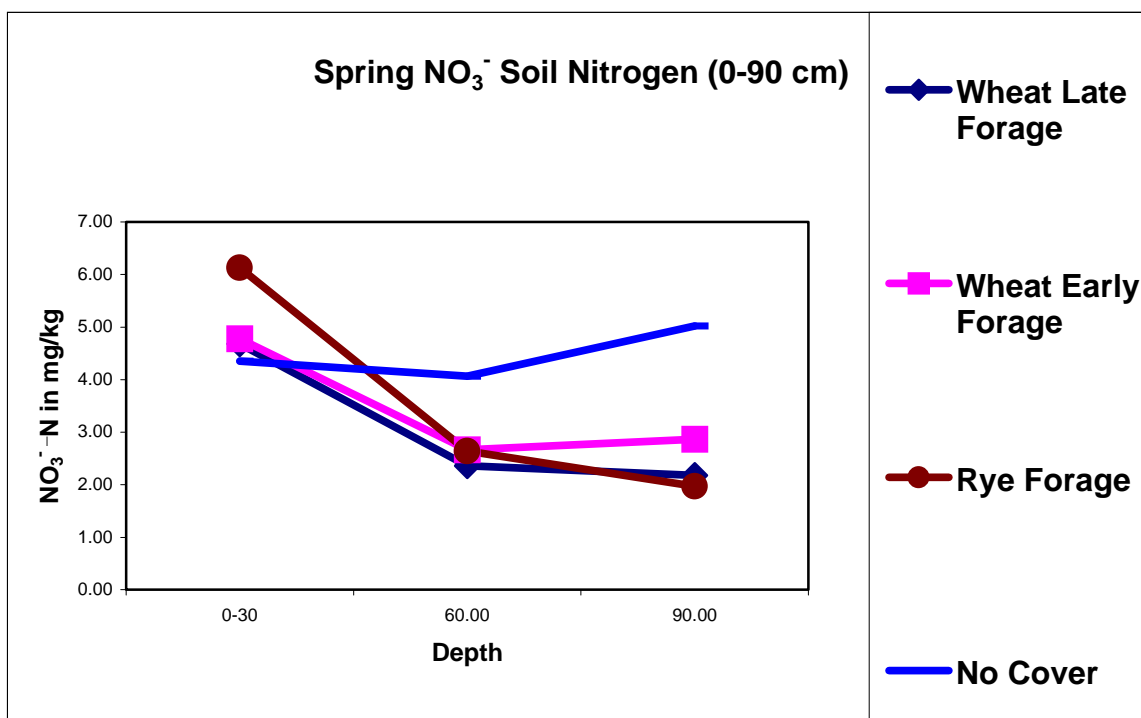


Figure 1. Residual soil nitrate concentrations at 30, 60, and 90 cm as affected by the presence or absence of the winter annual cover crop harvested as an early spring forage. The cover crops were effective at reducing residual soil nitrate levels.

Conclusions:

- Date of harvest was positively correlated with winter annual forage yield and negatively correlated with forage quality.
- The winter annual forage reduced the yield of successively planted corn grain and corn silage but did not affect the yield of successively planted soybean.
- Net returns to land and management were not increased when corn grain or corn silage were grown following the winter annual forage. However, returns were significantly increased when soybean was the successive crop.
- The winter annual cover crops were effective in reducing residual soil nitrate concentrations.
- Integrating a winter annual forage into a corn-soybean rotation is an effective cropping system for Michigan growers if the winter annual forage precedes soybean in the rotation.

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