Making Cover Crops Profitable

NEVIN DAWSON
SUSTAINABLE AGRICULTURE COORDINATOR
Raise your hand if...

- You are a farmer
- You are an ag service provider
- You have a basic understanding of soil health
- You have grown cover crops
- You have grown cover crop cocktails
- You know everything about cover crops
Soil health

- **Microbes:** FBI
  - **Fungi**
    - Feed on dead OM
    - Attack other microbes
    - Symbiosis w/ plant roots
    - Particle stickiness
  - **Bacteria**
  - Feed on OM
  - Store/cycle nitrogen
  - Decompose pesticides
- **Invertebrates**
  - Cycle nitrogen
  - Shred OM
  - Create pores
  - Particle stickiness
Soil health

- Organic matter
  - FBI food
  - Nutrient stickiness
  - Particle stickiness
  - Carbon sink
  - Water storage
  - Water infiltration
  - Compaction mitigation
Soil health

- Aggregate stability
  - Pore space
  - Water infiltration
- Limited disturbance
  - Allow Nature to do its job
  - Limit tillage as much as possible
  - Keep decomposition slow and steady
Why plant cover crops?

- Weed Suppression
- Protecting soil from rain or runoff
- Improving soil aggregate stability
- Reducing surface crusting
- Adding active organic matter
- Breaking hardpan
- Fixing nitrogen
- Scavenging soil nitrogen
- Suppressing soil diseases and pests
Weed suppression

- Rapidly established cover crops
- Allelopathy (e.g., hairy vetch residue)

A polyculture of crimson clover, cereal rye and hairy vetch used as a green manure cover crop for sweet corn, one week before termination. Photo credit: Danielle Treadwell, University of Florida.
Protecting soil from rain or runoff

- Broad leaves to intercept rain
- Robust root system to hold surface soil

Herefordshire, England
Improving soil aggregate stability

- Active exudation of glues and fungus food from roots
Reducing surface crusting

- Shallow fibrous root system
Adding active organic matter

- High biomass with mixture of quickly and slowly-decomposing plants
Soil Organic Matter

Organic matter is 1-6% of total soil mass

“*The living, the dead, and the very dead*”
Vermont Agric Exp Sta Bulletin 135, 1908
Breaking hardpan

- Deep roots that swell during growth
Fixing Nitrogen

- Legumes with high biomass and active fixation in farm fields

Nape Mothapo, North Carolina State University
Scavenging soil nitrogen (and phosphorus)

- Active growth in fall and good nitrogen storage over winter
Suppressing soil diseases and pests

- Support beneficial soil microbes
- Produce suppressive compounds (biofumigant)
  - E.g., mustards, rapeseed, sudangrass
  - Flail mower chopping and immediate incorporation (cultipacker or water, w/in 15 min.)
- Chemical and enzyme in cell walls come in contact and create toxin
- Affects soil-borne pathogens and weed seeds
Which crop(s) to use?

- Management goal
- Growing habit
- Planting time
- Sowing method
- Duration
- Kill method/time
- Following crop
Management goal

► Weed Suppression
► Protecting soil from rain or runoff
► Improving soil aggregate stability
► Reducing surface crusting
► Adding active organic matter

► Breaking hardpan
► Fixing nitrogen
► Scavenging soil nitrogen
► Suppressing soil diseases and pests

Prioritize!
Growing habit

- Upright
- Upright-spreading
- Prostrate
Planting time

- Early summer
- Mid to late summer
- Late summer
- Early fall
- Fall
- Spring
Early summer

- Good for rebuilding degraded soil
- Fills in gaps in rotation
- Late May/early June: sudangrass (OM, nematodes, penetrating hardpan, 70 days); buckwheat (weeds, mellowing, 40 days)
Mid to late summer

- Improve soil instead of building weed seed bank
- Scavenge N, add OM
- July: buckwheat or sudangrass
- August: BW, SG, or annual rye grass (overwintering, creates sod, weeds, flood tolerance; needs N)
- Consider interseeding
Late summer: legumes

- Build next year’s N (establish in fall, fix in May): red clover (overseeding, low water, soil compaction) and hairy vetch (may become weedy in small grains); 100-150 lb/ac N
- Nurse crop (wheat, oats, rye)
Late summer: crucifers

- Diseases, winter weeds, tilth, pump N from depth (must die in spring for availability)
- Low price/lb and lb/ac
- May or may not winter kill
Early fall (before Oct. 1/Oct 15)

► Brassicas

► Forage radish (best before Sept, OK in Sept, drills large hole, scavenges N, may not winter kill, can mix with oats or rye)

► Mustard (should winter kill, thick cover, not a biofumigant when planted in fall, yellow for height, brown for cover)

► Arugula (suppresses nematodes, slow establishment)
Early fall (before Oct. 1/Oct 15)

- Small grains (winter cover, erosion, spring weeds)
  - Oats (quick cover, winter kill)
  - Wheat (later seeding, overwinters, slower growing)
  - Triticale (earlier seeding, overwinters, slower growing)
- Rye (difficult conditions, abundant biomass, weeds, may suppress crop yield)
Late Fall (after Oct. 1/Oct 15)

- Last resort—best to plant earlier
- Rye (winter soil protection, higher seeding rate: 250 lb/ac instead of 80 lb/ac, drill v. broadcast, may suppress crops)
- Wheat (little growth, nurse crop for frost-seeded red clover)
- Spelt (some cold tolerance)
Spring

- Medium red clover
- Biofumigant mustard (needs warm soil and to bloom; incorporate before seed set)
Sowing method

- Broadcast
- Drilling
- Aerial
- Interseeding
- Frost seeding
Duration

- Time to flower, seed set
- Woody stems
- Sudangrass: 70 days
- Buckwheat: 40 days
Kill method/time

- Spray v. organic
- May need to allow time between kill and planting for decomposition
- May need a back up plan for winter kill fail
Following crop

- **Seedbed**
  - Buckwheat mellows the soil and breaks down quickly
  - Sorghum leaves lumpy crowns

- **N needs**
  - Legume v. non-legume
Also consider species variety traits

- Reduced seed viability
- Decrease weed potential
- Increased biofumigant compounds
Cover crop improvement

- Fertilize
- Mow
  - Root dieback creates flush of food for soil microorganisms
Cocktails

- Multiple species add multiple benefits
- Create hybrid effect
A conceptual diagram of our research hypotheses that:

A) Increasing cover crop diversity will increase the beneficial functions derived from cover crops and that this relationship will be non-linear, i.e., there is a level of diversity at which adding more diversity does not significantly improve the mixture function or outweigh management or monetary costs; and

B) Using a hypothetical example, a single species may maximize one or two functions, whereas mixtures will provide a broader suite of functions.
CC benefits/Mgmt goals

- Weed Suppression
- Protecting soil from rain or runoff
- Improving soil aggregate stability
- Reducing surface crusting
- Adding active organic matter

- to soil
  - Breaking hardpan
  - Fixing nitrogen
  - Scavenging soil nitrogen
  - Suppressing soil diseases and pests
- ...And one more
Management goal

Increase profit!
CC benefits/Mgmt goals

- Weed Suppression
- Protecting soil from rain or runoff
- Improving soil aggregate stability
- Reducing surface crusting
- Adding active organic matter
- Breaking hardpan
- Fixing nitrogen
- Scavenging soil nitrogen
- Suppressing soil diseases and pests
# WHEAT BUDGET

## PER ACRE FOR 2014

<table>
<thead>
<tr>
<th>ITEM</th>
<th>UNIT</th>
<th>QUANTITY</th>
<th>PRICE</th>
<th>TOTAL</th>
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<td><strong>GROSS INCOME</strong></td>
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<td>WHEAT</td>
<td>BUSHEL</td>
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<td><strong>VARIABLE COSTS</strong></td>
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<td>SEED</td>
<td>POUND</td>
<td>150</td>
<td>$0.39</td>
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<td>SOIL TESTING</td>
<td>ACRE</td>
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<tr>
<td>NITROGEN</td>
<td>POUND</td>
<td>70</td>
<td>$0.55</td>
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<td>PHOSPHATE</td>
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<td>40</td>
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<td>POTASH</td>
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<td>LIME</td>
<td>TON</td>
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<td><strong>HARMONY GT XP</strong></td>
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<td>TILT</td>
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<td>4</td>
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<td>WARRIOR</td>
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<td>OSPREY</td>
<td>OUNCE</td>
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<td>$3.03</td>
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<td><strong>CROP INSURANCE (RP 75%)</strong></td>
<td>ACRE</td>
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<td><strong>INTEREST ON OPERATING CAPITAL</strong></td>
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<tr>
<td><strong>TOTAL VARIABLE COSTS LISTED ABOVE</strong></td>
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<td>$213.86</td>
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<td><strong>FIXED/OVERHEAD COSTS (CUSTOM RATES ARE USED AS A PROXY FOR FIELD OPERATION COSTS)</strong></td>
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<tr>
<td>SPREADING FERTILIZER</td>
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<td>VERTICAL TILLAGE</td>
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<td>BROADCAST SEEDING</td>
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<td><strong>INTEREST ON FALL CUSTOM CHARGES</strong></td>
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<td><strong>LAND CHARGE</strong></td>
<td>ACRE</td>
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<td>$98.00</td>
<td>$98.00</td>
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<td><strong>TOTAL FIXED COST LISTED ABOVE</strong></td>
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<td>$222.65</td>
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<tr>
<td><strong>TOTAL VARIABLE AND FIXED COST LISTED ABOVE</strong></td>
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<td>$436.51</td>
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<tr>
<td><strong>NET INCOME OVER VARIABLE &amp; FIXED COSTS LISTED ABOVE</strong></td>
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<td></td>
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<td>$99.74</td>
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<tr>
<td><strong>PRICES</strong></td>
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<td>NET INCOME ABOVE VARIABLE AND YIELDS</td>
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<td>$5.36</td>
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<td>FIXED COSTS LISTED ABOVE FOR 56.25</td>
<td>$(134.87)</td>
<td>$(34.32)</td>
<td>$(66.22)</td>
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<td>VARIOUS YIELDS AND PRICES</td>
<td>75</td>
<td>$(34.32)</td>
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<td>93.75</td>
<td>66.22</td>
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## ANALYSIS

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<tr>
<td>BREAK EVEN</td>
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<tr>
<td>VARIABLE COSTS PER UNIT</td>
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<tr>
<td>OVERHEAD COST PER UNIT</td>
<td>$2.97</td>
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<tr>
<td>TOTAL COST PER UNIT</td>
<td>$5.82</td>
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<tr>
<td>PROFIT PER UNIT</td>
<td>$1.33</td>
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[Crop Budget](https://extension.umd.edu/grainmarketing/crop-budgets)
Long Term Soil Fertility and Water Storage Benefits

Cereal Rye-Soybeans
Cereal Rye/crimson clover/brassica-Corn

Years

$/acre

Soil Fertility Benefit
Water Storage Benefit
Amortized Soil Fertility Benefit
Amortized Water Storage Benefit
Financial Analysis Net Benefits

Cereal Rye-Soybeans
Cereal Rye/crimson clover/brassica-Corn
MD Cover Crop Program

- MD Ag Water Quality Cost-Share (MACS)
- Incentive payments for planting CCs after summer crop
  - Deadline in early November
  - Additional incentive for earlier planting
  - Kill-down: 3/1-6/1
Barley, canola, rapeseed, kale, rye, ryegrass, spring oats, triticale, forage radish and wheat may be used as cover crops.

New in 2014: mixes allowed

What do these have in common?
2014-2015: 1,849 farmers, 641,400 acres
<table>
<thead>
<tr>
<th>TRADITIONAL COVER CROPS PAYMENT OPTIONS</th>
<th>NO-TILL</th>
<th>CONVENTIONAL</th>
<th>BROADCAST WITH LIGHT, MINIMUM OR VERTICAL TILLAGE</th>
<th>AERIAL</th>
<th>BROADCAST STALK CHOP/AERIAL GROUND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base payment:</td>
<td>$45/acre</td>
<td>$45/acre</td>
<td>$45/acre</td>
<td>$50/acre</td>
<td>$45/acre</td>
</tr>
<tr>
<td>Plant by October 1, <strong>add:</strong> or</td>
<td>$20/acre</td>
<td>$10/acre</td>
<td>$10/acre</td>
<td>$0/acre</td>
<td>$0/acre</td>
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<tr>
<td>Plant by October 15, <strong>add:</strong></td>
<td>$10/acre</td>
<td>$5/acre</td>
<td>$5/acre</td>
<td>$0/acre</td>
<td>$0/acre</td>
</tr>
<tr>
<td>Plant fields where manure was used in spring, <strong>add:</strong></td>
<td>$10/acre</td>
<td>$10/acre</td>
<td>$10/acre</td>
<td>$10/acre</td>
<td>$10/acre</td>
</tr>
<tr>
<td>Plant in field with previous corn, tobacco or vegetable crop, <strong>add:</strong></td>
<td>$5/acre</td>
<td>$5/acre</td>
<td>$5/acre</td>
<td>$5/acre</td>
<td>$5/acre</td>
</tr>
<tr>
<td>Plant rye (no mixes), <strong>add:</strong></td>
<td>$10/acre</td>
<td>$10/acre</td>
<td>$10/acre</td>
<td>$10/acre</td>
<td>$10/acre</td>
</tr>
<tr>
<td>Farm located in targeted watershed, <strong>add:</strong></td>
<td>$10/acre</td>
<td>$10/acre</td>
<td>$10/acre</td>
<td>$10/acre</td>
<td>$10/acre</td>
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<tr>
<td>Maximum Payment Amount:</td>
<td>$100/acre</td>
<td>$90/acre</td>
<td>$90/acre</td>
<td>$85/acre</td>
<td>$80/acre</td>
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</tbody>
</table>

**HARVESTED COVER CROPS**

This program option is available to farmers who want to harvest their cover crops. Farmers should provide their best estimate of acres they plan to harvest on their applications.

- **Payment:** $25/acre ($10/acre bonus if rye is planted exclusively as the cover crop)
- **Acreage Cap:** None
- **Fertilizer Application:** After March 1, 2015. Early fertilization at green up is prohibited.
- **Certification with SCD:** Within one week of planting and no later than November 12, 2014.
Targeted watershed map
Cover Crop Anthem

Questions?

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Caroline Co. office
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A Farmer’s Perspective

AARON COOPER
CUTFRESH ORGANICS
EDEN, MD
WWW.CUTFRESHORGANICS.COM

AG TECH SUPERVISOR
SMALL GRAINS PROGRAM
UMD, LOWER EASTERN SHORE REC
Operated by Aaron and Betsey Cooper

165 acres
- 2/3 certified
- 1/3 transitional

Vegetables and grain

Machine harvest
7 or more crops
- Round green beans, corn, soybeans, cowpeas, wheat, barley, grain sorghum

Custom feed mixing/grinding

Work w/ portable soybean roaster

Wholesale only
Fa: Fallingston sandy loam
Wd: Woodstown sandy loam
Hb: Hambrook sandy loam
Rs: Runclint sand
Ru: Runclint loamy sand
Cover Crops

- Usually don’t qualify for MD incentive payments
- Cocktails
  - Rye, Austrian pea, tillage radish
CC kill/Weed Management

- Rolling basket or borrowed roller (from Univ. of MD Eastern Shore)
  - Good for broadleaf, bad for grass
- Disking
  - Pearl millet not killed
Field 8

- Orchard grass/clover
- 3 year organic transition
- Plowed down
Field 8

- Planted in soybeans
  - Conventional tillage
- Cover crop planted after harvest
  - Rye/Austrian pea
- Some strips rolled
- Some strips tilled (disked twice)
Field 8

- Corn planted in May
Southern corn rootworm?
Soil texture?
Soil fertility?
Soil temperature?
Rye allelopathy?
Timing?
Wildlife damage?
CC management objectives

- Increase organic matter
  - E.g. Field 8
    - 2010: 1.9-2.7%
    - 2012: 1.6%
    - 2013: 1.5-1.6%

- Improve soil health

- Break up plow pan at 6” depth
Questions?

Aaron cooper
Cutfresh organics
Eden, MD
www.cutfreshorganics.com

Ag Tech Supervisor
Small Grains Program
UMD, Lower Eastern Shore REC