Granting Agency:
USDA Natural Resources Conservation Service (NRCS), Virginia

Project Title:
Innovative Cropping Systems using Diverse Cover Crops & Manure Injection, Part I: Alternative Winter Cover Crop On-Farm Strip Trials

Grant Recipient:
Virginia No-Till Alliance (VANTAGE)

Other Key Project Partners:
- Virginia Cooperative Extension (VCE)
- Shenandoah Valley & Headwaters Soil & Water Conservation Districts

Project Timeline:
September 2012 to February 2017

Project Funding (for all parts):

NRCS Contribution:	$39,515
Recipient & Partner Match:	$41,850
Total:	$81,365

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Virginia Conservation Innovation Grant (CIG) Fact Sheet

VANTAGE Project Part I: Alternative Winter Cover Crops

Summary/Abstract: The overall purpose of this project was to demonstrate and promote innovative cover crops, dairy manure injection, and crop rotation for improved soil health in the Shenandoah Valley. Part I of the project, summarized below, involved growing alternative winter cover crops and mixes in on-farm strip trials. Matt Yancey, former Rockingham County Agent with VA Cooperative Extension (VCE) , oversaw all aspects of Part I of the project.

Figure 1: Alternative cover mix with vetch, clover

A total of 11 cover crop strip trials were planted by nine cooperating farmers. Most trials compared alternative cover crops with traditional small grain covers. The plots illustrated many of the advantages of alternative covers and mixes, including new opportunities for fall grazing, greater forage yield and quality, increased nitrogen (N) fixation, and better performance of subsequent cash crops. The demonstrations also showed that alternative cover crops are not a "free lunch" and involve more cost, more management, and an earlier and/or longer growing season compared to small grains.

This project gave a group of diverse Valley farmers first-hand experience with new cover crops and set the stage for increased farmer-to-farmer promotion of cover cropping. In addition, approximately 450 farmers and their advisors received face-to-face outreach education about alternative covers at six formal events. This project was likely a factor contributing to increased use of alternative cover crops across the Valley since 2012.

"Matt Yancey and this project helped push me further and faster down the path of soil improvement I was already on. I've now changed my crop rotation to return more residue to the land and we keep experimenting to see what works. For example, this year I planted corn into a living cover crop for the first time. It is amazing how I can see my soils changing."
— Wilson Burkholder, Farmer, Rockingham County

Project Objectives

- Investigate and demonstrate the pros and cons of replacing small grain cover crops in the Shenandoah Valley with alternative species and diverse mixes.
- Focus on farmer-planted strip trials in order to allow Valley growers to gain direct experience with alternative cover crops and to promote farmer-to-farmer information sharing.

Background / Justification

- Winter annual cover crops are common in the Valley, but are generally limited to monoculture small grains (barley, wheat, rye).
- Many Valley covers are "dual purpose" – depending on the farm or season, they may be harvested as spring forage or killed and left as mulch.
- Diversifying cover crops with alternative species and mixes has the potential to boost benefits to the soil and subsequent crops in multiple ways.

About the Grant Recipient

VANTAGE is a farmer-led non-profit helping western VA growers optimize no-till systems through education and farmer-to-farmer information sharing. VANTAGE has chapters in Harrisonburg and Rocky Mount.
www.VANoTill.com

- Alternative covers include some that are new to Virginia, like forage radish. Other alternatives, like hairy vetch, have been available in Virginia for centuries, but are seldom used today.
- Valley growers and crop advisors need opportunities to try and see these covers on a small scale before integrating them into their production systems.

Table 1. Alternative Cover Crop Species Demonstrated in Strip Trials

Grasses:	***Legumes:***	***Brassicas:***
Triticale	***Crimson clover***	***Forage radish***
Spring oat	***Hairy vetch***	***Forage turnip***
	Austrian winter pea	***Canola / rapeseed***
		Brassica hybrids

Methods / Plan of Action

- Nine cooperating farmers planted a total of 11 fall-seeded cover crop strip trials between 2012 and 2013.
- Most trials compared one or more alternative cover crop species (see Table 1) to one or more standard small grains. Alternative covers were typically grown in mixes of three or more species (see example in Table 2).
- The species grown differed from farm to farm, depending on the cooperator's interests. The number of treatments in each trial at each site ranged from three to 12.
- Emphasis was on demonstration, not data collection. However, representative data on cover crop yield, forage quality, and/or soil nutrient status were collected at some locations.
- At each site, each treatment was planted only once. In some cases, the same treatments were replicated across two or three locations to allow for more meaningful conclusions.
- Seed and VCE technical assistance were provided to farmers free of charge. Farmers contributed significant time and equipment resources to establish and manage the plots.

Cooperator Profiles

- Cooperators represented a wide range of enterprises including dairy, beef, cash grains, and sweet corn.
- Augusta County cooperators were Gerald Garber, Charles & Chuck Horn, Kyle Leonard, and Carroll Swartz. Rockingham County cooperators were Wilson Burkholder, Dennis Koogler, Mike Phillips, Matt Rohrer, and Buff Showalter.
- Cooperators ranged from cover crop novices to experts. Some had never grown any of the alternative species before. In other cases, the project helped farmers "rediscover" crops they (or their fathers or grandfathers) had grown in the past.

Results: Technical Findings

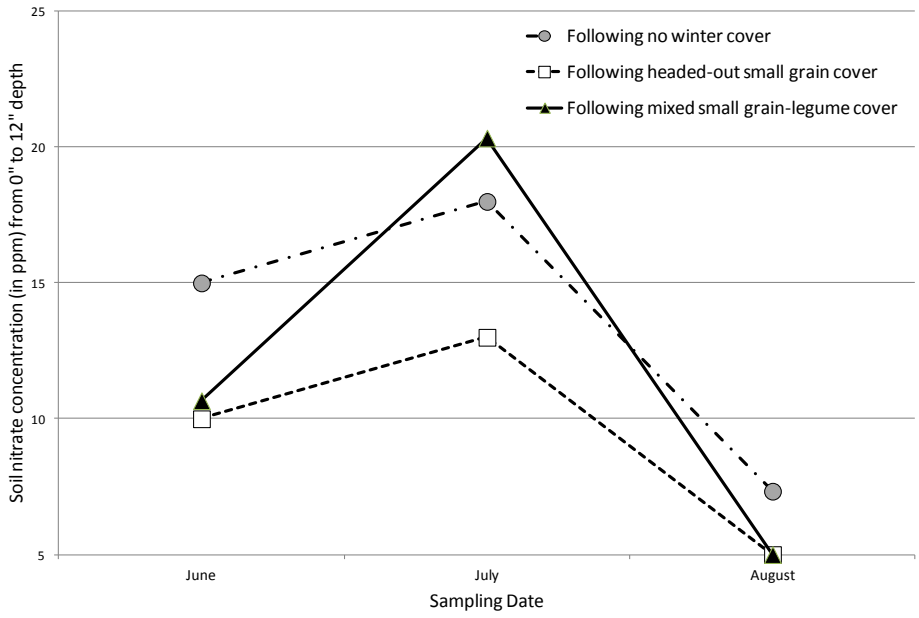
- The number of forage radish brands has increased dramatically, causing farmers to ask if there are differences between varieties. A comparison of radish covers from five different companies was replicated across three farms and showed no notable differences in performance.
- One innovative strategy is to plant a mix including fast-growing species like oats or brassicas in early fall. Under good conditions, a flush of fall growth is ready for grazing (or machine harvest) by early winter. Overwintering species in the mix like small grains and vetch can then provide regrowth and cover crop mulch in the spring. Alternative species in the mix are key to fast fall growth. A strip trial showed that a mix of rye, oats,

Figure 2. Matt Yancey examines a small forage radish in late fall. The root broke off at 29" depth. The full depth of the root was unknown but was likely 36" or deeper. This gives a sense of the subsoiling potential of even modest-sized fall-seeded brassicas.

Table 2. Examples of Treatments from a Cover Crop Strip Trial

Strip	**Species and Seeding Rates** *(numbers are rates in pounds per acre)*
1	*Barley (72)*
2	*Barley (48) + Crimson clover (5) + Hairy vetch (10)*
3	*Triticale (10) + Hairy vetch (15) + Forage radish 6)*
4	*Barley (10) + Spring oat (10) + Triticale (10) + Crimson clover (2) + Hairy vetch (10) + Austrian winter pea (10) + Forage radish (2) + Forage turnip (2) + Rape-turnip forage hybrid (2)*

Figure 3. Soil Nitrate Levels Under Corn After Different Winter Covers
(Average values from three treatments replicated across three sites, summer 2013)



clover, and brassicas produced up to twice the fall biomass of a rye monoculture.

- It is generally recognized that mixing legumes with small grains can increase the protein content of spring-harvested forage with no drop in yield. Spring forage testing on a number of plots in this project was consistent with this trend.
- Killing "high C:N ratio" small grain cover crops and returning those residues to the soil can temporarily tie up or immobilize soil N. Corn planted into those residues is more likely to be N-deficient than corn planted into ground with no cover crop. Adding legumes to the small grain cover crop can eliminate this N immobilization. This was demonstrated in a strip trial replicated across three farms. Soil nitrate levels were measured in July ahead of peak corn N need. Soil nitrate levels were higher following mixed cover crops or no cover crop, and lower following small grain cover (see Figures 3 and 4). These results were obvious to farmers visiting the plots who saw yellower corn following small grain and greener corn following mixes.

Figure 5. Typical cover crop strip trial from this project. Photo taken in spring. Three strips from left to right show brassica mix (yellow flowers), small grain monoculture, legume mix.

Figure 4. Mulching down high C:N ratio cover crops like this headed-out small grain can lead to immobilization of soil N. Adding legumes to the mix can eliminate this effect.

Results: Outreach Activities

- Farmer interest in new covers and mixes has increased in the Valley since 2012. This project is likely one of the factors responsible for this trend.
- Most farmer collaborators were highly engaged in the project. Multiple participants have continued to grow alternative species as a direct result.
- VANTAGE and VCE personnel explained the project and promoted alternative cover crops at six formal events attended by a total of approximately 450 farmers and crop advisors. These events included:
  a. Four field tours at collaborating farms between 2012 and 2013;
  b. 2013 Meeting of VA Chapter of Soil & Water Conservation Society;
  c. 2014 VANTAGE Winter Conference in Harrisonburg.
- VANTAGE brought cover crop experts David Brandt of Ohio and Charlie White of Penn State to three of the above events to promote covers and mixes.
- VCE educational documents produced to date include a factsheet summarizing the forage radish variety com-

Figure 6. Farmers gather at Matt Rohrer's Rockingham County farm in late fall of 2013 to look at cover crop plots and hear from Charlie White of Penn State.

This project is part of an NRCS initiative to promote greater implementation across Virginia of the "ring" of soil health management principles shown the diagram above.

"Since the project ended, I've continued to grow a diverse legume cover crop to mulch down ahead of corn. It saves me money on corn inputs, but I've also learned the cover isn't magic and doesn't always feed 100% of the next crop's needs. It's just another part of my no-till system."

— Matt Rohrer, Farmer, Rockingham County

parison and a brief guide to alternative cover crop species for the Valley (see references).

Conclusions for Farmers

- Fall-seeded mixes including legumes and brassicas can produce more forage, more cover, and more benefits compared to small grains alone.
- Legumes in particular show great promise for increasing forage quality and quantity while capturing atmospheric N to benefit future crops.
- When planting corn into heavy cover crop residue, it is crucial to understand how the quality of the residue (the "C:N ratio") impacts N nutrition of the corn and plan accordingly.
- Winter legumes and brassicas are not a "free lunch" – they cost more, demand more management, and require an earlier and/or longer growing season than small grain cover crops.
- Brassicas like forage radish need to be planted early in the fall (August or early September). Some legumes like hairy vetch can be planted later, but in order to achieve their full beneficial effect must be allowed to grow longer in the spring (i.e., until early May).
- Fall-planted mixes with a range of seed sizes can be "pre-mixed" and run together through the large seed box of a grain drill. Calibrate the drill to determine the right setting to deliver the desired rate of mixed seed.
- Alternative cover crops may require changes to herbicide programs and other adjustments to your cropping system. Talk to your advisors, conduct your own trials, and educate yourself before jumping in on a large scale.

Conclusions for Policymakers

- Alternative cover crops and mixes fit well on farms with appropriate openings in existing rotations. This includes farms where summer crops are out of the field by early September. Simple demonstrations such as those conducted here will likely continue to build interest on these operations.
- For other Valley growers, adopting alternative cover crops may require rethinking rotations in order to open the early fall and late spring "growing windows" which these covers require. More complex demonstrations evaluating modified rotations will be needed to gain the interest of these farmers.
- The option to harvest, and especially to graze, alternative cover crops and mixes is part of their appeal and great potential. Promoting more integrated crop-livestock systems could vastly increase adoption of alternative cover crops in Virginia.

References / For More Info

1. VANTAGE website: www.VANoTill.com
2. Summary of Forage Radish Variety Comparison: http://offices.ext.vt.edu/rockingham/programs/anr/Crops/daikon-radishes.pdf
3. Brief Guide to Alternative Cover Crop Species for Shenandoah Valley: http://offices.ext.vt.edu/rockingham/programs/