Virginia No-Till Alliance

VANTAGE

16th Annual Conference

2025 Winter Conference

February 5, 2025

Agriteer

Rockingham, Virginia

2025 Table of contents

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Agenda

February 5, 2025

16th Anniversary

"The Power of Profitable Soil Health"

8:00 a.m. Registration and Trade Show

9:00 a.m. *Managing Soil Compaction in No-till Systems*

- *Dr. Sjoerd W. Duiker*

10:00 a.m. Trade Show Break

10:30 a.m. *Profitable Soil Health in an Ever-Changing Climate*

- *Robert Waring*

11:30 a.m. *No-Till Champion Recognition*

Noon Lunch and Trade Show Break

1:15 p.m. *2024 Mid Atlantic "Plant Green" Corn Yield Contest Winner*

1:30 p.m. *25 Years of Systems Research: Key Lessons Learned from Pennsylvania Cropping Systems*

- *Dr. Sjoerd W. Duiker*

2:30 p.m. *Champions of the Field: Insights from Virginia No-Till Farmers Producer Panel Featuring Award Winning VA Farmers*

3:30 p.m. Conference Adjourns

2025 Speakers

Dr. Sjoerd W. Duiker
Professor of Soil Management and Applied Soil Physics

Dr Sjoerd Willem Duiker is a Professor of Soil Management and Applied Soil Physics at Penn State University, USA. He has helped to develop Conservation Agriculture systems in the United States and has made significant contributions to research in such areas as soil compaction, no-till systems, the use of cover crops and mulches.

I am Soil Management Specialist at Penn State University. My work has centered on no-till systems, including diverse crop rotations and cover crops to improve soil health and crop productivity. I work with Pennsylvania farmers and significant others. My passion for poverty alleviation and agriculture has led me to be involved with youth development through agriculture in Africa. I am currently working with former street youth in East Africa to coach them in haymaking as a custom business.

My specialization focuses on the effects of soil management practices on soil physical properties and processes. This includes the effect of no-tillage and tillage on soil physical properties, how soil compaction affects soil and crops, what effect crop rotation plays in maintaining soil quality, and the benefits and challenges of cover crops. The use of a systems approach to no-tillage, soil compaction and crop rotations is a crucial element in all my work. Research takes place on Penn State's research farms as well as in collaboration with farmers and field agronomists in Pennsylvania.

Robert Waring
Senior Agricultural Conservation Specialist, Colonial SWCD and Farmer at Brandon Farms

I was born and raised in Essex County, Virginia and graduated from Randolph-Macon College in 1992. Presently I am an elected member of the executive board for the Southern Cover Crops Council, member of the Ag and Forestry Advisory Board appointed by the Essex County Board of Supervisors, as well as past Chair of Virginia's Cover Crop and Nutrient Management Technical Advisory Subcommittee. In addition to working for CSWCD, I work for Brandon Farms, a third generation family farm, where we integrate cover cropping systems as a means of increasing soil health. Brandon Farms was selected as a case study with the American Farmland Trust, a national organization that highlights farms across the US that practice the highest levels of conservation and sustainability.

Robert Waring is a Senior Agricultural Conservation Specialist at Colonial SWCD and farmer at Brandon Farms. He works to integrate cover cropping systems as a means of increasing soil health. Presently he is an elected member of the executive board for the Southern Cover Crops Council and past Chair of Virginia's Cover Crop and Nutrient Management Technical Advisory Subcommittee.

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The **Virginia No Till Alliance** exists to maximize farm productivity and profitability by promoting successful implementation of continuous no-till systems through shared ideas, technology, conservation and education.

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Funding for today's speakers and the Farmer to Farmer Mentoring program was made possible by a grant from the National Fish and Wildlife Foundation

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Avoiding Soil Compaction

PENNSTATE

College of Agricultural Sciences
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Avoiding Soil Compaction

INTRODUCTION

Twenty-first-century farm economics stimulate farmers to increase the size of their operations. To improve labor efficiency, farm equipment usually increases in size. Tractors, combines, forage harvesters, grain and forage wagons, manure spreaders, and lime trucks are all bigger than they used to be. Twenty years ago, for example, 2.5-ton box-type manure spreaders were common in Pennsylvania, whereas today liquid manure spreaders may weigh 20 or 30 tons. The increasing size of farm equipment may cause significant soil compaction that can negatively affect soil productivity as well as environmental quality. This fact sheet focuses on ways to avoid soil compaction.

AIM OF SOIL COMPACTION MANAGEMENT

Our knowledge of soil compaction has increased substantially in the past two decades, especially after results of an international project of more than 20 soil compaction experiments in North America and Europe were published. Based on this work researchers have discovered that: (1) compaction in the topsoil is related to ground contact pressure only, (2) compaction in the upper part of the subsoil is related to both ground contact pressure *and* axle load, and (3) compaction in the lower subsoil is related to axle load only (Figure 1).

In a summary of the international soil compaction project, compaction due to axle loads of 10–12 tons reduced yields approximately 15 percent in the first year, decreasing to 3–5 percent 10 years after compaction. The lead researchers suggested that 10 percent of the yield loss in the first year was due to compaction in the topsoil and upper part of the subsoil. The effects of topsoil and upper subsoil compaction disappeared in approximately 5 and 10 years, respectively (Figure 2). Three to five percent yield loss was apparently due to deep subsoil compaction, which did not disappear during the period in which measurements were taken (12 years for the

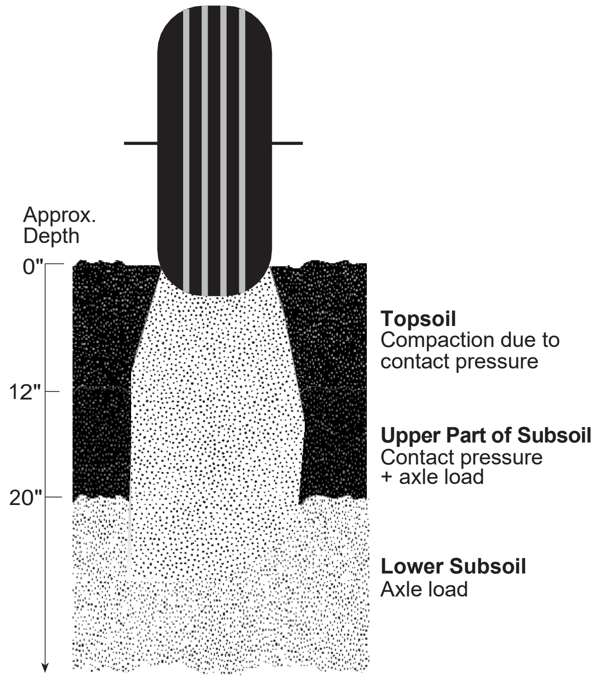

Figure 1.Topsoil compaction is caused by contact pressure, whereas lower subsoil compaction is caused by axle load.

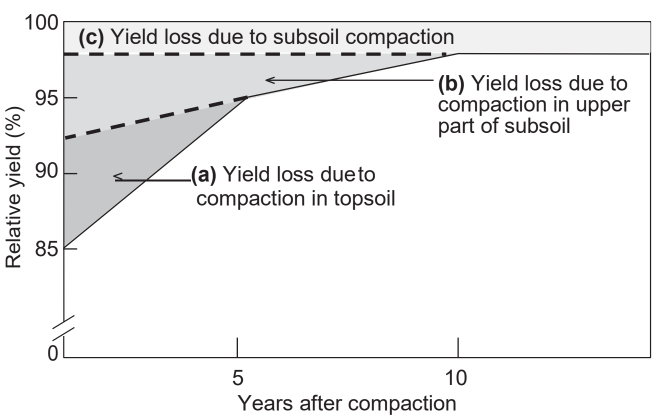

Figure 2. Effects of compaction in the topsoil (a) and upper part of the subsoil (b) are temporary, whereas deep subsoil compaction (c) is virtually permanent.

longest experiments). The conclusion is that lower subsoil compaction is, practically speaking, permanent and should therefore be avoided by all means, whereas topsoil compaction and upper subsoil compaction are temporary and should be limited as much as possible. Two other important observations from these studies are: (1) surface tillage (moldboard plowing in most experiments) did not completely alleviate surface compaction and (2) deep penetration of frost did not alleviate lower subsoil compaction (most experiments were located in northern latitudes where soil is commonly frozen to 40–50 inches in winter).

KEYS TO SOIL COMPACTION AVOIDANCE

Axle Load

Axle load is the first factor that has to be considered in soil compaction. Axle load is the total load supported by one axle, usually expressed in tons or pounds. Farm equipment with high axle loads will cause compaction in the topsoil and subsoil, whereas low axle loads will cause compaction in the topsoil and the upper part of the subsoil only (Figure 3). Deep subsoil compaction can only partially be alleviated with subsoilers, and at considerable cost. Freezing/thawing and drying/wetting cycles have been shown not to remediate soil compaction at this depth. Finally, biological activity is concentrated in the topsoil and therefore also contributes little to alleviation of deep subsoil compaction. Therefore, avoiding deep subsoil compaction is critical. The key to

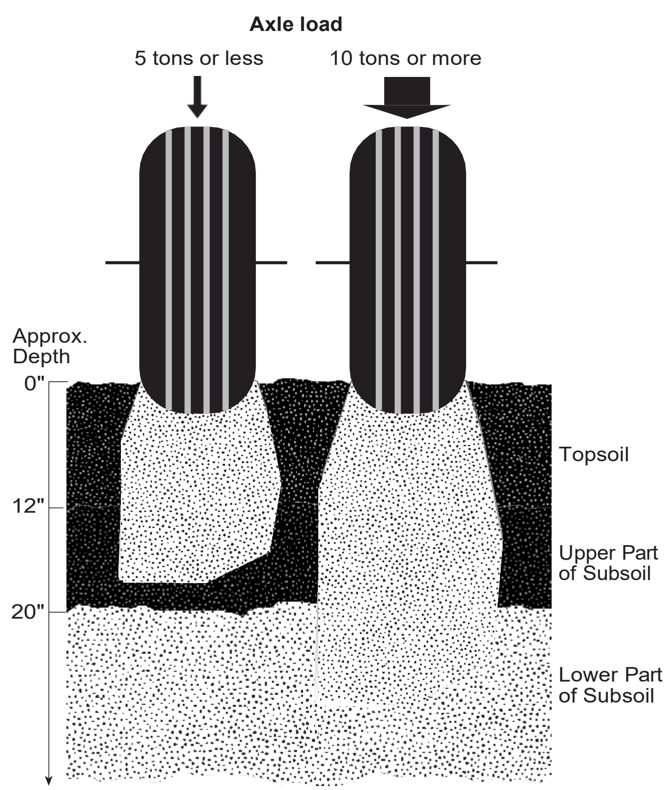

Figure 3. Low axle load causes compaction in the topsoil and upper part of subsoil only, whereas high axle load causes compaction in the lower subsoil as well.

> **Aims of Soil Compaction Management**
>
> 1. Avoid compaction in the subsoil altogether.
> 2. Limit compaction in the topsoil as much as possible.

eliminating deep subsoil compaction is to keep axle load low.

The amount of top- and subsoil compaction caused also depends on the presence of a natural or traffic-induced pan close to the surface (Figure 4). In a uniform soil, stress will be transmitted from the surface deep down into the soil profile. In a soil with a pan or dense subsoil, soil stress tends to concentrate near the surface.

What is the critical axle load that is likely to cause subsoil compaction? Research has shown that a 10-ton axle load almost always causes deep subsoil compaction (more than 20 inches deep) under wet to moist field conditions. If the soil is dry, deep subsoil compaction is less likely, even with high axle loads. The 10-ton axle load is only a rough cutoff point, but limiting axle loads to 10 tons at the very most is advisable. Swedish researchers stated some years ago that 6-ton axle loads contribute to subsoil compaction. Axle loads less than 5 tons are not likely to cause subsoil compaction, although they may create significant surface compaction.

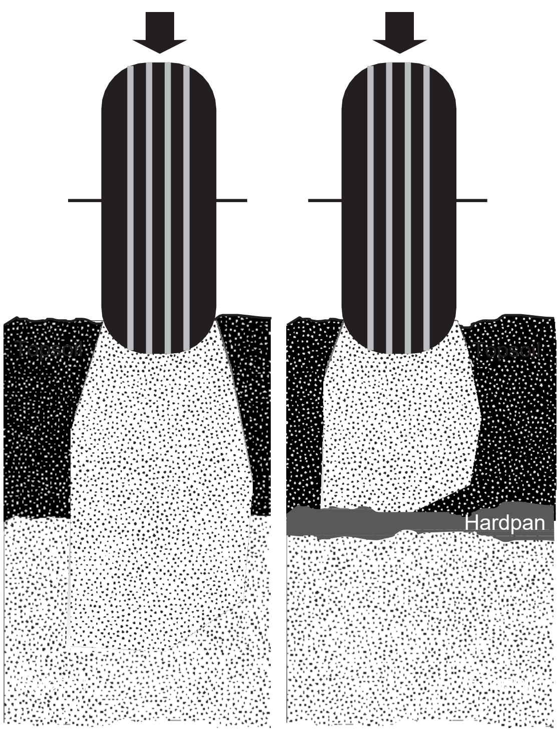

Figure 4. In a uniform soil, compaction is transmitted deep, whereas in a soil with a hardpan, compaction is concentrated above the hardpan.

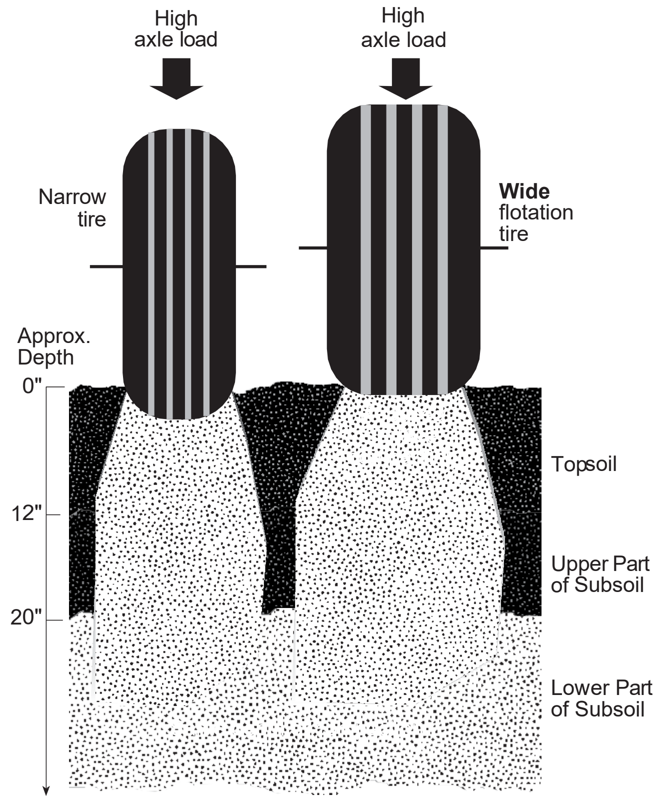

Figure 5. Increasing footprint reduces surface compaction but can still cause deep subsoil compaction if axle loads are high.

To assess the danger of subsoil compaction, start thinking about the heaviest pieces of equipment on the farm. Typical candidates are the manure spreader, combine, and grain carts. The average axle load can be calculated by dividing the total weight of the loaded vehicle (for example, 16 tons) by the number of axles (for example, 2 axles), giving an average axle load of 8 tons. In general, however, the load is not uniformly distributed across all axles. In such a case the heaviest axle will determine if subsoil compaction occurs. Therefore, the best approach is to weigh each axle on portable or farm scales. The axle load can be decreased by lowering the load or by increasing the number of axles.

> **Strategies to Reduce Subsoil Compaction**
>
> - Reduce load
> - Increase number of axles

Contact Pressure

Contact pressure is the pressure that is exerted by a tire or track on the soil surface, expressed in pounds per square inch (psi). Reducing contact pressures will cause less topsoil compaction (Figure 5). In completely flexible tires, surface contact pressure is similar to tire pressure. With most farm tires, surface contact pressure is about 1 to 2 psi higher than tire pressure due to stiffness in the tire. The best way to determine contact pressure is to calculate the load in pounds per wheel and divide it by the area of the tire that touches the soil (in square inches). This will give you the average contact pressure under that tire in psi. Lowering contact pressure will affect topsoil compaction but not subsoil compaction (Table 1). Table 1 clearly shows that tires run at 35 psi caused higher stresses at 14 inches depth and created ruts that were more than twice as deep as tires run at 12 psi tire pressure. However, at 22 inches, no difference was noted in measured stress between both tires because the tire load was the same.

Table 1. Experimental results of stress under tires (SR 20.0/70-20) inflated to different pressures (tire load was 3.6 tons).

Inflation pressure (psi)	Peak stress @ 14-inch depth (psi)	Peak stress @ 22-inch depth (psi)	Rut depth (in)
35	28	11	2.01
12	18	11	1.14

Adapted from J. J. H. van den Akker, W. B. M. Arts, A. J. Koolen, and H. J. Stuiver. "Comparison of stresses, compactions, and increase of penetration resistances caused by a low ground pressure tyre and a normal tyre." *Soil & Tillage Research* 29 (1994): 125–134.

Strategies to Reduce Topsoil Compaction

1. Reduce tire pressure to minimal allowable pressures
2. Use flotation tires
3. Use tracks or duals to replace singles
4. Adopt radial-ply tires instead of bias-ply tires
5. Install larger diameter tires to increase length of footprint
6. Use tractors with four-wheel or front-wheel assist or tracks to spread the load over larger footprint area
7. Properly ballast tractor for each field operation

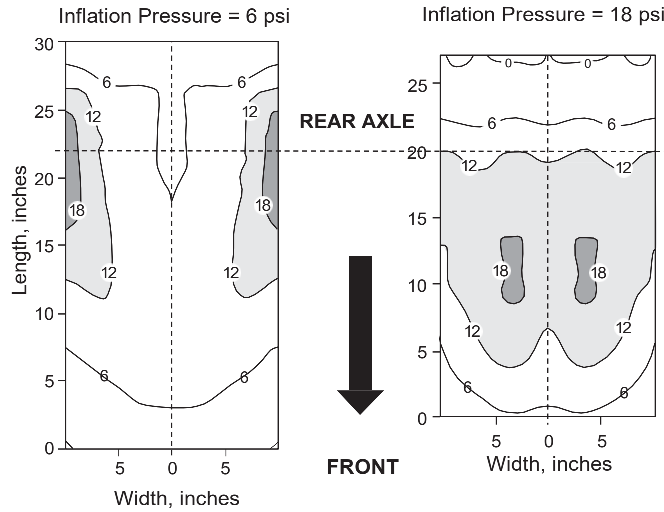

Figure 6. The same tire inflated to low and high pressures. At low tire pressure, highest stresses concentrate near the edge of the tire and represent a smaller area, whereas at higher inflation pressures, higher stresses concentrate below the center of the tire and occupy a larger area. From chapter 10: "Soil Compaction" by R. T. Schuler, W. W. Casady, and R. L. Raper, 2000, in *Conservation Tillage Systems and Management*, MWPS-45, 2nd ed., p. 74.

Contact pressure is not uniform under a tire due to sidewall stiffness (Figure 6). The area of high stress is greater when a tire is inflated to high inflation pressures and is concentrated under the center of the tire. In a properly inflated tire, the area of high stress is smaller, whereas the highest stresses are concentrated near the edge of the tire.

A common question is whether tracks are better than duals. The answer is that it depends on the tire inflation pressure in the duals. In an Ohio State study, a 310 HP tracked tractor was compared with a 350 HP tractor with duals. The duals were inflated to 24 and 6 psi, respectively. Total porosity was used as a measure of compaction. The tractor with overinflated duals caused most compaction, and least if used at proper inflation pressure (Figure 7). This shows that duals can do as good a job in avoiding topsoil compaction as tracks, provided the tire pressure is kept low.

Tracks offer some advantages such as a long but narrow contact area. The proportion of the field trafficked is therefore smaller than if using duals. Tracks are also known to provide better traction than tires. Very low average contact pressures under a track do not tell the whole story, however. The belt is flexible and there are pockets of high pressure under the axles of the belt that can be as high as those under a tire-mounted tractor (Figure 8). Each axle in a track represents a pass over the soil that causes a little more compression. Finally, tracks tend to increase the dwelling time of the load on the soil, which increases compaction. In conclusion, tracked

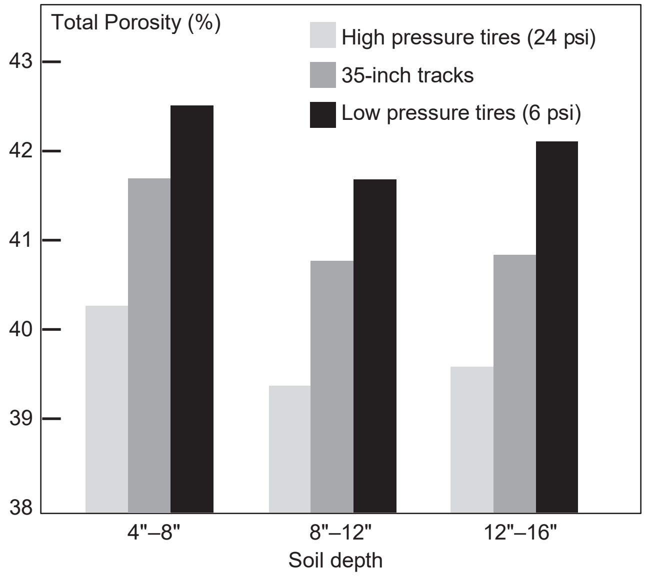

Figure 7. Duals inflated at high pressure caused more compaction than tracks, whereas the same duals caused less compaction if inflated at low pressure. From R. G. Hoeft, E. D. Nafziger, R. R. Johnson, and S. R. Aldrich. 2000. *Modern Corn and Soybean Production*. Champaign, IL: MCSP Publications.

tractors can cause the same compaction at the same total vehicle load as tire-mounted tractors.

Using larger diameter tires increases the length of the footprint and, therefore, decreases contact pressure without increasing the proportion of the field trafficked. Finally, front-wheel-assisted and four-wheel-drive tractors reduce topsoil compaction because the weight is more equally distributed (Figure 9). Remember, however, that the four-wheel-drive tractor might have higher axle loads than the two-wheel-drive tractor because of larger total vehicle weight, thus increasing the chance of subsoil compaction. Ballasting the tractor properly is a simple task that can dramatically reduce axle load as well as improve tractor efficiency.

Number of Passes and Travel Speed

Research in tilled soils has shown that approximately 75 percent of the increase in soil density and 90 percent of wheel sinkage is caused during the first pass. However, the compaction caused by subsequent passes may cause as much damage to a crop because the small changes to soil density are now in the high range, which is more likely to be detrimental to root growth. It has also been shown that the longer the dwelling time of a load on soil, the greater the increase in density. Therefore, (1) limit the percentage of the field trafficked, (2) concentrate repeated traffic in travel lanes so remedial action can be taken there, and (3) drive faster to shorten the load dwelling time.

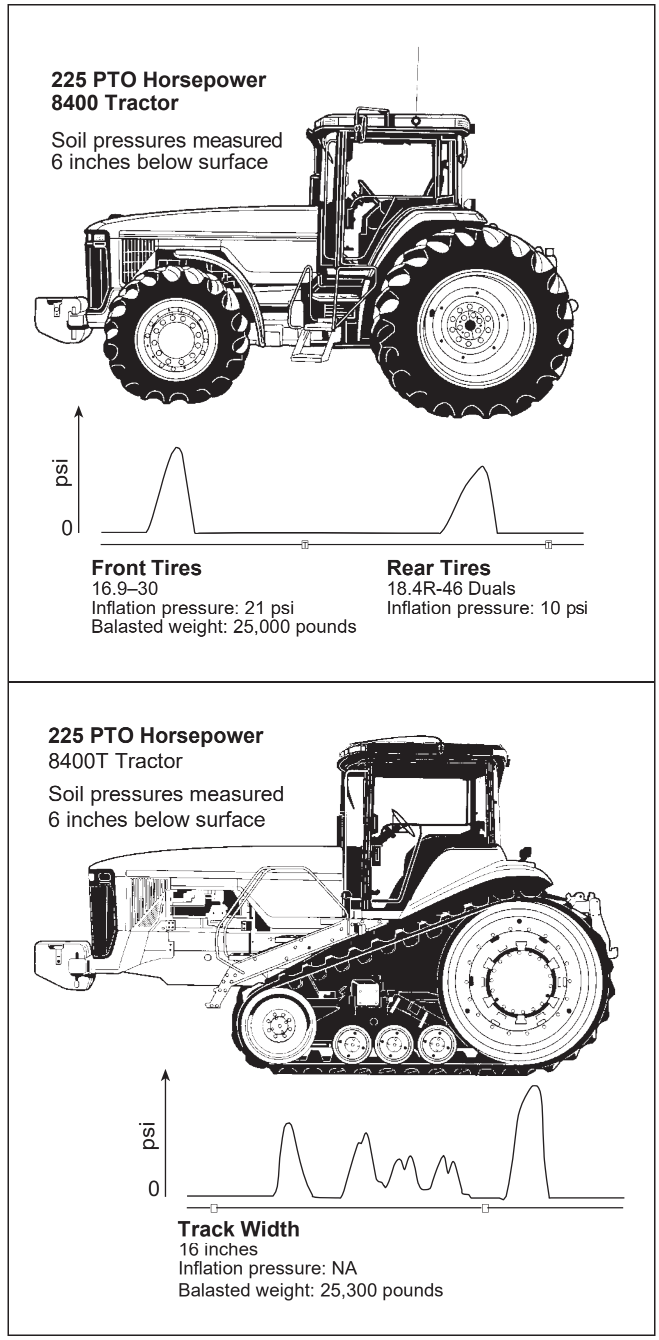

Figure 8. Although, on average, contact pressure is low under rubber tracks, there are pockets of high stress that can equal or exceed those under radial tires that are inflated to low pressures. From R. G. Hoeft, E. D. Nafziger, R. R. Johnson, and S. R. Aldrich. 2000. *Modern Corn and Soybean Production*. Champaign, IL: MCSP Publications.

Soil Moisture Contents

Monitoring soil moisture content is extremely critical to avoid soil compaction. Most compaction studies are performed at moisture contents near field capacity (approximately 24 hours after soaking rain) to simulate worst-case scenarios. If farmers can stay off their fields

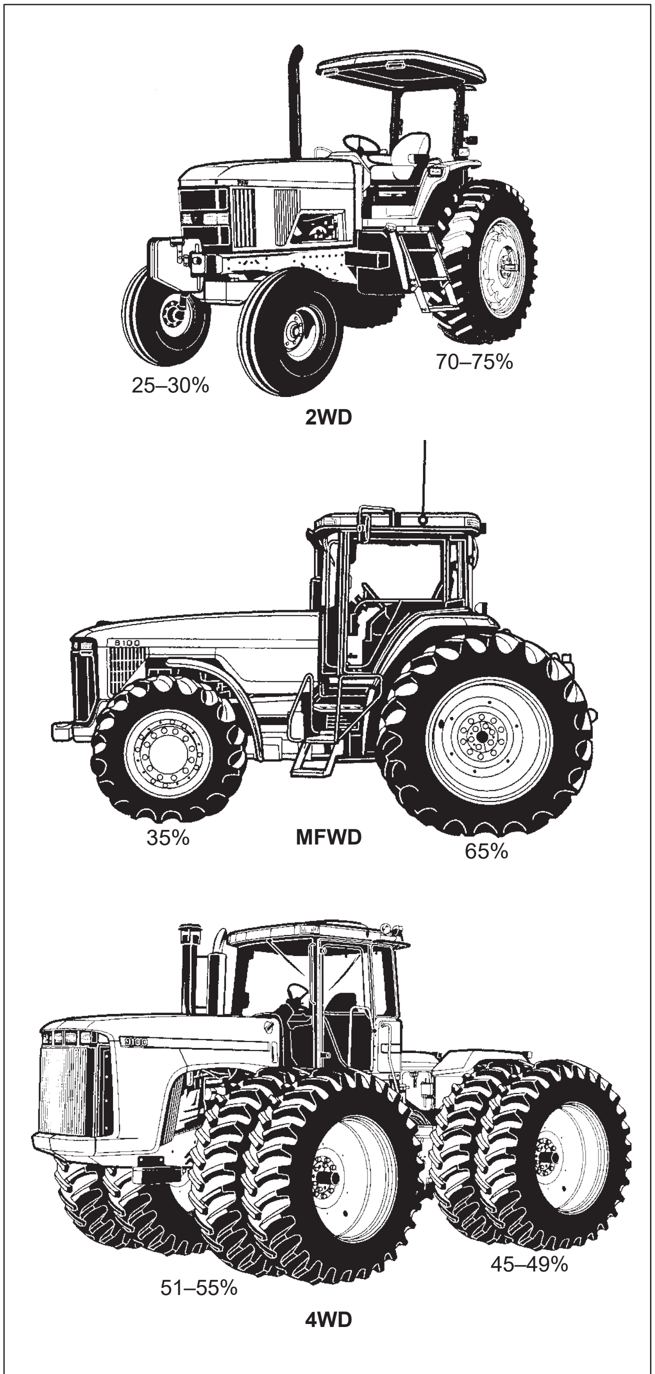

Figure 9. One advantage of four-wheel-drive or front-wheel-assisted tractors is that weight is more equally distributed. From R. G. Hoeft, E. D. Nafziger, R. R. Johnson, and S. R. Aldrich. 2000. *Modern Corn and Soybean Production.* Champaign, IL: MCSP Publications.

when soils are too wet, soil compaction is not likely to become a problem. Dry soil can sustain high axle loads and high contact pressures without adverse effects. The problem is, however, that factors such as optimum planting or harvest time often dictate that a farmer will be in the field at suboptimum soil moisture conditions for traffic.

Driving on wet soil causes rutting, slipping, and increased deep soil compaction. Dry soil cannot be compressed to as great a density as moist soil. However, at moisture contents above the "plastic limit" soil compaction decreases because all pores are filled with water that cannot be compressed. The Proctor density test is used to determine the plastic limit, or the optimum water content for compaction (Figure 10). Although this is a valuable test for road engineers, driving on agricultural soil that is wetter than the plastic limit has many problems. Rutting and slipping have devastating effects on soil structure that will be difficult to remedy.

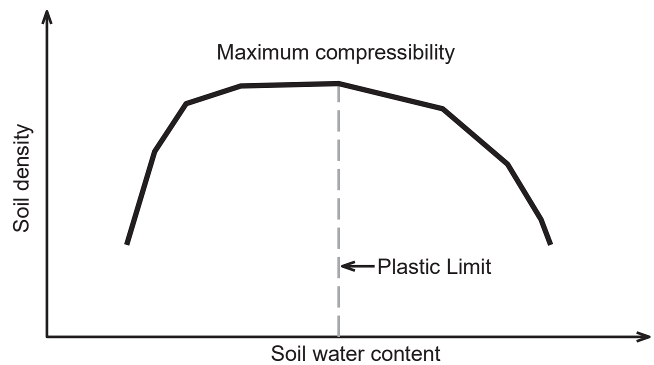

Figure 10. Engineers use the Proctor density test to determine the "optimum water content for compaction." The Proctor curve shows that soil near saturation cannot be compressed as much as at plastic limit water content.

Trafficking very wet soil (especially with high loads and tire pressures) causes a "hydraulic ram" effect. The topsoil is compressed very quickly to saturation. Because water cannot be compressed, surface stresses are now directly transferred to the subsoil. Therefore, driving on very wet soil is very likely to cause subsoil compaction. Plowing with one wheel in the furrow also directly compacts subsoil.

CONCLUSIONS

Deep subsoil compaction is permanent and should be avoided at all costs. This can be done by keeping axle loads below 10 tons, and preferably below 6 tons. Compaction in the topsoil can be avoided by reducing tire pressure, using flotation tires, doubles, radial tires, or tracks, and by employing large-diameter tires. Reducing the number of trips over the field and reducing the total area per acre actually traveled are recommended. Driving on soil that is wetter than the plastic limit should be avoided at all times.

Prepared by Sjoerd Duiker, assistant professor of soil management

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Cover Crops

Nutrient Management

Brandon Farms, VA

SOIL HEALTH CASE STUDY

JANUARY 2024

Corn after cover crops on the left = resilient!
No cover crops on the right = stressed!

Brandon Farms is a third-generation row crop farm located in Essex County, Virginia, along the Rappahannock River, a tributary to the Chesapeake Bay. Bob Waring Jr. manages the farm with his father, Rob, growing 1 year of corn grain and 2 years of soybeans across 450 acres, 100 of which they own. They have implemented no-till since the 1990s. For this study, we analyze their more recent adoption of cover crops and nutrient management on 300 acres, as the other 150 acres are managed using different practices.

Bob works as a nutrient management specialist for the Virginia Department of Conservation and Recreation. “Conservation is part of my job, but it’s also part of my life,” he says. After a back injury from an 11-foot fall in 2013, Bob recognized that by eating correctly, his body was able to withstand that stress and heal. He began applying that philosophy to his farm, believing that “plants are better able to withstand drought, insect pressure, and disease if they get nutrition through natural sources like cover crops.”

Bob and Rob began experimenting with cover crops as early as 2010, with help from state and federal cover crop cost-share programs.[1] In 2016, Bob partnered with Virginia Tech and Precision Sustainable Agriculture to implement a long-term field trial, with a side-by-side comparison of cover crops and no cover crops. They are comparing different nitrogen amounts and discovering application timing through extensive soil sampling, discovering that with cover crops, they can reduce synthetic nutrients applied. “Nutrients are staying in the soil that would have been lost to leaching,” says Bob. “Cover crops are harvesting potash, nitrogen, and sulfur for release to the next crop.”

Based on learnings from this trial, Bob has expanded his nutrient management practices. Bob now completes a Soil Test for Biological Activity (STBA) to determine nitrogen levels in the soil. He also tests soil for pH, nutrients, and organic matter and measures cover crop biomass and leaf tissue nutrients every year on every field. Previously, he used just one representative standard soil test per crop.

Bob and Rob are constantly fine-tuning how best to offset fertilizer costs in crop production with cover crops. They currently use high biomass, single-species cover crops—planting vetch before corn and black oats before soybeans—but are experimenting with cover crop mixes. Bob plants corn and soybeans into green cover, rolling vetch but not oats, as the soybeans didn’t mind either way.

Soil Health, Economic, Water Quality, and Climate Benefits

Partial budgeting analysis was used to estimate the marginal benefits and costs of cover crops and nutrient management on Brandon Farms. The study was limited to only those income and cost variables affected by the adoption of these soil health practices. The table on page 2 presents a summary of these economic effects, revealing that, due to the two soil health practices, Brandon Farms’ net income increased by $55/ac/yr, or by $16,439/yr, on the 300-acre study area, achieving a 70% return on investment.

The largest increase in net income was due to yield increases from the adoption of cover crops and nutrient management. Using Bob’s yield monitor and crop insurance records, we attribute 50% of his corn and soybean yield increases to the adoption of cover crops and change in nutrient management. We calculated a 43 bu/ac of corn and 9 bu/ac of soybean increase in yield when comparing average yield before and after adoption of cover crop and nutrient management. Bob adds, “I think we are getting a lot more resiliency, which is translating into better and more consistent yields.”

Additional increases in net income are attributed to decreases in cost. With the adoption of cover crops, pesticide application costs have been

DAWN HOWETH

Bob Waring with his family

Farm at a Glance

COUNTY: Essex, VA

WATERSHED: Rappahannock River/ Chesapeake Bay

CROPS: Corn & soybeans

FARM SIZE: 450 acres (300-acre study area)

SOILS: Sandy loam 0–2%

SOIL HEALTH PRACTICES: Cover crops & nutrient management

Joe showing his healthy soil in a rye cover crop shovel sample reduced by $16/ac, as Bob no longer applies an insecticide on soybeans and has reduced his herbicide costs on corn. The largest savings that Brandon Farms attributes to cover crops and nutrient management is a $37/ac reduction in fertilizer applications. On corn, they reduced nitrogen inputs by 85 lbs/ac, reduced phosphorous inputs by 25 lbs/ac, and reduced potassium inputs by 20 lbs/ac. For soybeans, they reduced their phosphorous inputs by 15 lbs/ac and potassium inputs by 5 lbs/ac. Additionally, with the pH buffering effects of the cover crops, they have reduced lime applications to one ton every 6 years, instead of every 3 years, for an annualized savings of $8/ac/yr.

The largest cost incurred by the farm is for cover crops at about $63/ac/yr, or a total of $18,950/yr, including seed, establishment, and management. This cost estimate does not include termination because a pre-plant herbicide spray was already part of the farm's no-till system. The chemical costs for burndown are $13/ac for corn and $7/ac for soybeans. Another cost increase is the additional soil, tissue, and grid sampling costs, which total $7/ac/yr.

Bob is a lifelong learner and estimates he spends 100 hours annually on learning activities related to soil health practices valued at $2,618/yr. This estimate does not include the additional time that Bob spends at work learning about and presenting on nutrient management to help other Virginia farmers.

AFT used USDA's Nutrient Tracking Tool to evaluate Bob's use of nutrient management and cover crop practices on a 77-acre field and found that the practices reduced N, P, and sediment losses by 84%, 76%, and 93%, respectively. The USDA's COMET-Planner Tool estimates that Bob's soil health practices resulted in a reduction of 129 metric tons of CO2-equivalents/yr, corresponding to taking 29 cars off the road for one year.

Closing Thoughts

As a soil health advocate and innovator, Bob is now an executive member of the Southern Cover Crops Council and the Innovation Roundtable, a farmer-led group of soil health leaders. Bob's passion is palpable in his presentations. As he puts it, "I grew up on the river. My heart is in saving the waterways and being a good steward of the land."

Writers: Kent Bohnhoff & Ellen Yeatman

ECONOMIC EFFECTS OF SOIL HEALTH PRACTICES ON BRANDON FARMS (2021 PRICES)[2]

Increases in Net Income			
Increase in Income			
ITEM	**PER ACRE**	**ACRES**	**TOTAL**
Yield increase of 15% for corn and 10% for soybeans	$71	300	$21,289
Total Increased Income			**$21,289**
Decrease in Cost			
ITEM	**PER ACRE**	**ACRES**	**TOTAL**
Reduction in pesticides due to cover crops (reduced weed pressure on corn & stopped insecticides on soybeans)	$16	300	$4,917
Reduction in N, P, & K on corn and P & K on soybeans	$37	300	$11,210
Lime application reduced by 50% due to nutrient management	$8	300	$2,502
Total Decreased Cost			**$18,629**
Annual Total Increased Net Income			**$39,918**
Total Acres in this Study Area			**300**
Annual Per Acre Increased Net Income			**$133**

Decreases in Net Income			
Decrease in Income			
ITEM	**PER ACRE**	**ACRES**	**TOTAL**
None identified			$0
Total Decreased Income			**$0**
Increase in Cost			
ITEM	**PER ACRE**	**ACRES**	**TOTAL**
Cover crop costs for vetch before corn and black oats before soybeans	$63	300	$18,950
Soil Test for Biological Activity (STBA) on every field once a year	$3	300	$801
Increased nutrient testing costs due to soil, tissue, & cover biomass sampling on every field	$2	300	$510
Grid sampling in lime application years and applying lime on grid	$2	300	$600
Learning activities (100 hrs/yr)			$2,618
Total Increased Cost			**$23,479**
Annual Total Decreased Net Income			**$23,479**
Total Acres in this Study Area			**300**
Annual Per Acre Decreased Net Income			**$78**

Annual Change in Total Net Income = $16,439

Annual Change in Net Income Per Acre = $55

Return on Investment = 70%

[1] Bob received $75/ac ($10,157/yr) through the NRCS EQIP program (2014-2016) and $40/ac ($10,000/yr) from the Virginia Department of Agriculture (1999-2023) for cover crops; and $37/ac ($9,323/yr) through EQIP (2014-2016) for nutrient management. This is not included in the analysis because cost-share is temporary and not received by all. [2] This table represents estimated average costs and benefits attributed to adopting cover crops and nutrient management over the 300-acre study area, as reported by Bob Waring. • Rounding of per acre values may result in minor discrepancies in totals. • All values are in 2021 dollars. • 2021 standard prices: Corn Grain $5.45/bu, Soybeans $13/bu (USDA NASS, Crop values: 2021 Summary); Nitrogen: $0.72/lb, Phosphate: $0.62/lb, Potash: $0.56/lb (ISU, 2022, Ag Decision Maker.) • Machinery costs include the cost of custom hire, labor, depreciation, interest, insurance, housing, repairs, and fuel (Univ. of IL at UC, 2021, Farm Business Management Machinery Cost Estimates: Field Operations.) • For information about (1) study methodology, see farmland.org/soilhealthcasestudies; (2) USDA's NTT, see ntt.tiaer.tarleton.edu; and (3) USDA's COMET-Planner Tool, see comet-planner.com.

For more information about this case study, contact:
Amanda Cather, American Farmland Trust, Mid-Atlantic Senior Program Manager, acather@farmland.org
To discuss soil health practices, contact: Dwight Forrester NRCS dwight.forrester@usda.gov USDA NRCS Essex County Office, 772 Richmond Beach Rd, Tappahannock VA, 22560, 804-443-2327
To read more case studies, visit farmland.org/soilhealthcasestudies

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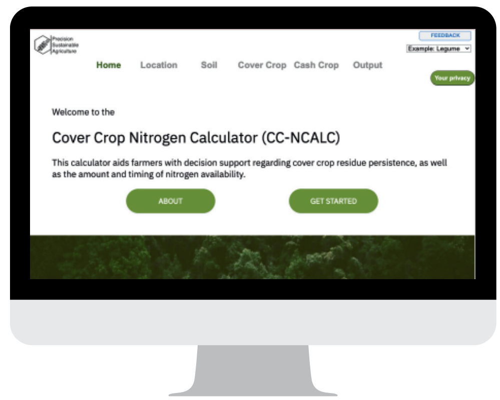
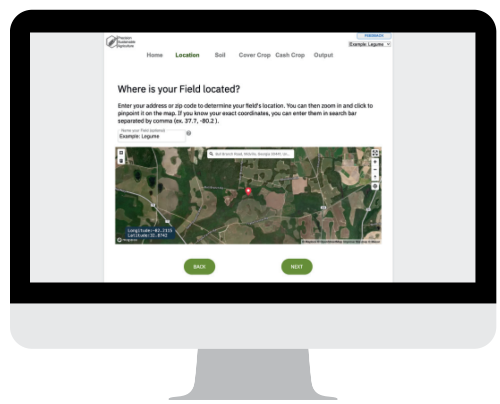
Cover Crop Nitrogen Calculator Decision Support Tool How-To

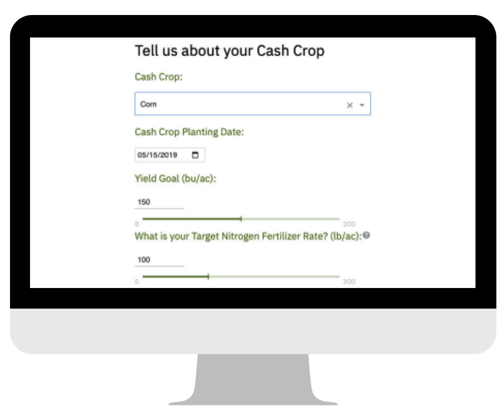
Cover crops influence nitrogen (N) management to subsequent cash crops. Some of the N taken up or fixed by the cover crops becomes available over the cash crop growing season following termination. Estimating the rate of N release is challenging. The Cover Crop N Calculator provides a user-friendly approach to estimate decay of cover crop residues and release of N for offsetting N fertilizer inputs. This tool was developed for farmers and agricultural professionals.

1. Input Your Information

1. Visit covercrop-ncalc.org & Click 'Get Started'
2. Find your field
    a. Search by address using the search bar in the top center of the map tool
    b. Drag the map and use the expand, zoom in, zoom out, or current location tools on the left to find a precise location
    c. Outline your field using the polygon tool on the top left
        i. Double click your last point
3. Tell us about your soil
    a. Adjust metrics in accordance with lab results OR
    b. Skip and click 'Next"
4. Tell us about your cover crop
    a. input the cover crop species you planted
    b. input termination date (can estimate)
    c. input dry and wet biomass measurements or estimation using sliders
5. Tell us about your cover crop quality
    a. Enter Nitrogen, Carbohydrates, Holo-cellulose, and lignin measurements OR
    b. Click Example: Legume or Example: Grass from the dropdown menu in top left corner to use estimates
        i. Click Cash Crop in Navigation Menu at top
6. Tell us about your Cash Crop
    a. input your cash crop and cash crop planting date
    b. input your yield goal and your target nitrogen fertilizer rate using the sliders







2. Explore Your Results

CC-NCALC estimates:

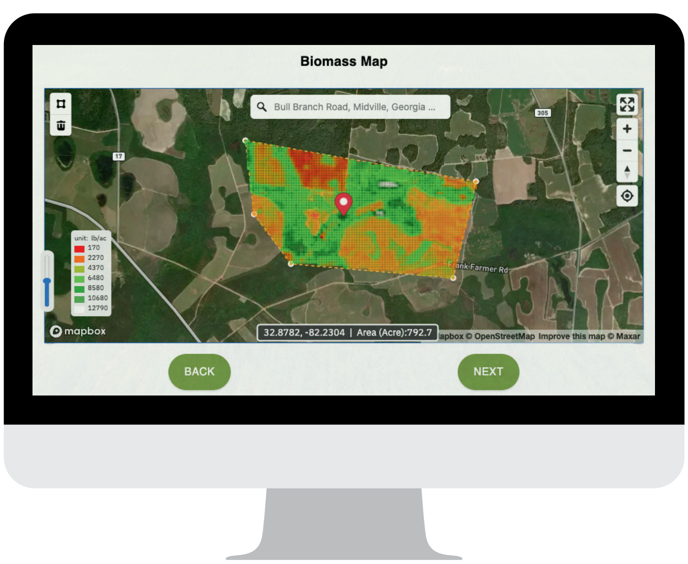
- How much N is released from decomposing residues over time,
- The amount of undecomposed residue remaining over time,
- Corn N uptake based on yield goal, and
- N fertilizer recommendations for the subsequent cash crop that accounts for cover crop N credit.

Outputs:

- The default output offers two views: N Released or Residue Remaining.
- The advanced output provides more in-depth analyses.

Default Output

Advanced Output



We continue to improve the Cover Crop Nitrogen Calculator as new data and technologies become available. Upcoming revisions will offer users the choice to enter cover crop forage quality values themselves or opt for satellite-derived calculations. The output of satellite calculations will be maps (see example left) showing the amount of nitrogen from residue that will be useful for prescribed applications.

Questions?
Kayla Driver, kldriver@ncsu.edu,
Research Communications for Precision Sustainable Agriculture and the Southern Cover Crops Council

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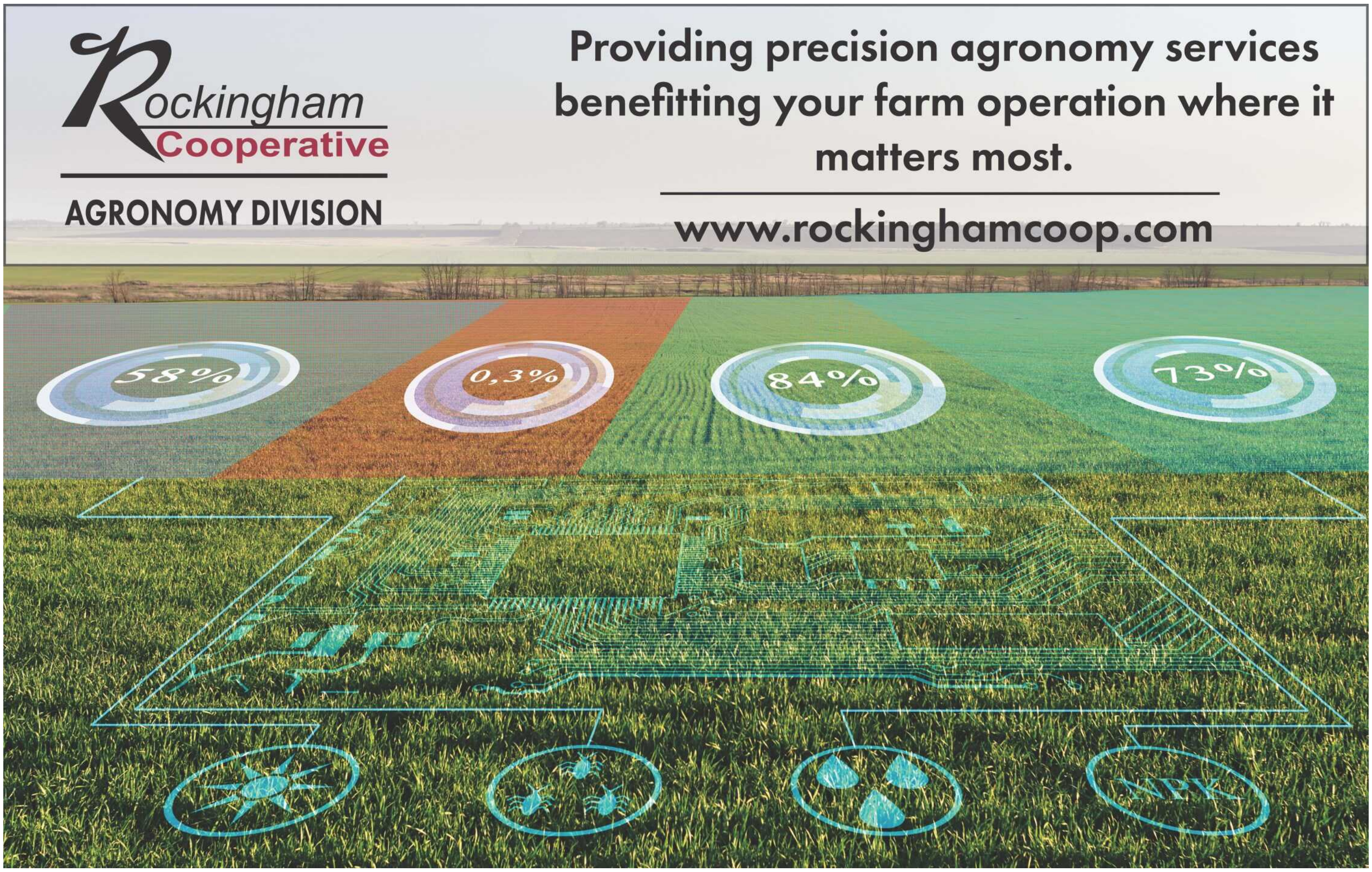
PrecisionSustainableAg.org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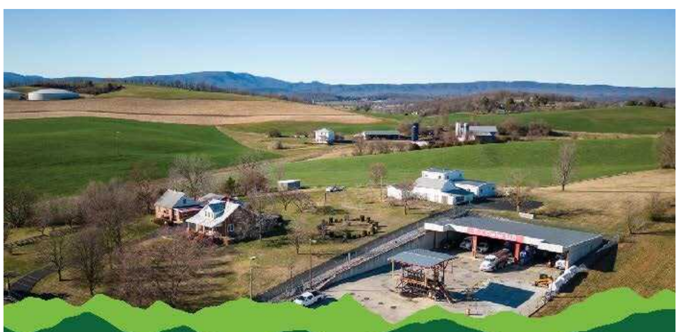

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