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Cover photo: Rocky Steady Farm’s team harvests cilantro in October 2021.

Jamie Johnson / Cornell Small Farms Program

SMALL FARMS QUARTERLY

Good Farming and Good Living
Connecting People, Land, and Communities

Small Farms Quarterly is for farmers and farm families — including spouses and children - who value the quality of life that smaller farms provide.

Our goals are to:
• Celebrate the Northeast region’s smaller farms;
• Inspire and inform farm families and their supporters;
• Help farmers share expertise and opinions with each other;
• Increase awareness of the benefits that small farms contribute to society and the environment;
• Share important research, extension, and other resources.

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Anyone is welcome to submit articles for consideration. See our guidelines at smallfarms.cornell.edu/quarterlywriters/ and contact Kacey Deamer with inquiries. Articles should be 1,000 - 1,600 words in length with at least three high-resolution image options.

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News from the Cornell Small Farms Program, Spring 2022

The Cornell Small Farms Program Announces Expansion of Team with Three New Additions

In our growing efforts to serve the Spanish-speaking farmer community, we have Mildred Alvarado and Hannah Rae Warren joining our LatinX farmer project. Mildred grew up on a small subsistence farm in western Honduras and has followed her interest in farming through two master’s degrees and a Ph.D. She most recently worked on promoting a sustainable agricultural sector throughout the supply chain in Central America and the U.S. As the LatinX Farmer Training Coordinator, Mildred will be focused on building bridges to facilitate knowledge and help farmers to overcome linguistic, cultural, and technical barriers to promote inclusive and profitable businesses.

Hannah Rae will be working jointly with our program and New York State Integrated Pest Management (NYSIPM) in a newly-created Bilingual Project Specialist position. After pursuing an undergraduate degree in International Agriculture and Rural Development from Cornell, Hannah Rae followed her passion for local food around the world. She eventually moved to Costa Rica and completed a master’s degree furthering her work in sustainable agriculture. In her new position, Hannah Rae will work on building relationships throughout our local and regional food system and supporting pathways for Spanish speakers to pursue farming and adopt IPM practices.

We’ve also welcomed Bailey Colvin to our Farm Ops project, as our support of veterans in agriculture continues to expand. Bailey’s primary goal with the Farm Ops project is to get to know our veterans, their backgrounds, and what transferable skills they carry from their military careers. She will work with our team and partners to effectively support the lifestyle change they are seeking. The education, training, and resources provided help afford veterans many opportunities to explore their interests with purposeful connections to their communities through agriculture and farming.

Learn more about our team on our About page: https://smallfarms.cornell.edu/about/#staff

Learn About Tarping on Northeast Farms with New Guide

Are you curious about how tarps work? Want to learn from successful practices as well as the challenges and shortcomings?

Our Reduced Tillage project is happy to share a new publication, “Tarping in the Northeast: A Guide for Small Farms,” that provides comprehensive information on the emerging practice of tarping – applying reusable tarps to the soil surface between crops and then removing them prior to planting – for weed and soil management. This guide is intended for both beginning and experienced farmers.

Based on research and farmer experience, the guide covers a range of management practices from using tarps for weed seed depletion, minimal tillage, and cover crop-based no-till, and uses case studies to highlight the methods of farmers across the Northeast. By combining the details of tarp logistics and management alongside the science of the practice, it is designed to support farmers in learning more about tarping and how to implement it to improve soil and weed management on their farm.

Ryan Maher, our Reduced Tillage project specialist, is a co-author on the publication. Maher has led tarping research experiments and worked with farmers to learn how they work and how to use them in reduced and no-till vegetable production.

“Tarps are a really multifunctional tool for small farms that help us get past some of the basic challenges using less tillage,” Maher said. “When we ask farmers how they work, we come up with a long list, then add a few jabs about the logistics. This guide puts all this practical information into one place, highlights successful farmers, and adds what we are learning through applied research, where still have a long way to go to understand what’s happening under there.”

The guide is a product of the NE IPM Working Group.

Message from the Editor

Do you have a story to share? We are looking for new contributors to our magazine, which is for farmers and farm families across the Northeast (and beyond) who value the quality of life that smaller farms provide.

We want to hear from you, whether it’s new techniques you are trialing in the field, how you’ve adapted to changing markets, or just about your life on the farm.

Learn more about contributing to the magazine, including article types, upcoming deadlines, and more, at https://smallfarms.cornell.edu/quarterly/contribute/.

Our team, and our Small Farms Quarterly readers, can’t wait to hear from you.

Kacey Deamer
Managing Editor
kacey.deamer@cornell.edu
Annual Maintenance in Support of Woodland Management

Woodland owners have different styles of management, from fairly casual to fairly regimented.

By Peter Smallidge

Woodland owners have different styles of management, from fairly casual to fairly regimented. All different strategies can work, but there are annual maintenance, management, and practical activities that are enjoyable, useful, and support the objectives of many owners. An owner who develops a list of annual or regular activities (some that may require a short amount of effort) will be safer, more aware of natural changes in the woods, and better able to maintain safe and effective equipment. These activities can be done alone or with family members, and require relatively little investment of resources other than time.

This tree was previously blazed with an ax or machete to create the oval shaped wound. The healed blaze will be apparent for decades, but a fresh bit of paint makes the boundary tree more apparent from a distance.

Boundary line maintenance is a good activity each year. The inspection of the boundary marks and corner posts can happen any month, but the dormant season allows for easier visualization of the line. Some families do this as a group activity so children learn the boundaries and it becomes a legacy project. If the boundary has been previously marked, maintenance is as simple as using the previous color, or a new color, of paint to refresh the boundary marks. If the property lines are posted, check to make sure the signs are intact and have the necessary information to be considered a legal posted sign. If the property lines were not previously marked, it is best to involve a professional surveyor or minimally discuss the location with the adjoining owner.

Access trails are an essential asset of any woodland property. Most properties have some combination of old woods roads, enhanced paths, or foot trails. These are useful for different modes of travel, but all benefit from regular inspection to look for fallen trees, hazard trees, poor access, or erosion. This activity is likely best when the ground is visible, not snow covered, and for issues of access or erosion perhaps when the soils are wet or soggy so that problems are more obvious. Use safe practices.

Wind, snow, and other events can create piles of debris in your trails. Use extra caution because stems and limbs may be under unusual stress that result in a pinched bar or kick-back.

when removing downed logs, especially being alert to logs that are under tension or connected to standing dead trees. Hazard trees, those likely to fall on the trail, are often better left alone, but place a marker on the trail on either side of the tree to alert travelers. Solutions to erosion problems that are severe may benefit from professional guidance by your local Soil and Water Conservation District or forester. Similarly, chronically soggy areas will need either control of the water, diversion of the source of water, or moving the trail to a new location.

A largely ubiquitous concern of owners is the health of their trees. Checking for tree health can be combined with other activities, or as a stand-alone walk in the woods a couple times per year. As a word of caution or comfort, the first time you go looking for tree health issues you may feel overwhelmed. A healthy woodlot will still have many examples of dead and dying trees. The goal is to identify extensive patterns of irregularity in trees. One instructive time to walk in the woods and assess tree health is shortly after the foliage emerges in spring. In addition to helping cure cabin fever, this time of year allows the owner to inspect tree crowns for unusual changes in foliage expansion and development to full size. Some damaging insects, such as forest tent caterpillars, are active as leaves emerge;

...continued page...
Woodland owners with a written management plan can spend some time reviewing their work schedule. Those without a written management plan can contact the NYS DEC and ask for assistance from a service forester, who will write one without cost to the owner. The work schedule suggests annual activities that are designed to help the owner more fully enjoy their woods and optimally gain the benefits they desire (Figure 4). As the work schedule is reviewed, the owner can also create some type of journal to document their past efforts, what they accomplished, and what they learned. One example of a creative solution to a journal is to annually make a copy of the property map and use colored pencils to highlight the year’s activities with marginal notes of lessons learned. For owners who are interested in generating revenue and who report expenses to the IRS, the journaling process provides an occasion to review your work records you kept during the year and make sure the actions, locations, dates, and receipts are clear.

Many of the non-native shrubs will expand their foliage earlier in the year than do native shrubs and plants. There is a window of a few weeks in late April or early May when the majority of the foliage in your woods be- longs to non-native species. This is a good time to inspect your property for existing or new species, identify them, learn about why they became a problem, and what you can do to limit their spread or abundance. In many cases, non-native plants gain dominance because deer selectively eat only the native plant species and thus favor the growth of non-native species. Owners can document the impact of deer with the AVID protocol that annually measures heights of tagged seedlings. The protocol can be found at www.AVIDdeer.com. Forest vegetation management to control non-native species won’t solve a deer problem, but it may limit the extent of an undesirable plant. In this springtime window, it is easy to find and focus attention on the non-native species. For owners who use foliar herbicides such as glyphosate, spray treatments to the non-native foliage will not impact species that have not expanded their foliage.

Although the activities suggested so far can be enjoyable, they are also at some level “work.” There are many other activities that are practical but have a strong element of pleasure. One example is to have a walk once or twice a year to areas of your property you seldom visit and make sure that all the species you see are on your property’s “species list.” You can decide if this list is just trees, just wildflowers, birds, or any combination of taxonomic groups. Once you add a species to the list, learn about the life history of that species. The life history attributes of a plant might include when it flowers, how the flowers are pollinated, how often there are bumper seed crops, what wildlife eat the fruit, if the plant has specific or general soil requirements, the plant’s shade tolerance, and more. Some of the species will be more special to you than others, and the life history attributes will allow you to develop a management scheme to favor their abundance.

A seasonal journal of nature in your woods is instructive to help you develop a keener sense of ecological patterns within a year and among years. This is a great activity to do with younger members of your “management team” so they can invest themselves in the property. The list of seasonal patterns can be as detailed as you like, but might include the dates of emergence of the leaves of specific trees, the date ice comes off the pond, when you hear the frogs and toads trilling, the number of days that the wood-cock make their mating flight, first frost, last frost, or the day your favorite tree starts to turn its autumn color.

Finally, a significant part of the joy of owning a woodlot is to share your wooded ecosystem with family and friends. This might include weekends to cut firewood, a gathering in the hemlocks for Thanksgiving, or the annual fishing derby in the pond. Set a time a few months before your event to make sure everyone knows about the event, and to make a list for necessary preparations.

Acknowledgments: My thanks to the many woodland owners from whom I’ve learned examples of annual activities – and how to make them fun.

This article originally appeared on www.ForestConnect.com, a program project of Cornell University Cooperative Extension and the NYS Department of Natural Resources. Support for ForestConnect is provided by the Cornell University College of Agriculture and Life Sciences and USDA-NIFA through McIntire-Stennis and the Renewable Resources Extension Act.

Peter Smallidge, NYS Extension Forester and Director, Amor Teaching and Research Forest, Department of Natural Resources, Cornell University Cooperative Extension, Ithaca, NY. Contact Peter at pjs23@cornell.edu. Visit his website, www.ForestConnect.info, and webinar archives at www.youtube.com/ForestConnect.

Many of the invasive shrubs expand their foliage before native plants. Herbicides such as glyphosate products that are used as a foliar treatment can be applied in a short springtime window when the invasive shrub has foliage and without collateral damage to desirable plants that have not expanded their foliage.
By Rich Taber

This article is the eighth installment on raising and managing beef cattle in the Small Farms Quarterly. Previous articles can all be accessed at the Cornell Small Farms website, www.smallfarms.cornell.edu.

Beef cattle have a gestation period of about nine months, or around 287 days. It is during the last trimester of pregnancy that the animals need a sharp increase in the quality of their nutrition. The energy and protein needs of pregnant beef mothers increase dramatically just prior to calving. If we overlook this important time, calves can be born weaker and stand a lower chance of survival, be born weaker and stand a lower chance of survival, be born weaker and stand a lower chance of survival, be born weaker and stand a lower chance of survival, be born weaker and stand a lower chance of survival, be born weaker and stand a lower chance of survival.

Ideally, by calving in spring-time, from April or May onward, the cows can avail themselves of high-quality grass pasture which is excellent for milk production and getting those calves to grow like gangbusters. Just prior to this time is the last trimester of pregnancy, and we will probably still be feeding stored forages. We need to be paying lots of attention to the quality of forages that the cows are receiving.

We need to get away from the mentality of "beef quality or heifer hay." This is a ploy sometimes used by people selling hay that is of too low a quality for milking dairy cattle. It may be later cut grass hay that may have even been rained on. Some of this can be used in autumn when cows are in the earlier stages of gestation. As the winter waxes on, however, the unborn fetuses need more energy and protein. It’s then a good strategy to start mixing in some of the higher quality hay that you have on hand. In the latter part of the gestation period, we need to be feeding the best quality hay that we can find every day. Early lactation for beef cattle demands that we keep feeding the best quality forages that we can offer until they are ready to start grazing on those lush spring grasses. If you need to purchase hay, keep in mind that all hay is not created equally. Late cut, weedy, unfertilized hay that has been left uncovered out in the field is a far cry from high quality hay or haylage/baleage that has been properly stored. Don’t be “penny wise and pound foolish” by buying low quality hay for late gestation animals!

We must also be vigilant in providing salt and the correct mineral mix to the animals. Free choice minerals are to be preferred over salt and trace mineral blocks to ensure enough intake. Just a cautionary note: If you happen to also be feeding sheep, make sure that they receive minerals designed for sheep, and which have no copper in them. Don’t feed beef minerals to sheep, or they can die from copper toxicity!

Nutritionally speaking, the nutrients that we need to be paying attention to are energy, which comes from carbohydrates and fats. This can portion out your lower quality stuff earlier in the season and save the “high octane” hay for late gestation. Vitamins are important too, and good quality hay generally provides enough of them, especially vitamin D. Minerals will be provided by your free choice beef cattle mixes. Calcium and phosphorus are the two biggest minerals that are needed to ensure healthy, strong calves. Do not shortchange your animals on minerals!

Pay attention to those soon-to-be mothers, especially first calf heifers and young cows that have been prepared 7

Preparing Your Beef Cows for Springtime Calving

In Part Eight of our “What’s Your Beef?” series on raising cattle on small farms, we explore why you need to be paying strict attention to the quality of feed that your late gestation beef cows receive just prior to calving season.

Happy healthy well fed calves as a result of maternal nutrition on the author’s farm.

Healthy calves grow into healthy, profitable yearlings like these.

Good nutrition for late pregnancy cows will ensure healthy calves like this one on the author’s farm.

Photo by Rich Taber / CCE Chenango
The Slow and Furtive Nature of Pasture Soil Compaction: Project Develops Ratio to Monitor Impact

Dairy farmer and Cooperative Extension Educator Fay Benson shares the results of a three-year study testing his Pasture Compaction Ratio hypothesis. He describes best management practices and how to measure compaction on the farm.

By Fay Benson

In my work, first as a grazing dairy farmer and now as a Cornell University Cooperative Extension educator working with graziers across New York State, I have been aware of pasture soil compaction, but one experience in particular gave me the insight into the slow and furtive nature of compaction in pastures. This article summarizes my findings from a three-year, Northeast Sustainable Agricultural Research and Extension (NESARE)-funded project developed to better understand soil compaction in pastures.

Permanent pastures for livestock can have some of the healthiest soils due to the fact they provide the four principles described by the Natural Resources Conservation Service to achieve a healthy soil: Maximize Soil Cover, Maximize Living Roots Year-round, Maximize Plant and Animal Diversity, and Minimize Soil Disturbance.

One weak spot for some pastures is soil compaction, which is a form of soil disturbance. Soil compaction reduces the spaces between soil particles causing them to become denser. Theoretically, the space in a healthy soil aggregate is made up of 25% air, 25% water, 45% sand, silt, or clay, and 5% organic matter. When compacted, the soil’s air and water portions are reduced so that biological functions, water retention, and root elongation are reduced.

Once the grazing season arrives, livestock go into the pastures no matter the weather. The other lesson I learned that day was that compaction was furtive, meaning that it happened slowly over time so the change was hidden from the farmer, who was a good grazer and had farmed there for nearly 20 years but had not noticed the change in his paddocks.

Permanent pastures for livestock can have some of the healthiest soils.

Jason Koski / Cornell University

The SARE study revealed that soil compaction will dissipate within months if management changes and has provided a basis for developing those changes to enhance pasture productivity.

Testing a PCR Hypothesis for Pasture Monitoring

To measure soil compaction, the penetrometer is a readily available tool. When pushed into the soil, it measures the soil’s resistance. Its meter indicates the pounds per square inch (PSI) of resistance at the tip. The limitation of the penetrometer reading is that the resistance is highly affected by the changing moisture of the soil. A soil that has more or less resistance on different days as the soil dries out or becomes bared. These types of animals are still growing and may need to be separated from the older, more aggressive cows. Pay attention to all your animals and make sure they are receiving adequate nutrition! The old saying goes: "The eye of the Master fattens his/her cattle!"

Rich Taber is the Livestock and Forestry Educator for Cornell Cooperative Extension of Chenango County, NY. He lives with his beef cows and other creatures on a 165-acre farm in the high, remote hills of nearby Madison County. He can be reached by email at rtab44@cornell.edu.

Preparing from 6

You may need to buy in some good dairy quality hay for late lactation beef cows.
For the Love of the Wild: Livestock Pastures as Wildlife Habitat

Our agricultural landscapes are habitat for wildlife, and we have a large toolbox of practices that can help us be better stewards of our land and all its inhabitants. One of these tools is adaptive grazing.

By Lee Rinehart

Farmers, ranchers, and researchers have come to understand the functionality of ecosystems on farms is largely dependent on plant and animal biodiversity. Functional ecological processes and services, such as soil and water quality, renewal and regeneration of soil and plant organisms, and nutrient cycling on farms and ranches, are facilitated by biology, necessitating maintenance of biological integrity and diversity in agroecosystems (Altieri, 1999). It is not surprising that adaptive multi-paddock grazing is an effective conservation practice on grazing lands for enhancing water conservation and protecting water quality (Park et al., 2017), as well as enhancing soil carbon, fertility, and soil water-holding capacity (Teague and Barnes, 2017) that soil organisms rely on for building healthy soil.

But there is another aspect of biodiversity that is just as important as soil and plant organisms. Livestock and wildlife compete for landscape resources, and they both put pressure on the forage available, as well as water, cover, and space, depending on their resource needs. In fact, wildlife species often “require considerably greater amounts of space to achieve acceptable levels of reproductive performance whereby survival of a population is assured” (Barnes et al., 1991). Birds need cover and shelter during their reproductive phase, and deer and elk need forage, cover, water, and a range large enough for them to thrive. Small mammals need space and protection from predators, and fish need quality streams and ponds. The concepts of resource supply and demand are just as important for wildlife as they are for livestock, and this affects our grazing management.

Historically, livestock have been a destructive force on landscapes (Ohmart, 1996), but they don’t have to be. Our agricultural landscapes are habitat for wildlife, connected and ecologically linked to set-aside wild lands, parks and reserves, wetlands and riparian zones, abandoned farms, privately owned non-agricultural forests and fields, and peri-urban low-density residential areas, which make up a large portion of the land in many areas. The ecology of

Warm-season grasses provide wildlife habitat and excellent livestock forage.

Soil Compaction from 7

Damp. This has precluded the penetrometer from being a reliable monitoring tool.

I decided to develop a ratio representing the unique conditions of pastures where the soil is impacted by grazing animals but the pastures’ fenceline is not impacted by animal- or machine-based compaction to determine if such a monitoring technique could be helpful. Monitoring with this Pasture Compaction Ratio (PCR) would look for any change between the optimum compaction area (fenceline) and the compacted area (pasture).

To test my PCR hypothesis, I selected a 35-acre pasture continuously over-grazed by 40 to 60 beef animals. As expected in over-grazed pastures, there is increased traffic by the animals as they get only small bites from the sward that consisted of mostly bluegrass, Dutch clover, and other forbs. The increased traffic leads to increased compaction. Due to the declining productivity of the pasture, the animals in the trial pasture mostly relied on stored hay brought into the pasture.

How to Compute the PCR

Using a penetrometer, collect five readings (pounds/square inch) of the pasture; these are averaged to determine Pasture Resistance. Do the same for the fenceline to determine the Fenceline Resistance.

Divide the Fenceline Resistance number by the Pasture Resistance number to determine the Pasture Compaction Ratio (PCR).

PCR = Fenceline Resistance/Pasture Resistance

In November 2019, I installed an enclosure, a 10-foot by 10-foot square, in the pasture that excluded animal traffic. To mimic hay production within the enclosure, I cut the area to a four-inch height twice during the season. In 2019 and 2020, I took penetrometer readings of the enclosure and divided them into the fenceline readings to arrive at the enclosure’s PCR (Figure 1). I continued to do the same for the pasture PCR.

Management Changes to Reduce Pasture Compaction

As mentioned, compaction in pasture soil is unavoidable. Some immediate suggestions for reducing compaction on your pasture and grazing lands include:

• Graze mature swards. Benefits include deeper roots, longer rest periods, and denser bites so that the animal fills with fewer footsteps.
• Know the soil texture of your pastures. Soils high in sand and silt are more prone to compaction problems. Where these soils are, try to graze when soil is dry. A healthy texture would be equal amounts of sand, silt, and clay.
• Track your organic matter. Higher organic matter makes stronger soil aggregates or particles.
• Vary the use of paddocks where possible, e.g., start your grazing in different paddocks each spring, and allow paddocks to be harvested for hay at times.


Soil Compaction 9

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Wildlife from 8

our lands has changed over time due to invasive species, exotic species, removal of large carnivores, and human encroachment. But farmers and landowners have become better wildlife stewards, and many include wildlife habitat into their whole-farm plans out of love of the wild and for quiet woods and fields populated with majestic creatures. And they invite friends and neighbors into the woods to see and reflect on the wilderness that constitutes an important part of their farm.

We have a large toolbox of practices that can help us be better stewards of our land and all its inhabitants. One way of including wildlife in farm planning is to manage plant succession to favor diversity that is beneficial for wildlife. The desired plant community for a diverse population of wildlife species is one comprised of a diversity of grasses, forbs, and woody plants interspersed across the landscape and having different structures in terms of size, growth form, and physical maturity (Stevens, 2016). Livestock grazing can be used to manipulate various paddocks to maintain different habitats throughout the grazing season. For example, habitat requirements vary seasonally for nesting, breeding, feeding, etc. for different wildlife species. Standing vegetation is often best for nesting birds but grazed diverse vegetation is good for feeding sites (Vavra, 2005). This is just one example of including practices that take wildlife into consideration.

An adaptive grazing system, because of its inherent flexibility, can be compatible with wildlife habitat management by mimicking the seasonal movement of species based on forage quality and quantity (Schieltz and Rubenstein, 2005). It can foster diverse landscapes at various times of the year by manipulating animal numbers in paddocks, grazing some paddocks heavily and some lightly, and some perhaps not at all for a part of the season, leaving diverse grasses ungrazed for a part of the year for wildlife. There are many resources to help farmers, ranchers, and landowners foster wildlife habitat on their land, including the U.S. Fish and Wildlife Partners Program, which works with private landowners to plan and implement on-farm projects to create, restore, or enhance habitat for wildlife. Farmers and ranchers are telling their own stories of restoration of the land for its own sake, much like Meredith Ellis, a second-generation Texas rancher, who put it better than anyone I’ve heard when she said species diversity and rare species are indicators that you’re doing something right (Ellis, 2021).

This article was first published on Feb. 1, 2022 on the ATTRA Blog. Visit the blog for more information about the references made in this article.

For More Information:
The Basics of Managing Wildlife on Agricultural Lands, Purdue University (https://www.extension.purdue.edu/extmedia/FNR/FNR-193-W.pdf)

Lee Rinehart is an agriculture specialist with the National Center for Appropriate Technology and has been writing about agriculture and grazing ecology for over 20 years. He can be reached at lee@ncat.org or 479.587.3474.

Soil Compaction from 8

Project Takeaways
The pasture PCRs for 2019 and 2020 are similar, which would be expected since no management changes happened.

In April the PCRs for both the pasture and enclosure in 2019 and 2020 start out the same. The rising pasture PCR after May 2020 indicates that the pasture’s compaction resistance is improving since the PCR is moving closer to the fence-line’s compaction PCR, which peaked at 1.0. The separation of the 2020 PCRs for the pasture and the enclosure is an indication that the use of the PCR is capable of monitoring management changes. The switch to hay production only within the enclosure reduced the compaction of the soil.

I would have expected that the reduction in compaction in the enclosure would have shown up in April 2020 due to frost and heating of the soil. The reduction in compaction happening after the beginning of May indicates that possibly it occurred as a result of the increase in soil temperature and biological activity causing the (aggregate) soil’s air and water spaces to expand.

I can’t explain why the 2020 PCRs for pasture and enclosure deviate in August. Why did they both drop? It was suggested that the one measurement I failed to track was soil moisture. I assumed that moisture would change equally but, if the pore spaces increase as the soil is less compacted, that soil would have more water in those pores.

The reduction in compaction in the enclosure happened within a few months. What didn’t change was the makeup of the sward of bluegrass and other lower productivity species that was brought about by years of compaction in the pasture. This is why it is important to monitor compaction, changing management before the sward species changes.

The most interesting takeaway from this study for me was how quickly the shallow compaction in the pastures dissipated. The real damage was caused in pastures where the management didn’t change and the years of compaction reduced the function of the soil so that it changed the grazing sward to less productive species.

Obviously, much more study is needed to better understand the usefulness of using a ratio between two soil management areas as a monitoring technique. This project raised more questions to be addressed before a PCR can be a reliable tool. Developing a way to monitor soil compaction with a readily available tool such as the penetrometer would provide a great advantage to farmers and advisors who seek to improve the function and health of agricultural soils. To learn more about the technical details of the PCR study, see the South Central NY Dairy and Field Crops website (https://scnydfc.cce.cornell.edu/submission.php?id=1477&crumb=soil%7C7).

Fay Benson is the New York Soil Health Technical Advisor, the education coordinator for the New York Dairy Grazing Apprenticeship Program, project manager of the New York Organic Dairy Initiative, and a small dairy support specialist with the six-county Cornell University South Central New York Dairy and Field Crops Team. He may be reached at 607.391.2669.
To Tarp, To Mulch, or To Do Both – That Was the Question
CSA farm experiments to minimize inputs, mechanization, and soil disturbance in their market-scale potato growing operation.

By Bob Tuori, Ryan Maher, and Michael Salzl

A major concern on our highly intensive organic farm, nook&cranny farm, is how to grow potatoes on a scale that supplies our diverse and abundant CSA shares in a way that minimizes labor needs and detrimental effects on soil health. We grow on a limited space (hence, the farm name) and so have largely relied on rented, off-farm fallow fields for potato growing, leaving the highly fertile and carefully managed on-farm land for specialty crops. Managing these fields in a minimal yet sufficient manner is complicated by their abundant weed seed seed bank and the added burden of transporting equipment. Weeds in potato fields that are minimally managed can be so aggressive as to completely crowd out the slow emerging vines. Even if the vines initially outcompete the weeds, the field can become overrun with weeds by the time the vines senesce, complicating harvest. Hay mulch is an inexpensive local input and provides a soil cover, reduces weed germination, maintains soil moisture, and adds organic matter to a field. Tarps, while a pricey upfront investment (we paid $500 for two 32x100 silage tarps), can be used for multiple years. The basis for our experiment was to see which method to use, or how to combine them, to improve our success with reduced tillage potato production.

Reduced or no-till farming has gained much attention in recent years, due to the potential for increased soil health and reduced labor inputs. Tarping has also emerged as an accessible and versatile tool for small farmers to overcome some of the common challenges of reducing tillage, including weed suppression and cover crop termination. However, farmers continue to look for examples of how to best fit tarps into specific windows in their crop rotation. Of growing interest is how tarps can be successfully integrated with other soil building practices, like cover crops and mulches, to provide both short and long-term benefits.

We designed this experiment to trial tarping as a method to improve cover crop termination, weed suppression, marketable crop yields, and labor use. We compared three growing methods: tarping with mulching (T+M), tarping without mulching (T), and no tarping with mulching (M; this was our standard practice). For each method, potatoes were planted into a tilled strip following a tilled strip following an over-wintered cereal rye cover crop.

What We Did

We started with an old hay field that had no history of vegetable production. In the autumn before the potato year, the field was mowed close to the ground, a cereal rye cover crop was broadcast by hand, and the entire field covered with about three inches of hay. Field preparation for planting potatoes started on May 3 for tarped treatments (T and T+M), about three to four weeks prior to our target potato planting date. At this date, the rye was between six and 12 inches tall. Before tarping, we made planting furrows about 12 inches wide, six feet apart, using a BCS tractor with a rotary plow attachment. The rye between these tilled strips was left undisturbed. We then applied tarps directly over both the furrows and untilled rye. They were secured with plenty of sandbags, left in place for four weeks, then removed just prior to planting (June 2) (Figure 1).

The rye cover on the non-tarped, mulched treatment (M) was allowed to grow during the month of May and then flail-mowed and furrowed on the same day as planting. We planted three different varieties in each treatment, one row each with an early (Pontiac Red), mid (Keuka Gold), and late-season (Red Maria) variety. Seed potato was placed in each furrow and covered with hoes. The potatoes emerged within a few weeks and on June 30, about one month after planting, we cultivated both sides of the planting row to loosen soil for hilling (about two inches deep, 30 inches wide) using a BCS tiller with precision-depth control. The potatoes were hilled with hoes and then mulch was applied by hand (about six to eight inches deep of hay) to the two mulched treatments (T+M and M; Figure 2).

Prior to mulching, we measured weed emergence and rye regrowth to assess the effectiveness of the tarp in rye termination and suppression of early season weeds. We also measured weeds and rye regrowth later in the season, close to potato harvest, to assess the role of tarping and mulching in longer term weed suppression. We monitored soil temperature and moisture throughout the season and sampled for soil nitrate in the planted furrow to see how tarps affected crop-available soil nitrogen. Starting in September, before the vines had completely senesced, we began hand harvesting. At this time, we also sampled the field for soil health using several of the Cornell Soil Health Test metrics (active C, soil respiration, and protein levels). All tubers were washed and then sorted as either marketable, greened, or vole-chewed.

Drone photos showing the field from tarp to mulch.

1) On 6/2, just before the tarp was removed and potatoes planted. The furrows on the bottom of the photo are in the M-only treatment and were built that day.
2) On 6/24, potato plants are just beginning to emerge, one week prior cultivation and mulching.
3) On 7/5, shortly after cultivation and application of hay mulch. Tarp-only treatment on top has only rye residue on the soil surface.
Ground cover in each of the three treatments on 8/3. 1) Mulch only. 2) Tarp + mulch. 3) Tarp only. Note rye regrowth in 1 and the mat of small weeds in 3.

What We Found

Some of our results were unsurprising and largely driven by the field and weather conditions rather than our treatments. Soil moisture was not different and consistently high, so not a limiting factor. The summer was very wet, but in dry years we would expect the mulch to provide additional benefits. Soil health tests showed equally high measurements across the field, which could be expected for a fallow field.

We found tarping effectively terminated the rye cover crop. Very little rye was found growing in either of the tarped treatments (T and T+M) while it regrew in the non-tarped and mulched treatment (M) so that by midsummer it covered about one-third of the area and was the most important weed. While mowing can kill rye when the rye is at full flowering, or anthesis, timing and logistics for this can be tricky and our rye stand was not quite there. However, when compared to mulching, tarping alone did not provide comparable full season weed suppression.

Throughout July and August weed pressure remained minimal, especially in the tilled planting row (Figure 3), but by the end of September, the perennial weed situation had become extreme in the non-mulched tarped treatment. Weeds covered 73% of the area between potato rows in this treatment, versus 45% in M and 28% in T+M treatments. It’s not clear how much these weeds affected potato crop growth as the vines had nearly completely senesced at this point, but they did make the harvest more cumbersome. It was clear that tarps alone were inadequate for suppressing our perennial weeds and these weeds are likely to return as problems in future years. T+M seemed to have a synergistic effect by combining to reduce rye regrowth and provide longer lasting weed suppression throughout the season.

One of the most notable results of our study was the increase in nitrate levels in tarped versus non-tarped soils (4 ppm pre-tarping baseline, 4.5 ppm M-only, 17 ppm T+M, and 15 ppm T-only). Tarping could have increased soil nitrate at planting by killing rye early and thus eliminating soil nitrogen uptake by the cover crop while creating warm, moist soil conditions that promote biological activity prior to planting. Our analysis of soil temperatures indicated that both daily maximum and minimums under tarps were consistently two to five degrees higher during the tarping period and returned to baseline within a week after the tarp was removed.

The overall marketable yield was highest in the T+M treatment (736 pounds) versus 524 pounds and 544 pounds in the M and T treatments, respectively. The marketable yield of two of the varieties (Keuka Gold and Red Maria) accounted for this discrepancy. Yield per row foot for each variety and each treatment is shown in the graph. Pontiac Red was poor-quality seed, with low germination and equally low yields in all treatments. We expect that in a dry year, the yield difference between mulched and non-mulched plots would have been even more significant. We suspect that the higher nitrate related to tarping, combined with added weed suppression provided by the mulch, helped account for the increased yield of T+M treatment.

All labor hours directly involved in production were carefully tracked throughout our study and used to calculate a ratio of yield versus labor hours invested. This analysis allowed for some helpful insights. Applying and removing the tarping required significant labor and tarping alone was not worth the labor investment. Tarping with mulching had the greatest yields but also required the most labor. Mulching without tarping did not demand as much labor but also did not yield as high. Therefore, we found the yield to labor returns to be nearly equal between the M and T+M approaches (T-only, 13; T+M, 17; and M-only, 17, all in pounds/labor hour). With practice, we have found that applying and moving a tarp becomes easier and we feel more confident about preventing the tarp from blowing away. This may reduce labor in future operations. Clearly, mulching seems to be indispensable for reduced tillage potato growing on our scale and it is relatively inexpensive. Adding tarping seems to improve yield, add some labor efficiency, and gives us more confidence and flexibility in killing cereal rye in spring without tillage.

We plan to continue to refine this method. One big adjustment will be to prepare the planting furrows after tarping the cover crop rather than before. Making the furrows prior to tarping added some logistical headaches: uneven ground made it difficult to walk and move sandbags without creating holes in the tarp. Laying the tarp directly over cover crop (with no furrows) would allow it to sit more tightly against the surface, resulting in higher soil temperatures and potentially improving suppression of rye and weeds. Tilling furrows after tarping could “awake” new weeds but we feel confident that hilling and mulching will take care of that. Both tarping and mulching practices have their benefits that can add up – that’s why our answer is both.

Learn more about using tarping in vegetable production on the Cornell Small Farms Reduced Tillage Project website at https://smallfarms.cornell.edu/projects/reduced-tillage.

Bob Tuori owns nook&cranny farm, a highly diverse and intensive organic vegetable operation in Brokondale, NY, that serves a 100-member CSA and sells at local farmers markets. The farm has been experimenting with off-site, low input, and reduced mechanization potato growing methods for years and recently introduced tarping in addition to heavy mulching and strip-tillage into their practices. Bob can be reached at btuori@gmail.com. Michael Salz is a farmer at nook&cranny farm. Ryan Maher is a Research and Extension Specialist with the Cornell Small Farms Program.

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New Findings Further the Study of Dynamic Accumulators

A new on-farm study in Central New York sheds light on the potential applications for dynamic accumulator plants for Northeast farmers and growers.

By Ben Tyler and Greta Zarro

As permaculture principles gain popularity, there is growing interest in “dynamic accumulator” plants and their potential as nutrient catch crops, “chop and drop” mulches, and fodder for home-brew liquid fertilizers. Dynamic accumulators are seen as a promising closed-loop nutrient management solution that converts common weeds into valuable nutrient sources while reducing the need for purchased fertilizers and soil amendments.

However, up until now the term “dynamic accumulator” has largely existed in the realm of informal research and in books on gardening and permaculture. This has led many to believe that dynamic accumulation is unproven pseudo-science, even though the accumulation of beneficial nutrients in the context of cover cropping has been extensively researched and accepted as fact. Likewise, the related field of “hyperaccumulator” plants has enjoyed over 40 years of enthusiastic research and discussion in peer-reviewed journals.

The thing is, literally speaking, hyperaccumulators and dynamic accumulation are two terms referring to the same biological process. But whereas the study of hyperaccumulators is specifically focused on the accumulation of toxic heavy metals, dynamic accumulation focuses on the accumulation of beneficial nutrients. In the context of agriculture, “dynamic” refers to the plants’ use of active transport, rather than normal diffusion, to transport a nutrient against the concentration gradient—in other words, to achieve a higher nutrient concentration in the plant than in the surrounding soil.

So, we know that mineral accumulation is real — we just need to establish clear criteria for the identification of dynamic accumulator species, as has already been done for hyperaccumulators. At Unadilla Community Farm in Central New York, we recently wrapped up a two-year study aiming to do just that. As first reported through the Permaculture Research Institute in March 2020, our SARE-funded research set out to define what exactly qualifies as dynamic accumulation and investigate potential applications for these plants. Two seasons later, here are the results.

First, following the framework laid out by Robert Kourik and Dean Brown and the USDA-hosted “Dr. Duke’s phytochemical and ethnobotanical databases” were used to compile peer-reviewed nutrient concentration data across thousands of plant species. Concentration averages were calculated across 20 beneficial nutrients, and dynamic accumulator thresholds of roughly 200% the average were set. “High ppm” values were used, as these correspond with dried plant tissue samples, consistent with hyperaccumulator thresholds. This resulted in a total of 340 plant species that have been shown to achieve nutrient concentrations high enough to qualify as dynamic accumulators. You can view the full list of dynamic accumulators, along with all available peer-reviewed nutrient concentration data, in an easy-to-navigate online tool titled “Dynamic accumulator database and USDA analysis.”

Since USDA databases receive regular updates as new plant tissue analyses make their way into peer-reviewed journals, the data set relied on for the study of dynamic accumulators is constantly growing. Nutrient concentration averages are constantly changing too. This illustrates the “dynamic” nature of the USDA databases themselves, and the importance of stable nutrient concentration thresholds to assist in further studies and discussion of dynamic accumulators. The dynamic accumulator database will also need to be regularly updated to reflect the latest information on plant tissue nutrient concentrations and averages, and the dynamic accumulator thresholds themselves should be periodically reviewed as well, as is done in the field of hyperaccumulators.

We’re lucky that the study of hyperaccumulators is far enough along that we can follow in its footsteps. But the use of nutrient thresholds and curated databases hasn’t been perfected yet. For example, in the field of hyperaccumulators, researchers are still facing some challenges, such as the existence of multiple competing sets of thresholds, several databases with conflicting criteria for inclusion, and additional quality control issues such as the use of “spiked” growing media or contaminated plant tissue samples giving inflated nutrient readings. But the implementation of nutrient thresholds and curated databases of hyperaccumulator species has gone a long way in facilitating the study of these plants. We hope that the creation of the dynamic accumulator database will spur on further study of dynamic accumulators as well.

The second step of our research utilized the dynamic accumulator database to select six promising species for two years of trials at Unadilla Community Farm: dandelion (T. officinale), lambsquarters (C. album), red clover (T. pratense), redroot amaranth (A. retroflexus), Russian comfrey (S. perennis), and stinging nettle (U. dioica). Crop yields and nutrient concentrations in the soil, dried plant tissue, and liquid fertilizer derived from these plants were measured. These data were used to assess the potential of these six species for a range of applications, including subsoil nutrient extraction, topsoil nutrient scavenging in buffer strips or fallow beds,
home-brew plant-based liquid fertilizer production, and nutrient-rich mulch production (aka “chop and drop” mulch). You can access our full report on the field trials at unadillacommunityfarm.org/dynamicaccumulators.

Perhaps most importantly, we found that plant tissue nutrient concentrations are relative to soil nutrient concentrations. Dynamic accumulators are well-suited to extract specific nutrients from fertile soil, but they aren’t going to create nutrition that isn’t there. As shown in our field trials, when grown in poor, unamended soil, all six trial crops possessed nutrient concentrations lower than those measured in previous studies. This confirms similar findings made by researchers of hyperaccumulators on the correlation between growing medium and plant tissue concentrations. For this reason, it is helpful to report nutrient concentrations for both plant tissue and the growing medium used. With these two data points, bioaccumulation factors can be calculated, by dividing plant tissue concentrations (in ppm) by “background” concentrations in the soil (also in ppm). It is only by reporting bioaccumulation factors for a plant species across a range of growing conditions and growing media that we can better understand how to effectively use dynamic accumulators in a larger permaculture system.

That said, even when grown in poor, unamended soil, two species surpassed dynamic accumulator thresholds. Dried lambsquarters foliage was found to possess potassium concentrations that exceeded dynamic accumulator thresholds (513 ppm), and liquid fertilizer made by steeping lambsquarters foliage in water for five days contained the highest potassium concentrations of all the trial crops (903 ppm).

Likewise, Russian comfrey foliage surpassed dynamic accumulator threshold concentrations for both potassium (52,959 ppm) and silicon (513 ppm), with similarly high potassium concentrations found in the resulting liquid fertilizer (889 ppm). This is particularly exciting because, while Russian comfrey has been known to be a dynamic accumulator of potassium, this may be the first study to reveal it’s a dynamic accumulator of silicon as well.

While the other four species studied did not surpass dynamic accumulator thresholds when grown in our field trials, there were some interesting findings. In particular, we found stinging nettle foliage to possess the highest calcium concentration of all trial crops, as well as the highest bioaccumulation factor for calcium. Liquid fertilizer derived from stinging nettle foliage proved to be very nutrient rich, possessing the highest concentrations of P, B, Ca, Cu, and Mn after five days of steeping compared to all other trial crops, as well as the highest nutrient carryover rates for all of these nutrients plus K and Mg, meaning stinging nettle’s nutrients are particularly soluble and well suited for liquid fertilizer.

Chopping and dropping with stinging nettle also produced some exciting results. Calcium concentrations more than doubled in the zero- to six-inch and six- to 12-inch soil horizons, while dropping to 63% in the 12- to 24-inch soil horizon. This is consistent with the widely held belief that dynamic accumulators enrich the topsoil by extracting nutrients from the subsoil. Overall, stinging nettle proved to be very well suited to virtually every aspect of these field trials: it thrived under low-maintenance food forest growing conditions; formed a thick, weed-suppressing ground cover; produced large yields of calcium-rich foliage with multiple commercial uses; displayed excellent potential as a source of highly soluble liquid fertilizer; and showed promise as a nutrient-rich mulch as well.

Redroot amaranth (also known as pigweed) is one species you probably don’t want to intentionally plant. But if you already have it growing as a weed, you might want to try brewing some liquid fertilizer out of it. Our trials showed that liquid fertilizer derived from its foliage possessed the highest concentrations and the highest nutrient carryover rates of iron and sulfur compared to all other trial crops. But due to its invasiveness, great care should be taken to harvest before it sets seed.

Dandelion possessed the highest concentrations of phosphorus and sodium of

Redroot amaranth trial row at Unadilla Community Farm.
Pasture Rest

How long should my pasture rest before I graze it again?

By Ulf Kintzel

After a pasture cell has been grazed it should rest so that the plants in it can regrow, restore nutrients, and stay viable. How long the pasture rest should be depends on the time of year. Pasture rest in humid climate like in New England, the Northeast, and Midwestern states is very different than pasture rests in arid climates out west. My article will speak exclusively to humid climates like at my farm in western New York.

Let's assume for the sake of this article that we have a well-established pasture or hay field with cool season grasses and legumes as well as a variety of desirable weeds. The growing season starts with spring. The early weeks of growing season include exclusively vegetative growth. This rapid growth will only last until about mid-May and seed stems and seed heads will emerge. During these early weeks of pasture growth, the pasture rest should be relatively short – as short as three weeks. Longer rest periods will lead to pasture growing ahead of you and quality and palatability being lost.

Spring is also the most forgiving time for pasture. At that time, it is less vulnerable to shorter rest periods and even to shorter grazing.

When the seed stems and seed heads emerge and throughout summer the pasture rest should be increased. More time is needed to restore depleted resources. I suggest a rest period of five to six weeks. The closer we get to autumn, the more critical is a longer rest period.

Stockpiling starts, depending on the region, sometime in August and as late as early September. Seven to nine weeks, or about 50 to 65 days, of stockpiling are desirable. Somewhat longer grass has the added benefit of being more accessible when sheep dig through the snow in winter to get to the forage.

Longer pasture rests than I described can, under extreme or unusual circumstances, be desirable, such as restoring soil health on depleted farms or when establishing a new seeding. However, longer pasture rests under normal circumstances offer no added benefits but carry several risks.

The biggest risk of longer pasture rests is the loss of quality in the forage (less energy and less protein) as well as lower digestibil-

Dynamic from 13

all the trial crops, both in its leaves and in liquid fertilizer made by steeping its foliage in water for three days. This isn’t terribly good news. Being an accumulator of phosphorus is a good thing, but while a little sodium has been shown to be beneficial for plants, many growers grapple with excess sodium in their soil. Also, possibly because of its small size and low yields, dandelion didn’t affect the surrounding soil nutrition very much, meaning it probably wouldn’t be very effective as a nutrient catch crop.

Finally, while the sixth species studied, red clover, did not surpass dynamic accumulator thresholds in our field trials, its dried plant material didn’t affect the surrounding soil nutrition very much, making it probably wouldn’t be very effective as a nutrient catch crop.

Our analysis of Dr. Duke’s databases and calculation of dynamic accumulator thresholds, resulting in the creation of the new dynamic accumulator online tool, help lay the groundwork for further study of these plants. Like cover crops and hyperaccumulators, dynamic accumulators are proven mineral accumulators. But our field trials showed mixed results, with some species surpassing dynamic accumulator thresholds, while other plants did not live up to previously recorded nutrient concentrations. This underscores the importance of soil health in achieving high nutrient content in plants, and the need for more data on bioaccumulation factors in our field trials, its dried plant tissue foliage did exhibit the highest concentration of iron out of all trial crops, as well as the highest bioaccumulation factor for iron. This makes sense, since red clover has been shown in previous studies to surpass the dynamic accumulator threshold for iron. However, liquid fertilizer derived from red clover did not possess particularly high nutrient concentrations or carryover rates for any nutrient.

As our two-year study on dynamic accumulators comes to a close, it is clear that more research is needed.

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Farm Ops Expanding to Reach Military Veterans

The Cornell Small Farms Program’s veterans in agriculture project is working with local Cornell Cooperative Extensions to in-person workshops.

By Nina Saeli

For the first time since March 2020, when the COVID pandemic swept across New York State, the Cornell Small Farms Program’s Farm Ops project brought military veterans together for three in-person workshops beginning in October 2021. Although still having to follow COVID-19 mitigation protocols, these in-person events gave veterans an opportunity to connect and learn together.

“I prefer in-person events and to learn from other people’s experiences,” stated veteran Ralph Felter. “Plus you get to meet other veterans who are subject matter experts.”

The first workshop took place on Rich Taber’s farm. Rich Taber, an Army veteran and longtime farmer, works as a Cornell Cooperative Extension (CCE) grazing, forestry, and animal science educator. Topics that day consisted of reclaiming old fields using brush hogs, native seedbanks, fertility inputs, and principles of regenerative agriculture to inexpensively provide lush, nourishing pastures for livestock.

The workshop included lunch and a guided tour of Rich’s farm to show how the theories of grazing have been applied to this cold, high elevation property.

CCE Broome Agricultural Economic Development Specialist Laura Biasillo hosted two veteran workshops last autumn. The first workshop, “Maple Syrup for Beginners and Maple Confections,” included tree identification, tree health, tapping, sap collection and handling, boiling, energy efficiency, finishing and grading syrup, canning, marketing, and regulations. The afternoon focused on the production of maple confections and featured training and hands-on demonstrations of making maple granulated sugar, molded maple sugar, crystal coating, and maple cream.

The last autumn workshop focused on different food preservation techniques, including dehydration and hot water bath canning. Veteran participants also learned basic food safety principles to set up for success in the kitchen. Veterans made jerky and pickles in addition to a fresh salsa.

“I had a great time and learned a lot of best practices that I will implement when I start canning/preserving our harvest,” stated Air Force veteran Nora Ling-Browning. “I met a lot of other veterans, including the ones that attended Armed to Farm, and felt the camaraderie that I had sorely missed that could only be found while serving in the military. I look forward to attending future classes to learn more about gardening, farming, and any other best practices that we can implement on our farm and for our livelihood.”

Nina Saeli, Farm Ops project associate, agreed with Ling-Browning that learning to preserve food is important to a farmer’s livelihood.

“Army veterans and mother/daughter Kathy Merrial (L) and Caroline Greene (R) practice using tools in the maple syrup industry.”

“I think workshops like this are important to veterans because many veterans are interested in being self-sufficient and being able to preserve your harvest for winter use is a huge part of self-sufficiency,” Saeli said.

Learn more about the Farm Ops project on the Cornell Small Farms Program website at https://smallfarms.cornell.edu/projects/farm-ops/

Nina Saeli retired from active duty in 2009. She and her husband, Jeffrey, own and operate Centurion Farm in Locke, NY. Nina also now works with the Cornell Small Farms Program as coordinator of our Farm Ops project, supporting veterans in agriculture.

Pasture from 14

Air Force veteran Nora Ling-Browning processes beets for pickling.

Pasture 16

with the desirable residue of about four inches.

There are other reasons why a longer pasture rest can be detrimental to your pasture. While clover, a desirable pasture legume with extraordinary longevity under ideal conditions, needs light to thrive. Long pasture rest may lead to grass that is so tall for too long of a time that it deprives the clover of light and thus outcompetes it.

The thickness of a stand is negatively influenced also when pasture rests become too long. However, a thick stand is desirable because a lower but thicker stand yields more desirable forage than a taller but thinner stand.

There are financial considerations as well. If you purchased the farm and you have to pay a mortgage – and many of us either do or have – you want a return for your investment. After all, many of us need to make a living. If you now extend pasture rest beyond a point that it benefits yield and quality of your forage, beyond a point that soil health
Cornell-Inspired NY Soil Law Buoys Climate-Change Resilience

New laws, supported by Cornell Research, will help New York farmers adapt to the effects of climate change by implementing sustainable management practices on their farms. They will also expand current programs aimed at training farmers in these practices.

By Blaine Friedlander

When winter melts into the upcoming agricultural planting season, New York growers will get a boost from the new Soil Health and Climate Resiliency Act – backed up by Cornell research, supported by the state’s farmers – and signed into law by Gov. Kathy Hochul.

The new law (Senate: S4722A/House: A5386A), signed Dec. 23, will help farmers mitigate and adapt to the impact of climate change by applying sustainable soil and crop management strategies that improve farm resilience and benefit the environment. It also codifies an existing program aiming to encourage, assist, and train the state’s farmers in improving soil through better tillage techniques, cover cropping methods, composting, and other novel practices.

“This law is philosophically built on the research we’ve conducted at Cornell in the last two decades,” said Harold Van Es, professor in the School of Integrative Plant Sciences (SIPS) in the College of Agriculture and Life Sciences (CALS), who – with Matt Barten, associate professor in SIPS – now leads the New York State Soil Health initiative.

Now that the soil health initiative is fully funded, establishing and maintaining soil health standards will be reliant upon further Cornell scholarship. Cornell University state climate goals by storing more carbon in soil.”

State Sen. Michelle Hinchey (D-46th District) and Assemblymember Donna Lupardo (D-123rd District) introduced the original bills to the New York Legislature in February 2021, while Ithaca Assemblymember Anna Kelles (D-125th District) was among the co-sponsors.

The Soil Health and Climate Resiliency Act is the first major piece of legislation in New York that paves the way for farmers,” Hinchey said, “who are already leading on environmental management, to become a cornerstone of our fight against the climate crisis.”

Agriculture plays a vital role in helping New York achieve its climate goals, Lupardo said. “It starts off with the simple premise that the health and resiliency of New York’s agricultural soil is an important priority,” she said. “Healthy soil produces healthier foods, mitigates climate change through carbon sequestration, and protects our natural resources.”

Cornell, CALS, and New York farmers have been at the forefront of the soil health movement. In 2017, State Sen. Tom O’Mara (R-58th District) helped the group obtain initial state funding for the university’s New York Soil Health program.

By 2018, the program leadership organized the New York Soil Health Summit in Albany, where more than 140 people from nearly 40 stakeholder groups including farmers, politicians, nonprofits, and scientists met to share expertise and set new priorities.

Soil Law 17

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NY-VT Corn Silage Program Enhances Purchasing Power for Farmers

A seed company can assure you of the quality of their product, but how do you evaluate those claims? The NY-VT Corn Silage Program acts as a third party to evaluate these products and to help farmers make informed decisions.

By Catherine Andreadis

Joe Lawrence is the Dairy Forage System Specialist for Cornell CALS Department of Animal Science PRO-DAIRY. Here he provides insight into the research and Extension work accomplished by PRO-DAIRY to evaluate the quality of feeds available on the market for dairy farmers. Specifically, his work is part of a larger joint project between New York (represented by Extension specialists at Cornell CALS) and Vermont (represented by Extension specialists at the University of Vermont).

What is the New York-Vermont Corn Silage Program?
The idea behind the NY VT Corn Silage Program is to offer third-party evaluation of corn hybrids, giving farmers greater insight into the quality of these products. There are numerous agricultural companies that sell seeds. Each has protocols to develop and internally test performance of their hybrids available on the market for farmers.

Each winter we send out requests to seed companies to test their products. Companies pay an entry fee for each hybrid to cover analysis and labor costs, knowing that the data from the studies will be made available to the public. All results are open source for farmer and seed companies alike.

How many companies participated in the trials in 2021? This year we tested 61 hybrids from 12 different brand names. The most participation we ever had was 90 hybrids from 16 different brand names. This year we experienced a dip in participation since many companies had lowered their budgets for scientific testing due to the coronavirus.

A seed company can assure you of the quality of their product, but how do you evaluate those claims? The NY-VT Corn Silage Program Enhances Purchasing Power for Farmers

Each winter we send out requests to seed companies to test their products. Companies pay an entry fee for each hybrid to cover analysis and labor costs, knowing that the data from the studies will be made available to the public. All results are open source for farmer and seed companies alike.

How do you account for testing so many different hybrids with specialized growing needs?
We split up the seeds into two different groups – those that have a short growing season and those that have a long growing season. Both groups are planted in two distinct locations in New York State with different growing conditions. The seeds are evaluated against those that are most similar to them, which provides more accurate results that farmers can use to make purchasing decisions.

Can you speak to the collaboration between Cornell and the University of Vermont (UVM)?
Yes, this arrangement has been one of the major contributors to the growth of the program. Cornell takes entries for all the growing locations in New York and UVM agrees to grow the same hybrids at a site in Vermont to assess the seeds’ performance in different climates and agricultural conditions. Their team plants and collects data throughout the growing season, adding to the diversity of growing conditions each hybrid is tested in. Testing multiple conditions affords the best data possible.

What are some key findings from the 2021 NY-VT Corn Silage Program?
Overall, it was a good growing season. It started off quite dry in May and June, but as rain increased as the season went on, the crops seemed to withstand the change and produced high yields. Forage quality is also really important for silage production, even more so than grain. We try to emphasize that our focus is on the quality of the forage that farmers feed their animals. In this case we prioritize quality along with yield, which means we take a unique approach to feed analysis.

Joe Lawrence in a cornfield. Image provided

Tom Overton, department chair and professor in Cornell CALS Department of Animal Science.

Soil Law from 16

The summit’s detailed breakout sessions led to the 2019 New York Soil Health Roadmap, a 40-page document, which opened with: “Historical land use and intensive agriculture with poor soil management have led to an alarming loss of organic matter in agricultural soils worldwide. The profitability and sustainability of many New York farms are vulnerable to this trend [and] the importance of organic matter to soil health cannot be overstated.”

Van Es agreed. “Allowing thought leaders like Cornell and the College of Agriculture and Life Sciences faculty to speak on these issues translates into important policy and legislation – and well-being,” he said. “Sometimes it just takes a long time, but moonshot thinking is something that pays off in the long run.”

Van Es, Ryan, and Wolfe are faculty fellows at the Cornell Atkinson Center for Sustainability.

This story first appeared in the Cornell Chronicle.

Blaine Friedlander is a senior science writer for the Cornell Chronicle. His work focuses on astronomy, sustainability, food science, architecture and planning, and Cornell history.
By Melanie Greaver Cordova

The storm in autumn 2020 brought more than just torrents of wind and rain. Biting midges, no wider than a few millimeters, were swept up as the storm rolled to the Northeast. Deposited at their new northern home, the midges — Culicoides midges — went back to doing what they do best: biting deer.

Soon deer in New York’s Hudson Valley started showing symptoms of epi-zootic hemorrhagic disease spread by the midges: weakness, bruising, swollen tongue, and loss of fear of humans.

A field biologist with the New York State Department of Environmental Conserva-tion (DEC) quickly contacted Elizabeth Bunting, wildlife veterinarian and associate professor of practice at the College of Veterinary Medicine (CVM). They found a buck exhibiting suspicious symptoms and would bring it in for testing.

The New York State Wildlife Health Program was ready to confirm the diagnosis. A key partnership between Cornell and the DEC, the program coordinates re-sponses when disease strikes New York’s wild ani-mals. And it helps prevent outbreaks, in domestic an-imals and people too, by translating data into policy.

Bunting knew the disease could spread not only to wild deer but also to captive herds and cattle. She alerted partners across the state about the outbreak through the Wildlife Health Program’s robust communication network. Ultimately, the disease killed only about 1,500 wild deer that autumn out of a population of one million. In compari-son, other northern states have fared much worse and have lost tens of thousands of wild deer to outbreaks of the disease.

“Because of climate change, we are seeing more insect-borne diseases moving into New York,” Bunting said. “Collecting data from these outbreaks helps us to investigate the why, how, and where so that the agency can make sound management decisions.”

In April 2021, the DEC re-newed the Wildlife Health Program for a third five-year contract, this time for $6.4 million.

“Our program is the best of its kind and has served as a model for other states,” said Kevin Hynes, DEC program leader and wildlife biologist. “We are entering our second decade of this joint en-deavor, which combines the expertise and capabilities of both the DEC and Cornell to help protect New York’s wildlife populations and hu-man residents.”

A Knowledgeable Network

The Wildlife Health Pro-gram develops high-quality scientific information about disease ecology in wildlife species through surveil-lance and research via the program’s network of DEC field biologists and manag-ers, veterinarians, and collaborat-ing scientists. The program examines 1,600 wildlife cases each year. They generate and centralize diagnostic data, perform epidemiological modeling, advise on health-related policy, and make it easily accessible to the state and public.

For instance, if a field biol-ogist recovers several dis-eased crows, they can send them to one of three labs — Cornell’s Animal Health Diagnostic Center in Itha-ca, the Cornell University Duck Research Laborato-ry on Long Island, or the DEC’s Wildlife Health Unit in Delmar — that analyze the cause of death. Is it an avian reovirus, which can spread throughout crow populations in winter when they’re in close quarters? If it’s not, the program can sound the alarm if a new disease has emerged.

And the program takes a “One Health” approach — the concept that humans, animals, and the planet are interconnected. “If there’s a disease that kills wild-life, we care for the sake of that animal population and its interconnected role in the ecosystem,” Bunting said. “But we also care in case that disease affects domestic animals or even people, whether directly or indirectly.”

Zoonotic diseases — those that animals transmit to people — like West Nile vi-rus, rabies, tularemia, and Lyme disease, can have significant negative conse-quences for humans. But it works both ways.

Sometimes human activi-ties are the number one cause of death in wildlife: vehicle strikes, birds flying into windows, poisoning, habitat loss, and domestic pet attacks. Humans can spread some wildlife dis-eases by moving animals, feeding them, or tracking in the disease via shoes and equipment — like the fun-gus that causes lethal white nose syndrome in bats. “It is important to have a pro-gram in place to detect new disease occurrence and to study the effects and conse-quences of those diseases,” Hynes said.

The ongoing coronavirus pandemic is an excellent example of how complex that can be, Bunting said. “Humans have caught coro-naviruses from animals several times in the past. But this time we’ve given SARS-CoV-2 to wildlife, and now there is concern that it could bounce back into humans in a different form.”

A Decade of Data

In 2011, Bunting and Kry-sten Schuler, assistant re-search professor at CVM, created the Wildlife Health Program in partnership with the DEC. At that time, the DEC had weathered many wildlife disease crises: West Nile virus, chronic wasting disease, and white nose syndrome, but without any veterinary staff in the agen-cy. Partnering with CVM was a natural fit.

“They came to Cornell be-cause our Animal Health Diagnostic Center had as-sisted them with detecting and eliminating chronic wasting disease in deer, and diagnosing white nose syndrome in bats,” Bunting said.

Schuler, a wildlife disease ecologist, provided the per-fect complement to Bun-ting’s expertise in clinical wildlife veterinary medicine. “There could not have been anybody better,” Bunting said. “She had years of experience in investigating wildlife disease outbreaks all over the country.”

Bunting, Schuler, and the DEC outlined what would be needed to achieve the program’s goal: an accu-rate, robust, and efficient wildlife disease surveillance program.

The first 10 years of the Wildlife Health Program re-versed around five pillars: training, surveillance, com-munication, policy, and out-reach.

Staff, environmental con-servation officers and part-ners learned safe practic-es when interacting with or handling wildlife in the field – a crucial step as biologists submitted wildlife cases to create a baseline of infor-mation.

“That first year we tested ev-ery animal we received for rabbies, even deer,” Bunting said. “We found eight deer carrying rabbies, which was unexpected. They didn’t fit the typical descriptions of rabid animals. It really land-ed with our biologists that they had to be careful.”

Communication is Key

To improve communication, the program’s data analyst, Nick Hollingshead, helped create a statewide disease database, adapting special-ized software and designing a website to make surveil-lance data accessible to all DEC biologists.

“We needed to be able to share this information back to the agency in a useful way,” Schuler said.

The program forged part-nerships with the state’s departments of Health and of Agriculture and Markets, so all partners are informed when an issue arises. The program also informs pol-lymakers on wildlife health topics, such as chronic wasting disease (CWD). The disease is universally fatal and causes progres-sive weight loss and loss of brain function. It spreads through direct contact as well as saliva, feces, and urine. The prions that cause CWD can bind to soil or be taken up in plants, where they remain infectious for years. It is currently present

Disease 19

Wildlife veterinarian Elizabeth Bunting co-founded the Wildlife Health Program and is associate professor of practice at the College of Veterinary Medicine.

Ryan Young / Cornell University

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Virtual Reality Farm Tour Expands Access to Urban Agriculture

The pandemic has hindered farm visits and peer-to-peer learning between farmers, which were already difficult to arrange. A new virtual reality urban farm tour aims to change that.

By Krishna Ramanujan

One way farmers learn best practices is through their peers, but the pandemic has limited in-person meetings.

And when it comes to urban farming, a growing practice across the state that is not yet mainstream, traveling to farms in other cities may be difficult even in the best of times.

Now, Cornell researchers have created the most advanced virtual reality (VR) urban farm tour ever made – an online learning experience that promises to transport urban (and rural) farmers to New York City’s Red Hook Farms without ever leaving home.

“It may be the best and one of the only high-resolution 3-D models of an urban farm in existence,” said Tapan Parikh, associate professor of computer and information science at Cornell Tech. Parikh is the first author of the paper “Greening the Virtual City: Accelerating Peer-to-Peer Learning in Urban Agriculture with Virtual Reality Environments,” which was published Feb. 3 in the journal Frontiers in Sustainable Cities.

The research team used drones and a technique called photogrammetry to create a virtual model of Red Hook Farms, a youth-centered urban agriculture and food justice program in Brooklyn, managed by the Red Hook Initiative.

Users will be able view the platform with a VR headset, but also through a computer or mobile phone to accommodate varied access to technology, due to lack of infrastructure, or an inability to afford equipment such as headsets that can run upwards of $300. Ambient sound will add to the experience of being at Red Hook Farm. Users will be able to “walk” around the farm and enter areas with demo and instructional videos led by farm managers. These videos will show aspects of farm production, such as cultivation, composting, and weeding.

With urban farms now established across New York State in New York City, Buffalo, Rochester, Syracuse, Utica, and Binghamton, VR offers urban, rural, and smallholder organic farmers new ways to network.

“An in-person farm visit can be prohibitively in terms of time and resources to bring people from all across the state together,” Parikh said. “We’re looking for some kind of happy medium between a situated embodied experience and the ability to convene people from across the state. We hope that’s what virtual reality provides us.”

The goal is to not only to connect farmers and improve New York’s agricultural education, but to introduce new participants to the world of agriculture. Cornell’s land grant mission, which provides services and trainings through the Cornell Cooperative Extension (CCE), has historically catered to state wildlife agencies to contain it without further spread of diseases – all in support of wildlife and the people of New York State.

“This is a way to see if there are technologies and engagement opportunities that are distinctly different,” said Jenny Kao-Kniffin, associate director of CCE and the paper’s senior author. “It’s a completely different agricultural system that’s being defined by people who don’t own land.”

“Virtual reality creates more exposure that goes outside your area as well,” said Koron Smiley, Red Hook farm manager and a co-author of the paper. A former video gamer, he sees the use of VR in urban agriculture as a way of reaching new audiences that bridge the tech world with farming.

“Virtual reality is a way to show another perspective of the farm, especially in 26 states. Schuler had arrived at Cornell from the U.S. Geological Survey’s National Wildlife Health Center in Wisconsin with a Ph.D. in CWD ecology. She worked on the center’s CWD surveillance and interagency management plan and advised on regulations guiding the importation of deer into the state. In 2019, she addressed the U.S. House of Representatives’ Committee on Natural Resources on CWD and provided scientific testimony, which lead to increased federal funding to state wildlife agencies to work on the disease.

“In New York, we helped design a risk-based weighted surveillance program that improves both collection of samples and our ability to detect the disease,” Schuler said. “We’ve provided that system to more than 20 other states, tailored to their needs.”

On Jan. 5, the National Deer Association named Schuler its 2021 Professional Deer Manager of the Year.

“So far, New York is the only state to have had an initial outbreak of CWD and contained it without further detections,” Schuler said. “and we want to keep it that way.”

Outreach Outcomes

The program has also created exhaustive resources for wildlife experts and the public. Their online fact sheets cover approximately 40 wildlife diseases and have been downloaded thousands of times. Other outreach includes social media, news articles, live webinars, and recorded videos and lectures. This information helps people understand the consequences their actions have on wildlife.

For instance, the program is investigating rodenticide poisoning, which kills rodents but can also sicken and kill animals that hunt and eat them. Hawks, owls, and fishers (part of the weasel family) have become collateral damage; more than 70% examined in New York had rat poison in their systems. The program is working with partners across multiple states to see how rat poison affects other species, like bobcats; CVM is using the program’s samples to develop a new diagnostic test for wildlife.

The program is also working on strategies to engage the public about the effects of lead with Katherine McComas, Ph.D., professor of communication in the College of Agriculture and Life Sciences and vice provost for engagement and land-grant affairs. “Because there is a potential concern that fragments of lead ammunition can wind up in venison,” Schuler said, “we’re working with the DEC on a campaign to educate hunters about the potential hazards of using lead ammunition.”

The Next 10 Years

Sampling wild animals is challenging and time consuming, and the program has turned to mathematical models to extract more information from state wildlife agency efforts.

For example, testing from 30 years of Hynes’s bald eagle samples showed that about 20% of the birds die from lead poisoning after scavenging game killed with lead ammunition. Schuler hired Brenda Hanley, research associate and mathematician, who built models on how such losses would impact the bald eagle population.

“Every loss is not just the loss of one animal,” Schuler said. “It’s the loss of that animal’s future reproductive capacity, and the reproductive capacity of every offspring that animal would have had.”

Said Bunting, “Our highest priority will always be taking our information and using it to do something – prevent, detect, and respond to diseases – all in support of wildlife and the people of New York State.”

A view of the 3-D model of Red Hook Farm in Brooklyn, NY, featuring a processing shed and high tunnels for vegetable production.

Tapan Parikh / Provided

to people who may not know about it, who are more into virtual reality, and may not go outside as much."

In the future, bridging high tech and agriculture may offer new career training opportunities, added Kao-Kniffin, who is also associate professor in the School of Integrative Plant Science Horticulture Section in the College of Agriculture and Life Sciences.

The work is funded by the USDA and a Cornell Tech Urban Hub Seed Grant.

Krishna Ramanujan is a science writer at Cornell University in Ithaca, NY, where he publishes news stories on genetics, agriculture, entomology, biology, ecology, health, and veterinary medicine.
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