

Cover Crop Economics: Costs, Risks and Adoption



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The Road to Conservation Tillage



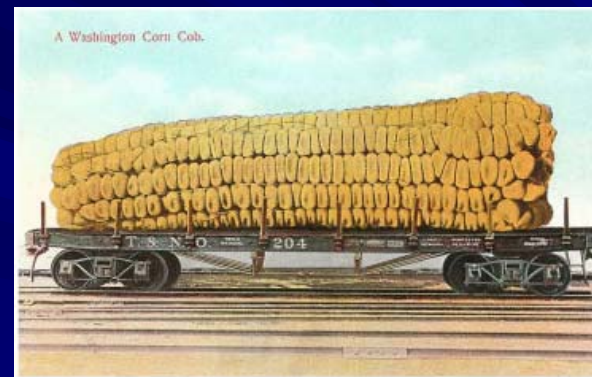
Soil Erosion → Loss of Soil Productivity

The Road to Conservation Tillage



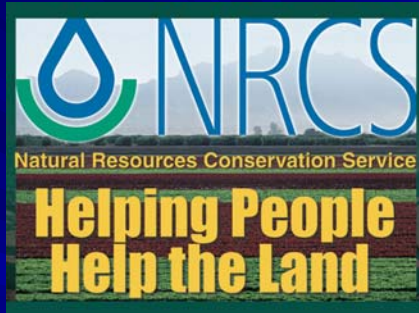
Less Labor and Higher Energy Prices

The Road to Conservation Tillage



Improved Crop Yields, Water Conservation and
Productivity From Conservation Tillage

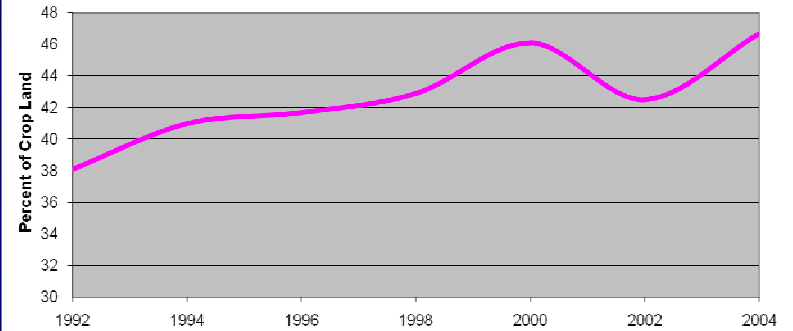
The Road to Conservation Tillage



Farm Policy and Conservation Programs (EQIP, CSP)

The Road to Conservation Tillage

Percent of Crop Land Under Conservation Tillage in the Midwest, 1992 - 2004



Is there a next step?

COVER CROPS

Cover crops are grasses, legumes, brassicas, or small grains that are grown between regular cash crop growing seasons to reduce soil erosion, improve soil organic matter, and conserve soil moisture by increasing the amount of residue on the soil surface.

Residue is a key component of conservation tillage systems!

Types of Cover Crops

Legumes: (Fix N, Biomass)

**Clovers, Cowpeas
Hairy Vetch, Soybean,
Sunnhemp, Lupin**



Types of Cover Crops



Small Grains:

(Biomass, Allelopathy & Weed Suppression)

**Wheat, Cereal Rye,
Triticale, Oats, Millet, Barley**



Types of Cover Crops



Grasses and Brassicas

(Biomass, Soil Tillth,
Weed Suppression)

**Ryegrass, Rapeseed,
Radish, Turnip**



Benefits and Costs of Cover Crops

Benefits

- Improve soil quality
- Improve water conservation
- Increase soil moisture content
- Reduce soil erosion
- Weed suppression/Reduce herbicide costs
- Protect water quality/Reduce nutrient and pesticide transport
- Increase cash crop yields
- Reduce variability/risk

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Costs

- Planting and management
- Interference with production of following cash crop (e.g. hair pinning, use of limited water resources)
- Slows soil warming
- Prediction of N mineralization
- Opportunity cost of a potential foregone cash crop.

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Increase/Decrease Crop Yields and Profitability

Purpose

To examine the economics of cover crop use, focusing on Kansas. Examine:

- Costs of Production
- Cover Crop Management
- Cost Savings
- Yield and Productivity Gains
- Opportunity Costs
- Adoption and Conservation Policy



Purpose

Goal is to present cover crops as a step toward intensifying conservation systems.

Keep an open mind and recognize cover crops may not be for everyone.



Costs of Production

The costs of production can be broken down into:

- Seed Costs
- Planting
- Fertilization
- Termination



Seed Costs

Type	Seeding Rate (lb/acre)	Price (\$/lb)	Cost (\$/acre)
Annual Ryegrass	10-20 (15)	\$1.00	\$15.00
Oats	80-110 (90)	\$0.15	\$13.50
Cereal Rye	60-120 (90)	\$0.23	\$20.70
Wheat	60-120 (75)	\$0.22	\$16.50
Hairy Vetch	15-30 (20)	\$2.50	\$50.00
Crimson Clover	15-30 (20)	\$1.68	\$33.60

Multiple Sources, '06-'08

Planting

Planting Options: (Iowa Custom Rates, 2008)

- No-till Grain Drill (\$12.00/acre)
- Broadcast (\$9.00/acre – higher seeding rates)
- Aerial Application (?)

Equipment modifications to cash crop planter may include row cleaners, down pressure springs and/or spoke closing wheels (\$350 - \$700 /row).



Fertilization

Amount of N Applied (to small grains):
30 to 50 lbs (\$28 to \$47 per acre).

Application Costs:

Single Application (\$5.25/acre)

Split Application (\$10.50/acre)

Split application may provide optimal biomass production from the cover crop.

(Ag Valley Coop, 2008, Norton, KS)

Termination - Burndown

- **22 oz. Glyphosate & 10 oz. 2-4D**
\$13.05/acre
- **Cost to custom apply is \$5.25/acre.**

(Ag Valley Coop, 2008, Norton, KS)

Note: If using no-till, this practice is already included in production costs.



Termination - Mechanical

Roller/Crimpers (\$4.41/acre)

Developed at USDA-ARS, NSDL, Auburn, AL



Long-straight bars

\$9000



Smooth with crimping arm

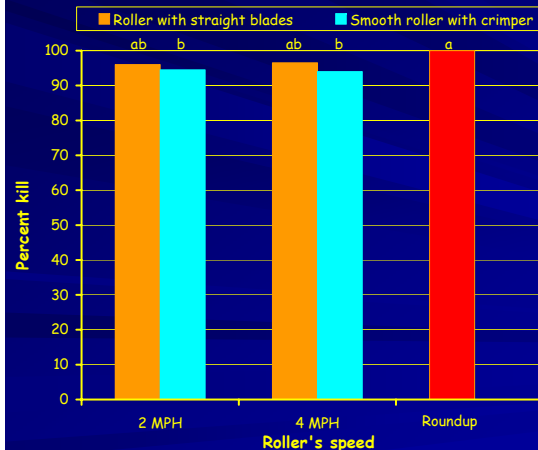
\$6500

Roller Costs are from custom made units in 2005.

Termination - Mechanical

Time Sensitive – termination rates greatly increase with cover crop maturity.

Percent Kill after three weeks



Long-spiral bars

Source: Ashford & Reeves, 2003; Kornecki, 2005

Cost Summary (\$/ac)

	Hairy Vetch	Wheat/Rye
Seed	\$50	\$17 - \$21
Planting	\$12	\$12
Fertilization	---	\$33 - \$57
Termination *	---	(\$3) – \$4 (roller-crimper)
Total Variable Cost	\$62	\$59 - \$94

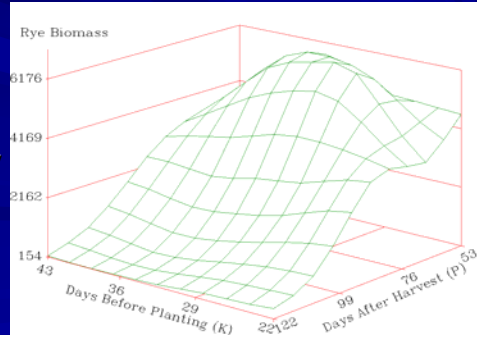
** Termination costs for chemical burndown are not included, assuming producers using conservation tillage will already incur these costs. Savings of \$7 in chemical costs may be realized when using roller-crimper due to reduced herbicide rates for burndown (assume 1/2 rate). (Kornecki et al., 2007)

Management Considerations

- Timeliness of Operations
- Optimizing Biomass
- Selecting Viable Crop Rotations – compatible cover crops that fit into a manageable cash crop rotation.

Timeliness of Operations

- Planting/termination dates: to optimize biomass production and nitrogen fixation means planting early and terminating late (Morton et al., 2005).
- Considerations:
 - ✓ Cash Crop Selection (planting & weeds)
 - ✓ Soil Moisture Availability
 - ✓ Soil Warming
 - ✓ Use of Roller/Crimper

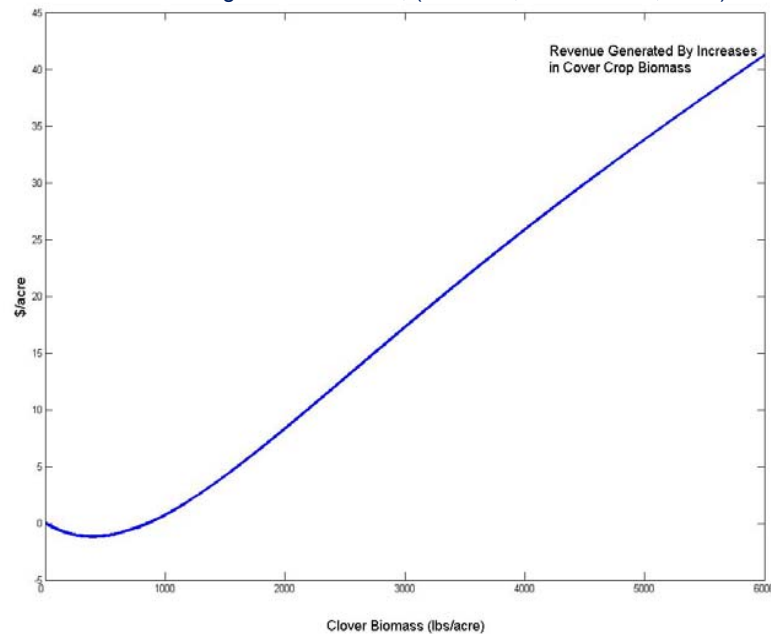


Optimizing Biomass Production

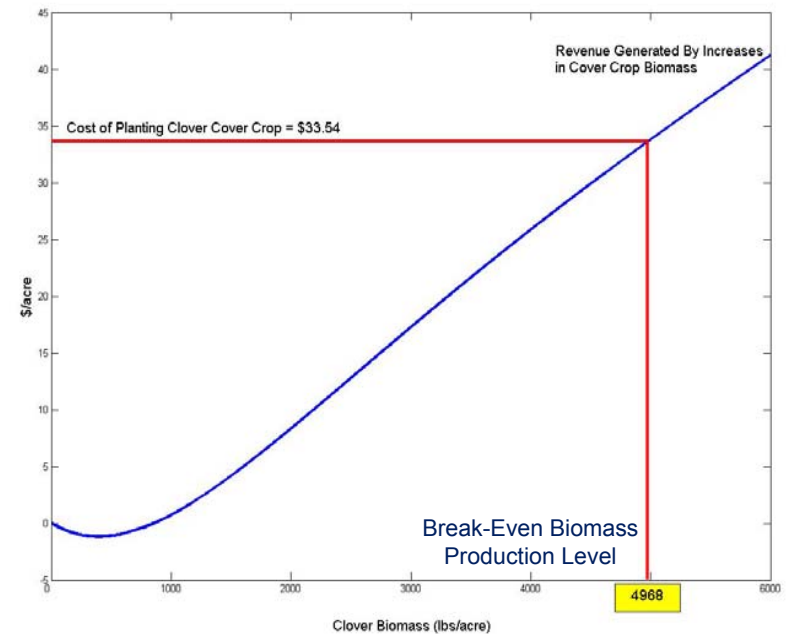
- | | |
|---|--|
| <ul style="list-style-type: none"> ■ Costs <ul style="list-style-type: none"> – Increased expenses for labor, seed, and fertilizer – Increased planting costs (planter modifications) – Delayed planting (soil temp) | <ul style="list-style-type: none"> ■ Benefits <ul style="list-style-type: none"> – More soil carbon – More mulch – Better water conservation. – Better weed suppression. – Improved nutrient cycling. |
|---|--|

With proper management some cover crops (e.g. cereal rye, sunn hemp) can produce upwards of 10,000 – 12,000 lbs. of biomass per acre. At some point a permanent residue mat may be formed that can be replenished with cash crop residues and occasional cover crops (reducing costs).

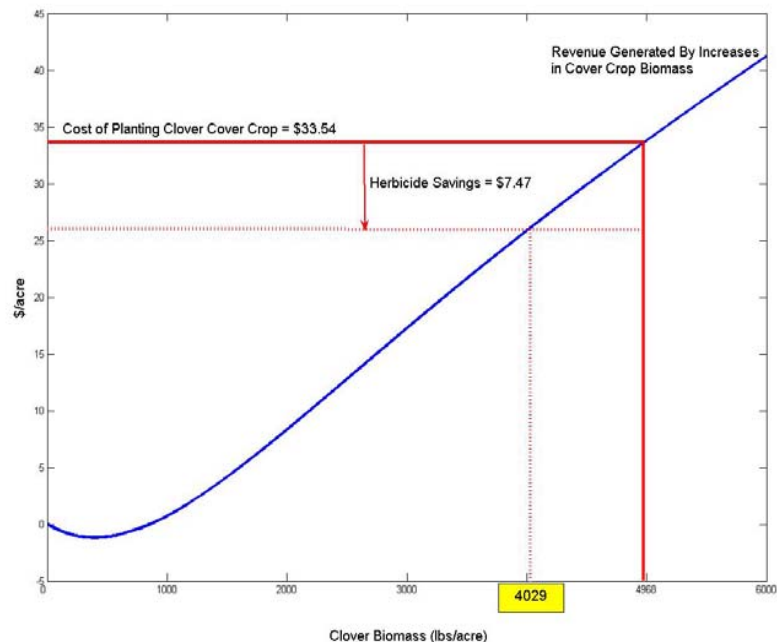
Corn following Crimson Clover, (Alabama, Morton et al., 2005)



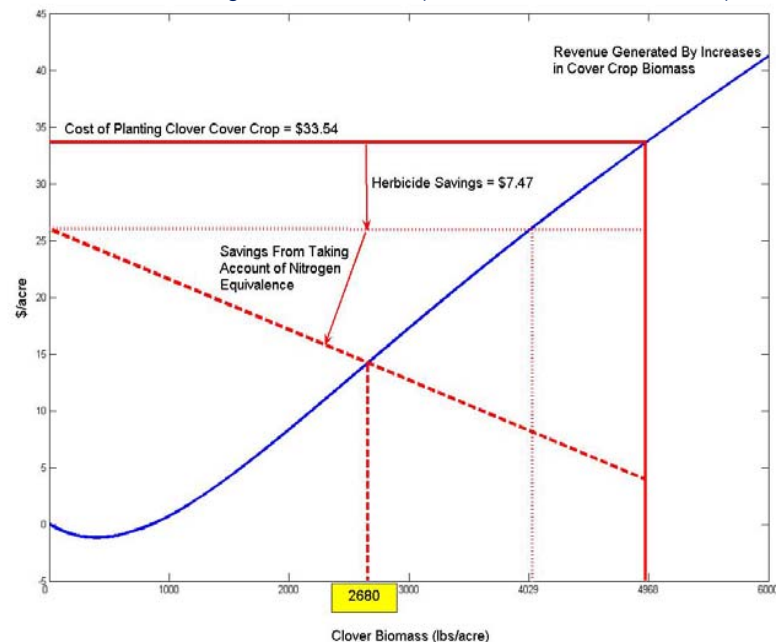
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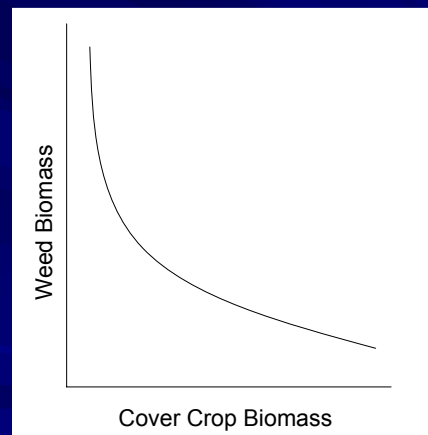
Cost Savings



These are potential cost savings in CASH CROP production from using a COVER CROP (e.g. recall the corn following crimson clover example).

- Herbicide Savings
- Fertilizer Savings
- Subsoiling Savings (? , with brassicas)
- Irrigation Savings

Herbicide Savings



Cover crops can potentially provide weed suppression (as a mat and allelopathy), reducing herbicide and spraying costs by as much as **\$13 to \$30** per acre. (A thick residue mat helps maximize weed suppression benefits.)

Fertilizer Savings

Cover Crop	Potential N fixation (lbs/ac)	Available N (lbs/ac) *assuming 50% of fixed N	Potential Fertilizer Savings (\$/ac)
Crimson Clover	60-150	30-75	\$28-\$70
Hairy Vetch	60-180	30-90	\$28-\$84
Sunn Hemp	100-125	50-62.5	\$47-\$58
Cow Peas	90-150	45-75	\$42-\$70
Soybeans	60-110	30-55	\$28-\$51

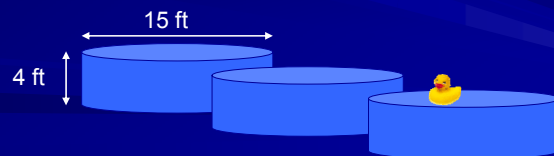
Fertilizer Savings, cont.

- ✓ Fertilizer savings are only realized if the producer credits the available N from the cover crop toward the fertility requirements for the cash crop.
- ✓ Research has shown that risk-averse farmers are not likely to take account of these potential nitrogen savings (Bergtold et al., 2008), which is exacerbated by difficulties in predicting N mineralization.
- ✓ Not taking account of the potential N savings can make planting legumes economically infeasible (e.g. no potential yield gain!)
- ✓ Incorporating cover crop residue into the soil (through tillage) as green manure increases immediate N availability, but drastically reduces other soil health benefits.

Water Conservation

Use of a cover crop can provide an additional 5% soil moisture during the growing season. This is equal to **16,300 gallons of extra water per acre**, or 3 above-ground swimming pools! This may mean irrigation savings during the growing season.

For dryland cropping, some evidence suggests heavy residue cover crops may provide up to 1-2 weeks of drought protection during the growing season.



* determined using preliminary research data, USDA-ARS 2004.

Yield Gains

- Following crimson clover or hairy vetch increased grain sorghum yields 79%-131% at Parsons, KS (Sweeney & Moyer, 1994).
- Corn yields were up 20% in NE Kansas following hairy vetch (Mikha, 1998)
- Pennsylvania corn yields following a soybean cover crop were higher and more stable over time (Lotter et al., 2003)



Yield Gains

- Claassen (2004) found average grain sorghum yield increases of 12.5 bu/a and 17.8 bu/a and wheat yield increases of 4.4 bu/a and 6.3 bu/a following soybean and sunn hemp cover crops.
- Not all studies show yield improvements. Management can be a limiting factor in gaining benefits from a cover crop rotation!

Performance Summary

- While cover crops bring cost savings, the primary economic benefit is improvements in cash crop yield and yield stabilization over time (Lu et al., 2000).
- Yield benefits arise from improvements in soil health and productivity, water conservation and weed suppression, over time (Snapp et al., 2005).

Performance Summary

Example Partial Budget: Corn following Hairy Vetch Cover Crop

	Dryland (90 bu/ac)	Irrigated (170 bu/ac)
Yield Gain (10% increase, \$4.50/bu)	\$40.5	\$76.5
Fertilizer Savings (20% of legume-fixed N)	\$14	\$14
Total Variable Costs	(\$62)	(\$62)
Return to Cover Crop	(\$7.5)	\$28.5

Other Considerations (not included)

- ✓ Opportunity cost of foregone cash crop
- ✓ Fixed costs of cover crop production
- ✓ Potential of harvesting cover crop biomass for cellulosic ethanol production
- ✓ Potential for winter annual grazing
- ✓ Build-up of SOC/Carbon Markets

Cover Crop Adoption

- Pannell (1990) contends that the most important phase of the adoption process is trialing of the new innovation, in our case cover crops.
- Bergtold et al. (2008) show that farmers already involved with conservation tillage are more likely to trial and see the benefits of cover crops due to past conservation experience.



Cover Crop Adoption

- Singer et al. (2007) reports that only 6.4% of Iowa farmers have used cover crops in the past 5 years.
- Farmers indicated that they would be more willing to adopt cover crops with cost-share assistance (mean of \$23/acre) (Singer et. al., 2007).

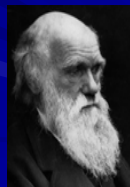


Conservation Programs

- EQIP – Cover Crop, \$17.65 per acre (contact local NRCS office).
- Conservation Stewardship Program (under new Farm Bill).
- With EQIP payments, short term return to cover crop is \$10.15 per acre for dryland corn.



“It is not the stronger of the species that survives, nor the most intelligent, but the one most responsive to change.”



Charles Darwin