

Making the Most of Mulch: Strategic Systems for Small Organic Tomato Growers

A mulch made with cover crop residue can help suppress weeds while building soil health. In Indiana, two tomato growers have teamed up with researchers and tomato growers at Indiana University's farm to experiment with mulch that combines leaf and cover crop residues. So far, their organic mulch strategy has resulted in improved soil health and salable yields of tomatoes.

"Mulches created from nitrogen-fixing cover crops, such as white clover and hairy vetch, are particularly attractive for nitrogen-demanding crops such as tomato, and in-row leaf mulch strips show promise for mitigating cover crop challenges," said Indiana University researcher and tomato grower Heather Reynolds. "Yet reliability and convenience often turns farmers to plastic mulch, a fossil-fuel intensive product that generates substantial landfill waste, and helps retain but does not build soil nutrients or organic matter. Straw is another common mulch choice, but can contain weed seed, promote mold, and lead to crop nitrogen deficits."

With support from a \$28,394 NCR-SARE Partnership grant, the team tested combinations of cover crops (living white clover or residue of winter rye-hairy vetch) and in-row leaf mulch for organic fresh-market tomato production.

First, they set up replicated mulch treatments and controls at the three partner farms. Their treatments consisted of white clover living mulch or winter rye-hairy vetch residue with and without un-decomposed leaf mulch. The leaf mulch was collected from the Indiana University campus in fall of 2018. Their controls consisted of leaf mulch by itself and the current standard practice at each farm (such as black plastic or straw).

Each farmer started their own seedlings, using either the Celebrity or Mountain Fresh variety. Tomato seedlings were planted into treatment and control beds in late May 2019. They trellised the tomatoes in early June 2019 and harvested July-September 2019. They conducted soil tests when the tomatoes were planted in May, and then again in early September.

The project is ongoing, but so far, across the three organic farms with quite different soil qualities, they have found that cover crop and leaf mulches were able to suppress weeds and build soil health.

Cover Crop Tomato Mulch Findings

- Soil health: Indicators of soil microbial health tended to be higher with alternative mulches. For example, at one farm white clover increased soil nitrogen cycling compared to plastic mulch. Likewise, indicators of soil carbon sequestration potential tended to be higher with cover crop mulches compared to plastic or straw mulches.
- Yields: Farmer's standard weed suppression method (black landscaping fabric, black plastic film, or straw) resulted in 28-95% greater salable tomato yield at all farms compared to the treatments and control. However, when combined with leaf mulch strips, white clover living cover crops and/or rye-vetch cover crop residue tended to promote the second highest salable yields at all farms.

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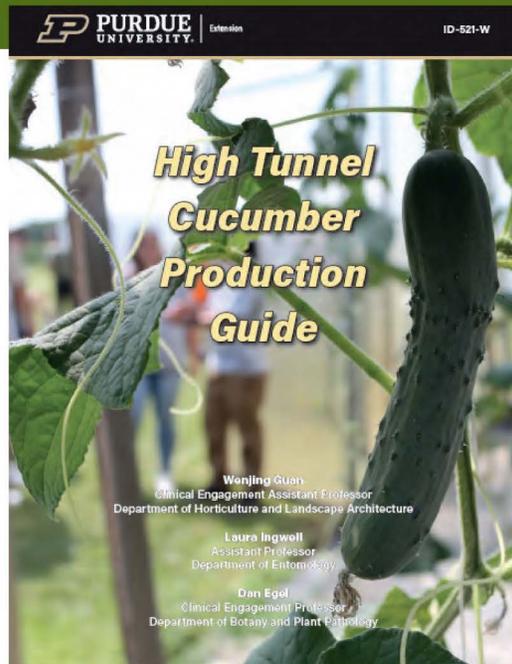


In Indiana, Stranger's Hill Organics, Blue Hour Farm, and Indiana University's Campus Farm are testing combinations of cover crops and leaf mulch for organic, fresh-market tomato production. Photo courtesy of Heather Reynolds.

"Cover crop mulches outperform plastic and straw mulches in terms of indicators of soil health and carbon storage," explained Reynolds. "And in-row leaf mulch strips show promise for mitigating cover crop challenges, but more research is needed to optimize these mulches so that they are truly competitive with conventional plastic or straw mulches."

Learn more about this SARE Partnership grant project at <https://projects.sare.org/project-reports/onc18-044> or contact the NCR-SARE office.

Production Guide for High Tunnel Cucumbers



High tunnels, also called hoop houses, are a form of protected agriculture. These plastic-covered structures can block rain, snow, and strong wind that crops are exposed to when growing in the open field. High tunnels hold heat, and that allows crops to be planted earlier and harvested longer. However, compared with greenhouses that are typically equipped with active heating and cooling and often supplemental lighting systems, high tunnels have a limited capability to maintain environmental conditions at the crop optimum range.

Heating and cooling of high tunnel structures rely on passive measures: closing and opening of the sidewalls and/or gable vents. Thus, high tunnels are a more open environment compared to greenhouses, resulting in unique growing conditions.

Over the past 20 years, high tunnels have become increasingly popular as a season extension tool for small farmers. Seedless cucumber is one of the most popular crops grown in high tunnels. The climbing growth habit, ability to set fruit without pollination, high yield potential, and long harvest window make seedless cucumbers an ideal crop for high tunnel production.

With support from a \$200,000 NCR-SARE Research and Education grant, Wenjing Guan along with Laura Ingwell and Dan Egel at Purdue University Extension developed a cucumber production guide to share resources and recommendations tailored to the distinctive growing environment of high tunnels.

"I really like the layout, with lots of pictures," said a vegetable specialist from Cornell. "I like how simple and direct to the point the language is, too, it feels very grower-friendly and attuned to shortened attention spans, while still giving enough info to troubleshoot the common problems. I'm excited to share the resource!"

Get the Cucumber High Tunnel Production Guide

Find the *Cucumber High Tunnel Production Guide* online at <https://northcentral.sare.org/resources/high-tunnel-cucumber-production-guide/>

Learn more about Guan's SARE grant project at https://projects.sare.org/sare_project/lnc17-390/ or contact the NCR-SARE office.

Join an NCR-SARE Committee

Do you live and work in the North Central region and have an interest in sustainable agriculture? NCR-SARE has openings on our review committees.

Grant Review Committees

Serving on an NCR-SARE grant review committee can be a rewarding and educating experience. Each review committee has varying requirements, but generally, members review proposals, discuss the proposals, and make recommendations to the Administrative Council. To apply, visit <https://tinyurl.com/NCRSAREReviewCommittee>.

Erin Schneider and Rob McClure run Hilltop Community Farm in La Valle, Wisconsin, where they grow and sell vegetables, herbs, fruit, and flowers. Schneider has reviewed SARE grants as a member and chairperson of NCR-SARE's Administrative Council and as a member of the Farmer Rancher Grant Review Committee.

"As a reviewer, I have appreciated the chance to learn from a diversity of experiences and backgrounds throughout the region and network



Erin Schneider of Hilltop Community Farm. Photo by Colin Crowley.

with others," said Schneider. "It feels good knowing that through a consensus process among farmer peers, I'm helping farmers and practitioners find support, share in the risk, and advance sustainable agriculture in the region. I always felt valued for my time and contributions, even when disagreements arose. Often there is no

shortage of great ideas expressed in proposals, the challenge is limited funding. Offering feedback and encouragement to applicants has helped me cultivate a degree of empathy toward others, and be a better communicator when it comes to my own ideas for my farm business. I encourage you to try it out and apply!"



Above: David Karki came to South Dakota State University from Nepal in 2004 to pursue a master's degree in soybean breeding. Today, Karki is an SDSU Extension Agronomy Field Specialist and a South Dakota SARE State Coordinator.

SARE Grant Writing Assistance

If you are interested in writing a proposal for an NCR-SARE grant, we are here to help. We can provide grant reports from other projects, lists of funded projects, or other sustainable agriculture information. Visit <https://northcentral.sare.org/grants/apply-for-a-grant/> for more information or contact the NCR-SARE office.

Before writing a grant proposal, determine a clear project goal and explore previous research. It often helps to contact NCR-SARE, local agriculture groups, the Natural Resources Conservation Service, and/or Extension educators to share ideas and invite participation.

Michael Fields Grant-Writing Assistance
The Michael Fields Agricultural Institute's (MFAI) Grant Advisory & Resources can help you apply to grants and cost-share programs of state or federal sources. For more information and to sign up for grants advising e-mail list for program announcements, please visit the website at <http://michaelfields.org/grant-advising-resources/>, or contact MFAI Grants Advisor, Martin Bailkey at (608) 698-9478 or martinbailkey@gmail.com.

Grant-Writing Assistance from SARE State Coordinators

SARE has a network of state coordinators working in each state and island protectorate. Your SARE state coordinator can provide advice and feedback as you work on your grant proposal. Find your SARE State Coordinator and view documents about funded grants in your state by visiting NCR-SARE online at <https://northcentral.sare.org/state-programs/state-coordinators/>. or contact the NCR-SARE office.

Hosting Virtual Field Days

As we approach the 2022 field tour season, you might find that you still need to convert your in-person field day to a virtual one. NCR-SARE recorded two webinars for SARE grantees with tips about hosting virtual field days. The first webinar

was hosted with agricultural professionals and educators in mind, while the second webinar was geared toward farmers and ranchers. This online resource also includes equipment recommendations and costs.

Find SARE's virtual field day information online at <https://www.sare.org/publications/farmer-field-day-toolkit/hosting-virtual-field-days/>.

Right: With support from a SARE grant, Lauren Rudersdorf created an online video series for aspiring CSA farmers. The videos can be viewed online at <https://www.csainnovationnetwork.org/>



Online Sales and Marketing

SARE recognizes that producers are continuing to navigate sales and marketing strategies to comply with physical distancing associated with CoVID-19. Resources have been developed to help producers navigate online sales and marketing. NCR-SARE's collection of online marketing educational resources

is available here: <https://northcentral.sare.org/about/covid-19-sales-and-marketing-resources/>.

Left: Buckeye Valley Beef Cooperative compared the effectiveness of multiple advertising channels. Overall, the team determined that Facebook ads were the most effective method tested, after word-of-mouth advertising. Read more here: <https://northcentral.sare.org/news/ohio-beef-cooperative-measures-advertising-roi/>



Figs as a Niche Crop in Northern Ohio

Construction of a high tunnel for fig production at Hearthstone Berry Farm in Nova, Ohio. In this photo, the fig plants are about 3-4 feet tall. Photo courtesy of Tim Malinich.

Imagine sitting down for lunch and receiving an update from a local farm that fresh figs are available for pick up.

Tim and Beth Malinich run a small niche fruit farm in Nova, Ohio where they grow and direct market fruits like elderberries, currants, pears, peaches, and figs. Tim is a retired extension educator, who for many years worked with fruit and vegetable growers through Ohio State University Extension in Erie County. Beth is a veterinarian. In 2008, they bought a former hay farm and converted about 6 acres into niche fruit production. Starting with berries, they slowly expanded their offerings, and in 2018 decided they wanted to try growing figs on their farm in hardiness zone 6a.

“Figs are a niche crop with a definite market to a smaller number of buyers,” said Tim Malinich. “It makes a nice addition to the market, pick-your-own or otherwise.”

In 2018, they applied for and received a \$7,494 NCR-SARE Farmer Rancher grant to plant four varieties of figs using three types of overwintering methods: high tunnels, low tunnels, and no protection. They learned that figs could, in fact, be overwintered successfully with protection in Ohio.

Fig Findings

- All the fig plants in the open field died in the first winter. The low tunnel plants survived the winter but emerged too late to provide a decent crop. The high tunnel plants were more successful, emerging in late April and producing new canes.
- The Olympian and Chicago fig varieties have been the best performers—Olympian figs are larger, and Chicago Hardy figs are more prolific and sweeter.
- They keep the figs hot and wet— “The high tunnel is a sauna,” said Malinich, “and the figs love it.”
- They originally questioned whether a 12’ high tunnel made sense, but the fig plants are now reaching 10’, and they must prune the tops to protect the high tunnel plastic from the branches.
- Since the time of the study, they have increased the amount of mulch they use to better match the size of the mature plants.
- Fig-loving pests include mice, rabbits, and yellow jackets.

The Malinichs continue to grow figs in a high tunnel environment. Although they have increased their prices, they have more consumer demand for the figs. Tim Malinich questions the commercial viability of fig production in high tunnels in Ohio. He says regions with a warmer

climate would find it easier to produce a viable fig crop and make it profitable. Still, they intend to continue growing and selling figs at their farm.

“When the research project was finished and we determined that under the research parameters, figs were not profitable in our area, I asked my wife what she might want to plant in the high tunnel in place of figs,” said Malinich. “Without hesitation, she said she wanted to keep the figs and improve the planting—she likes marketing the unusual crops we have. Though not quite profitable for our market, the plants have been more productive with each year of maturity. Continuing to monitor the high tunnel production for several more years will reveal the extent of the maturity of the plant, root system, and pruning practices on the total marketable harvest. Increased production will open new markets and a possible increase in price.”

Dig Deeper

Learn more about this NCR-SARE Farmer Rancher fig project on the SARE project reporting website at <https://projects.sare.org/project-reports/fnc18-1111/> or contact NCR-SARE.

Fruitful Figs

Left: These two fig varieties successfully overwintered in high tunnels in Ohio. Olympian above, Chicago Hardy below.

Right: Fig plant growth being trimmed before it damages 12 foot high tunnel plastic. Photos courtesy of Tim Malinich.



Advancing Grassland Conservation in Nebraska



From the shortgrass prairies in the west to the tallgrass prairies in the east, rangeland ecosystems occupy a whopping 46 percent of Nebraska's 49.5 million acres. University of Nebraska graduate student Kyle Martens was a teenager at the height of the corn commodity boom and as a youth he enjoyed stories about the great grasslands.

"To think that over one million square miles with some of the richest species' diversity could one day disappear is troubling. It was difficult to see large swaths of habitat—areas I had explored and hunted in my formative years—practically disappear overnight," recalled Martens. "As part of a natural system, these landscapes can provide income for ranching operations and employment in rural communities; habitat for grassland plants, animals, and migratory species; and offer other services not always readily observed such as improved soil health, clean water, and carbon sequestration. Despite the overarching benefits, the conversion of grasslands to other uses remains widespread throughout much of the remaining Great Plains ecosystem."

Martens is working to better understand ranchers' preferences with regards to grassland conservation programs in Nebraska. In 2020, he received a \$7,926 NCR-SARE Graduate Student grant to learn which elements of a hypothetical payment for ecological services (PES) program could lead to adoption by Nebraska ranchers.

Partnering with Nebraska Extension, Nebraska Cattlemen's, Nebraska Grazing Lands Coalition, and the Nebraska Game and Parks Commission, Martens developed and distributed a survey to gather feedback directly from ranchers. They looked primarily at preferences for management actions, payment amounts, and contract lengths in voluntary conservation programs.

Key Survey Findings

- Participants preferred management actions that were tied to practices known to improve biological diversity.

- Ranchers showed strong preferences for the types of management actions that were incentivized and were less concerned about the accompanying contract length or payment.
- The least preferred practices were related to the management of water resources on the ranch.

"Of all of the 16 management actions we tested, using grazing to conserve biodiversity was preferred over all other possible program options," said Martens. "This suggests not only that biodiversity is a recognized term within Nebraska's ranching community, but it also indicates ranchers see biodiversity as a management strategy that can coexist with the core business of livestock production."

Understanding why the least preferred conservation practices were related to water management requires understanding that water supply and delivery may need a delicate management approach. Martens suggested that a conservation program like PES could look for more ways to specifically address biodiversity needs in relation to aquatic resource management.

"For example, rather than consultations on individual impaired species, it may be more effective to highlight the overall net decline of the aquatic ecosystem and what these declines tell us about water quality and landscape health," said Martens.

Advancing Conservation

Nebraska producers enrolled 350,981 acres through the 2021 Grassland CRP signup, coming in third behind Colorado and South Dakota. That seems promising, but Martens shared a 2015 study that shows that the rate of conversion in remaining temperate grassland

is occurring five times faster than what can be protected currently (Lipse et al., 2015). Martens' survey results suggested the need to offer flexible conservation programs that reflect the challenges of cattle ranching in a natural grassland system.

With support from a SARE grant, the Switzer family struck a balance between stewardship of natural resources and future economic sustainability on their ranch in Burwell, Nebraska. The small changes they made to their ranch management plan made a big difference for two native bird species and the bird-lovers who flock to watch them at Calamus Outfitters. Learn more at https://projects.sare.org/sare_project/fnc08-736/. Photo of lesser prairie chicken by Ryan Hagerty.

Martens hopes that stakeholders from ranching, conservation, and the private sector will come together to lay the foundation of a payment for ecosystem programs (PES) marketplace in Nebraska. He suggested collaborative trust networks as part of a leveraged approach. The approach could also include developing pilot locations statewide which could eventually serve as information exchanges among potential program participants.

"Conservation planners must work with ranchers to develop the long-term, cost-effective policy and practices we'll need on the farms and ranches of the future," said Martens. "Not only do these programs need to achieve the measurable conservation and delivery of ecosystem services, but these programs need to enhance profitability and demonstrate congruency with ranching lifestyles."

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Dig Deeper

Learn more about Martens' SARE project in Nebraska at <https://projects.sare.org/project-reports/gnc20-307>, or contact NCR-SARE.



Smart Water Use Bulletin Highlights Sustainable Water Management

Strahinja Stepanovic (right) works with farmers such as Steve Tucker of Venango, Nebraska, to grow field peas as a soil-building alternative to fallow. Photo courtesy Strahinja Stepanovic, University of Nebraska-Lincoln.

As the effects of climate change intensify, water management has become essential to the success of producers. SARE's newly revised *Smart Water Use on Your Farm or Ranch* discusses how producers and educators like Strahinja Stepanovic, a University of Nebraska Lincoln Extension educator, are using innovative methods to improve water-use management.

Stepanovic received a SARE grant to work with Nebraska producers to diversify their rotations with field peas, which is helping some conserve water, improve soil health, and adapt to market fluctuations.

"Farmers in the semi-arid regions of western Nebraska (14–19 inches of annual precipitation) who have no irrigation often conserve soil water by rotating cereal crops, such as corn or wheat, with a period of summer fallow," says Stepanovic. "Unfortunately, fallow expenses are increasing due to development of herbicide-resistant weeds, record-low wheat prices and low protein levels. Farmers are slowly abandoning the fallow concept and are searching for alternative crop rotations. We have shown that pulse crops like field peas and chickpeas are a solid alternative to fallow."

Smart Water Use on Your Farm or Ranch is available for free in print and for download; it is particularly useful to farmers and educators considering innovative approaches to agricultural water use.

Incorporating water management techniques is crucial to the success of agricultural production. Producers can maximize production efficiency, regenerate their soil, and conserve water by using techniques such as crop rotation, drip irrigation, and conservation tillage.

Part one of *Smart Water Use* examines how soil management strategies, such as cover cropping, adding organic matter and conservation tillage, can build soil health, improve soil structure, and boost the water holding capacity of soil. Part two discusses plant selection, crop rotation, and livestock management strategies. Part three highlights how irrigation and drainage systems can be used to better manage water use in cropping systems.



Download or order your free print copy of *Smart Water Use on Your Farm or Ranch* at www.sare.org/resources/smart-water-use-on-your-farm-or-ranch/ or by calling (301) 779-1007.

Smart Water Use on Your Farm or Ranch is available in quantity for free to educators for use in educational workshops, classes or tours.

Learn more about Stepanovic's NCR-SARE Partnership grant project in Nebraska at https://projects.sare.org/sare_project/onc16-021/ or contact the NCR-SARE office.

Grant Project Highlights

Learn more about exciting SARE-supported projects! Use the project number listed with the projects below to find more information at <https://projects.sare.org/> or follow NCR-SARE on Facebook or Twitter to receive regular updates like these:



At 17 years old, Gabe Olson-Jensen aims to prove that growing Honeycrisp apples organically is a workable option in his area

of western Wisconsin and eastern Minnesota. This is SARE project FNC21-1294. Photo by Mikey Moose.



The University of Illinois 4H Extension is exploring FarmBot open-source precision gardening technology with

Illinois youth. This is SARE project YENC20-144.



Six Midwest farmers have teamed up with The Land Institute to intercrop four legumes including alfalfa, red clover,

birdsfoot trefoil, and sainfoin with Kernza®. This is SARE project LNC18-406. Photo courtesy of the University of Minnesota.



Mark Gleason received a SARE grant to experiment with mesotunnels (protective tunnels that are twice as tall as low tunnels)

to help control cucumber beetles and squash bugs. This is SARE project LNC18-404. Photo courtesy of Iowa State University.



Erin Gaugler received SARE support to conduct on-farm research of bale grazing with multiple species. This is SARE project

FNC20-1218.

Growing Food and Community in North Saint Louis

Good Life Growing is an urban farm with a public service mission in North Saint Louis, Missouri. It uses a combination of aquaponic, hydroponic, aeroponic, and other sustainable farming methods to grow a variety of produce including microgreens, salad greens, and tomatoes. As a community-based organization, its broader goals address community revitalization and food insecurity in North Saint Louis.

In 2019, Good Life Growing received a \$25,736 SARE Farmer Rancher grant to use a 2,000 sq. ft. section of a larger indoor space to work with Urban Space Farms, Saint Louis Indoor Produce, and other community partners to create a modular, vertical aquaponic growing system and host educational programming.

“We intend to prove that formerly vacant property can be converted into thriving, sustainable, food-producing hubs capable of feeding the masses and creating living wage jobs,” said James Forbes of Good Life Growing.

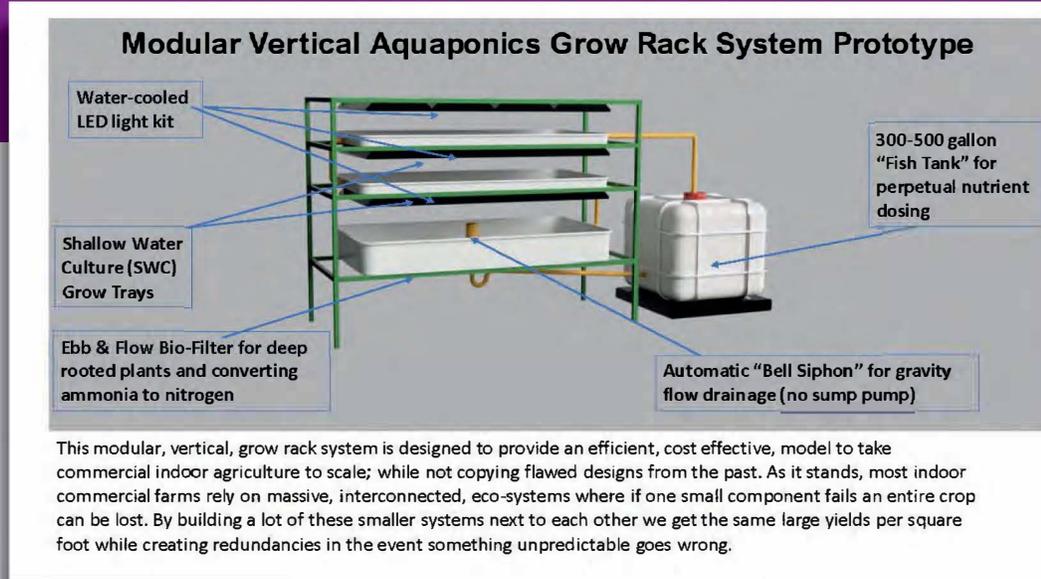
Building a DIY Aquaponics System

“We wanted to create a modular, vertical Aquaponic Growing Rack System that can produce a broad range of vegetables, an edible fish source that doubles as the nutrient supply, and innovative LED lighting technology that is energy efficient while putting out high density lighting capable of mimicking the sun,” said Forbes.

After looking at a variety of commercially available systems, the team developed a 4'x10'x8' grow rack system (pictured above right) using materials available from bulk ag suppliers, pallet rack manufacturers, and local hardware stores. For \$1,000, they were able to achieve a system of similar size and scale to commercial systems that were 300% more expensive.

“The advantage of implementing our project was identifying the best ways of producing an inexpensive, high performance aquaponic system and being able to share the designs with the general public,” said Forbes.

They designed their grow system to optimize production of lettuce, spinach, and kale (high



This modular, vertical, grow rack system is designed to provide an efficient, cost effective, model to take commercial indoor agriculture to scale; while not copying flawed designs from the past. As it stands, most indoor commercial farms rely on massive, interconnected, eco-systems where if one small component fails an entire crop can be lost. By building a lot of these smaller systems next to each other we get the same large yields per square foot while creating redundancies in the event something unpredictable goes wrong.

demand products in their market).

Results

- Volumes varied depending on type of crop, but per month they calculated roughly 1.5 lbs. of product per cubic square foot was produced (\$10 per cubic square foot monthly for their market).
- They developed cloud-connected software that allows them to gather and store data from their systems. This software is open source and is readily accessible to the public via their SARE report (linked on the right).



Advancing Quality of Life

“The biggest success story from this project has been the relationships we formed,” said Forbes. “While this project was designed for the masses to benefit from across the country, it was a dream come true to see so many economically challenged participants sign up and complete the educational program.

Good Life Growing has reached more than 100 urban farmers, rural producers, novice horticulturists, and experienced academics with their educational programming and tours. They have also employed 12 of the participants who completed affiliated programming through their project, as well several interns from St. Louis University who were tour participants.

Good Life Growing in North Saint Louis used SARE support to develop a scalable, replicable vertical aquaponic grow rack system. The system not only enables Good Life Growing to grow produce, but it also allows them to engage in enrichment activities with local community members. Photo by Layne Thompson-Forbes.

Dig Deeper

Read more about this SARE project online at https://projects.sare.org/sare_project/fnc19-1162/.



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Did you know NCR-SARE is on Facebook, YouTube, Instagram and Twitter? Keep track of our grant opportunities, projects, events, and more. Search for North Central Region SARE and follow us!

ABOUT NCR-SARE

NCR-SARE funds cutting-edge projects every year through competitive grant programs, and has awarded more than \$74 million worth of grants to farmers and ranchers, researchers, students, educators, public and private institutions, nonprofit groups, and others exploring sustainable agriculture in the 12 states of the North Central region.

Are you interested in submitting a proposal for an NCR-SARE grant? Before you write the grant proposal, determine a clear project goal, and look for sustainable agriculture research on your topic. Need help determining which program is best suited for your project? Go to www.northcentral.sare.org/Grants for more information, or contact the NCR-SARE office.

For more information about any of the NCR-SARE grant programs, go to www.northcentral.sare.org or contact the NCR-SARE office at 612-626-3113 or ncrsare@umn.edu.

TIMELINES*

Farmer Rancher

Mid-August - Call for Proposals Released
Early December - Proposals Due
February - Funding Decisions
Spring - Funds Available to Recipients

Graduate Student

February - Call for Proposals Released
April - Proposals Due
July - Funding Decisions
September - Funds Available to Recipients

Research and Education

August - Call for Preproposals Released
October - Preproposals Due
January - Full Proposals Invited
April - Full Proposals Due
July - Funding Decisions
Fall - Funds Available to Recipient

Professional Development Program

February - Call for Proposals Released
Early April - Proposals Due
August - Funding Decisions
October - Funds Available to Recipient

Youth Educator

Mid-August: Call for Proposals Released
Mid-November: Proposals Due
February: Funding Decisions
Spring: Funds Available to Recipients

Partnership

Early August: Call for Proposals Released
Late October: Proposals Due
February: Funding Decisions
April: Funds Available to Recipients

* Timelines are subject to change.

**NORTH CENTRAL REGION
SUSTAINABLE AGRICULTURE RESEARCH AND
EDUCATION PROGRAM**

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Iowa youth learned the benefits of sustainable pasture practices for livestock, people, and the environment through a series of workshops presented by Amy Powell with Iowa State University Extension. Powell's curriculum "Paddocks, Pastures, and People" is available online at <https://projects.sare.org/information-product/curriculum-paddocks-pastures-and-people/>