

Biogas System

Dickinson College Farm • Boiling Springs, Cumberland County, PA • blogs.dickinson.edu/farm
submitted by Matt Steiman • steimanm@dickinson.edu

Biogas systems convert organic wastes (manure, food waste, etc.) into burnable gas and liquid fertilizer. Dickinson College Farm has several smaller DIY digesters that have proven to be effective for several years at making gas for kitchen stoves in the farm's valued-added kitchen and crew living quarters.



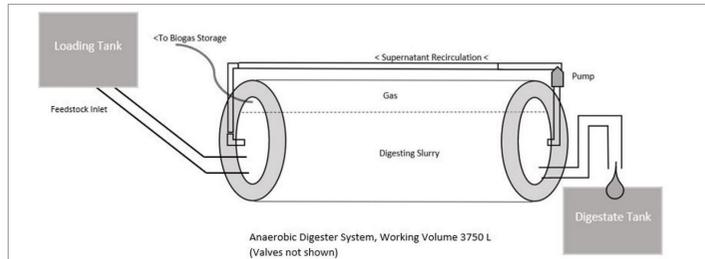
1000 gal pilot digester installed in greenhouse



Project Co-Designer Biogas Bob Hamburg



Mini digesters for lab analysis



Bags of biogas ready for transport to the kitchens

BENEFITS:

- prevents water pollution through improved manure management
- reduces landfill loading and methane emissions
- generates renewable electricity and revenue
- increases self sufficiency

DRAWBACKS:

- Small-scale systems require waste handling and thus are not for everyone.
- Small-scale systems only work in warmer months of the year.
- Large-scale systems are expensive and require several years of planning to implement.

YEARS IN SERVICE: 6

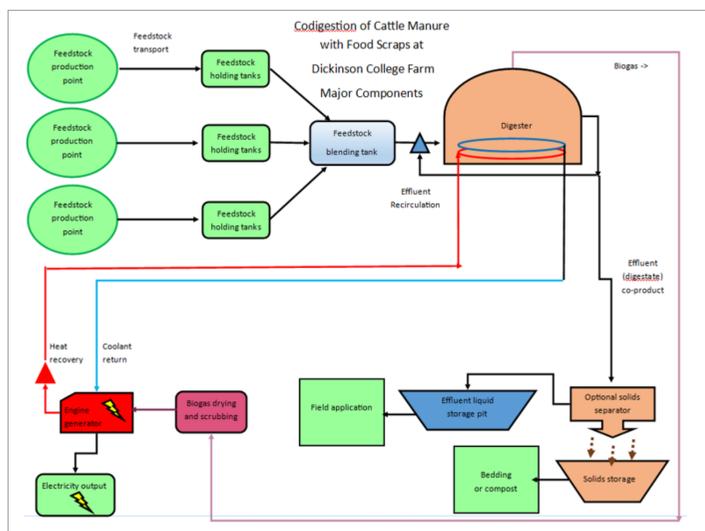
YEAR DEVELOPED: 2015

SUPPLY LIST:

- waste source
- hermetically sealed tank with an inlet and outlet for fluids and a gas tube on top
- gas storage
- gas transfer pump

ESTIMATED COST:

\$1,000



SCALE CONSIDERATIONS:

Smaller homestead systems can be owner-built or purchased off-the-shelf and are typically used to make cooking gas. In the Mid-Atlantic region, small digesters do best inside a greenhouse to maintain temperature.

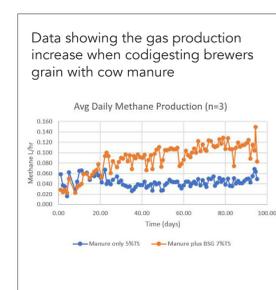
Larger systems for livestock farms are automated and typically used for making electricity that can power the farm or be sold to the grid.

EXPERIMENTING & LEARNING:

In 2021, we investigated the gas production value of brewers grain mixed into cow manure. In 2022, we'll look at spoiled milk and milk byproducts as co-substrates.

SCALING UP:

In 2022–23 the farm will install a large commercial food waste and manure digester to generate electricity.



Learn more about Dickinson College Farm's biogas project by pointing the camera on your mobile device here:



Grant funding for this project provided by NRCS-EQIP; US Environmental Protection Agency; Pennsylvania Department of Agriculture; and Sustainable Energy Fund.

Kreger Farms Interseeder

Kreger Farms • Morris Township, Tioga County, PA
submitted by Heidi Kreger • hmm5047@gmail.com

Machinery for seeding cover crops can be expensive and hard to come by. Our interseeder offers a low-cost option made with readily available parts and a repurposed John Deere 6000 sprayer. This allows farmers to plant cover crops into mature corn without damaging the cash crop, and can also improve cover crop success through earlier establishment.

BENEFITS:

- low-cost, readily available parts
- ability to plant into mature corn without damaging the crop
- improved cover crop success in areas with shorter growing season

DRAWBACKS:

- Interseeding becomes another task during an already busy time of the year.
- Broadcast seeding does not give ideal seed to soil contact, so not all types of cover crops work well using this method.

YEARS IN SERVICE: 3

YEAR DEVELOPED: 2019

SUPPLY LIST:

- John Deere 6000 sprayer or another high crop tractor
- broadcast seeder
- hydraulic motor
- angle iron to fasten the seeder

ESTIMATED COST:

\$3,000 (sprayer)
\$1,000 (other parts & materials)



SS2 Triticale, radish after corn silage harvest 2020



SS2 Triticale/radish at May 21, 2021 harvest

FINE TUNING:

Right now it takes two people to operate—a driver and a seeder opener. We would like to develop a way to open and close the seeder hydraulically.

Grant funding for this project provided by Northeast SARE: FNE20-956

Remay Roller

Snakeroot Organic Farm • Pittsfield, Somerset County, ME • snakeroot.net
submitted by Tom Roberts • tom@snakeroot.net

We love our versatile floating row covers, but rolling them up once they were no longer being used was one of the least fun jobs at the farm. This always left us with a bulky ball of Remay, which later had to be rolled out along the row to be covered in reverse procedure to the rolling up process. We knew there had to be a better way. After some initial experimentation with a cardboard roll, we refined that model using standard 10' sections of 1.5" PVC pipe as a winder spool and the rear-mounted tool bar on the tractor as a working station.



SUPPLY LIST:

- winder crank - two 90 degree 1.5" PVC elbows
- winder crank arm - one 1' length of 1.5" PVC pipe
- winder spools - five+ 10' lengths of 1.5" PVC pipe
- winder spool cradle assembly - two 18" lengths, 2" x 8" wood with 2" square holes and notches



ASSOCIATED EQUIPMENT:

tractor with 2" rear-mounted toolbar

ESTIMATED COST:

\$30 (one crank assembly and one spool)

BENEFITS:

- quickly and efficiently collect row cover when it is no longer in use
- easily move rolls of row cover around the farm for future use
- uniformly store rolls of row cover

DRAWBACKS:

- This version must be attached to a tractor, preventing it from being used elsewhere on the farm.
- This also requires three people to use, including a tractor operator.

YEARS IN SERVICE: 13

YEAR DEVELOPED: 2008



FINE TUNING:

Our current remay roller has evolved from the model shown here.

We continue to use the 1.5" PVC winder spools to deploy, recover, and store row cover.

However we now securely fasten the end of a row cover roll to the soil using ground staples, then we roll it out and recover it using only two people. This method only requires that adequate tension be maintained on the row cover and the PVC roll.

A garden cart or saw horses could be used as an anchor point to both spool and unspool row cover, as well.

See more of Snakeroot Organic Farm's innovations on their website by pointing the camera on your mobile device here:



Perennial Groundcover in Hazelnut Hedgerows

Nutwood Farm • Cummington, Hampshire County, MA • nutwoodfarm.com • [@nutwoodfarmers](https://www.instagram.com/nutwoodfarmers)
submitted by Seva Water • nutwoodfarmers@gmail.com

As an alternative to wood chip mulch, which must be reapplied annually and requires labor to maintain, we planted a mix of perennial groundcover species beneath rows of seedling hazelnuts during the establishment phase (the first three to five years). This groundcover planting reduces annual weed growth and improves soil health. We found that planting a perennial polyculture increased organic matter, soil exchange capacity, and nutrient cycling, but may have slowed the growth of the hazelnuts somewhat. However, unlike wood chips, the polyculture needs almost no maintenance after establishment.



BENEFITS:

- reduce annual weed pressure
- reduce labor needed to maintain hedgerows before nut production
- improve soil health
- increase nutrient availability

DRAWBACKS:

- Groundcover may slow the growth of hazelnuts.
- Results may vary by site condition.

YEARS IN SERVICE: 3

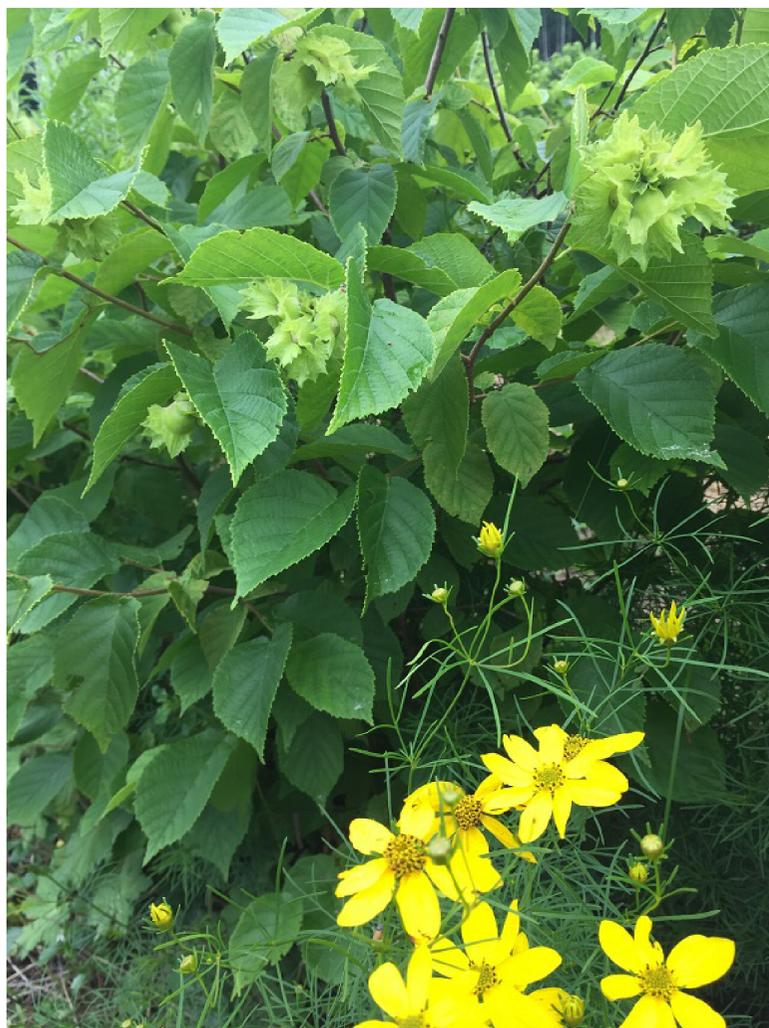
YEAR DEVELOPED: 2019

SUPPLY LIST:

- seeds and seedlings

ESTIMATED COST:

\$50 (per acre)



PRO TIP:

Based on our observations, we found these groundcovers to be most hardy, useful, and effective: comfrey, peppermint, coreopsis, geranium, and trefoil.

Integrative Crop Rotation

Rodale Institute • Kutztown, Berks County, PA • rodaleinstitute.org • @rodaleinstitute
submitted by Dan Kemper • @d.r._kemper

This unique farming rotation uses a diversity of enterprises with conservative tillage and regenerative standards. The plot using this scalable technique is 3 acres with three separate 1-acre fields, in a three-year rotation. Key parts of this rotation include: vegetables grown with 5-foot-wide living cover crop alleyways between beds; poultry put on vegetable fields after harvest; deep rooted covers like tillage radishes are sown after certain crops, and compost applications happen once every three years.



BENEFITS:

- low input—using only cover crops, compost, and animals for fertility
- reduced and conservation tillage
- high percentage of soil has continuous living cover throughout the season due to interplanting clover between cash crops
- diversity of enterprises/scopes within rotation

DRAWBACKS:

- requires some land to not be in cash crop production due to 5' alleyways of clover

YEARS IN SERVICE: 5

YEAR DEVELOPED: 2016

ASSOCIATED EQUIPMENT:

- grain drill
- rototiller set to 2" depth
- broadcast seeder
- 5' wide cultipacker
- plastic mulch layer and lifter
- tractor

Vegetable production



May 31

Tillage radish cover crop



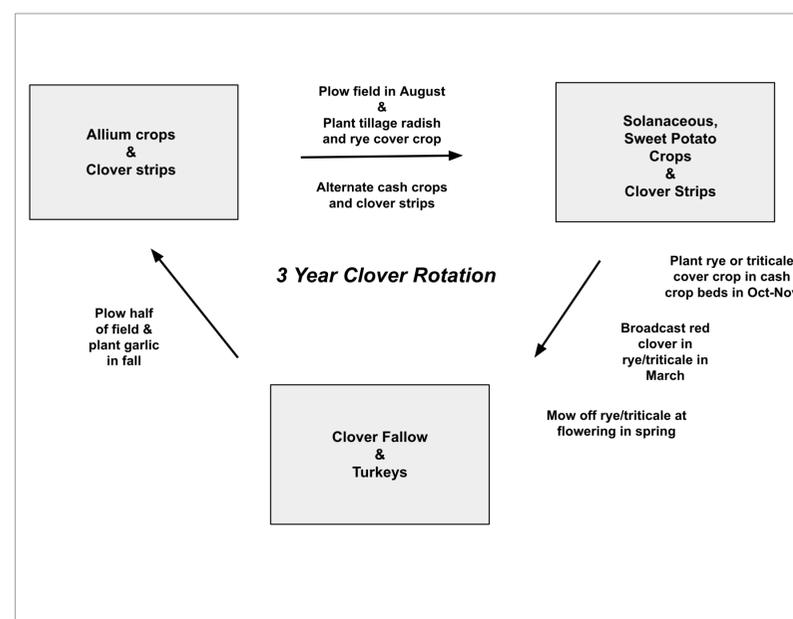
Aug 29



Sept 12



Dec 20



Pastured poultry for post-harvest fertilization



FINE TUNING:

In 2022, we hope to incorporate dry beans for human consumption in this rotation as well as a fallow clover field for chickens to spend an entire season on.

Legume root nodules fix atmospheric nitrogen



Alternative Energy High Tunnel

Tommye Rafes • Caldwell, Greenbrier County, WV • @t.l.fruitsandvegetablesllc
Submitted by Tommy Rafes • tommyerafes@aol.com

High tunnel temperature control and ventilation are key to successful year-round growing, especially during the winter months. We developed an effective low-cost, self-sustaining temperature moderation system for large high tunnels utilizing a geothermal network and powered by a configuration of solar panels, wind turbine, and batteries to energize fans that circulate moderating air into the high tunnel from geothermal piping. This system supports year-round plant growth including during extreme hot and cold, while reducing the need for fossil fuel inputs.



Solar panel to operate side wall ventilation

BENEFITS:

- decreases crop failure due to disease and temperature fluctuations
- improves winter crop growth
- self-sustaining system

DRAWBACKS:

- time, materials, equipment, and specialized knowledge to install

YEARS IN SERVICE: 3

YEAR DEVELOPED: 2019

SUPPLY LIST:

sleeve pipes, fans, manifolds, wiring, pipe connectors, installation boards, solar panels, controller, wiring, metal stand, concrete, batteries, wind turbine, and touchscreen controller from Advancing Alternatives

ESTIMATED COST:

\$10,000



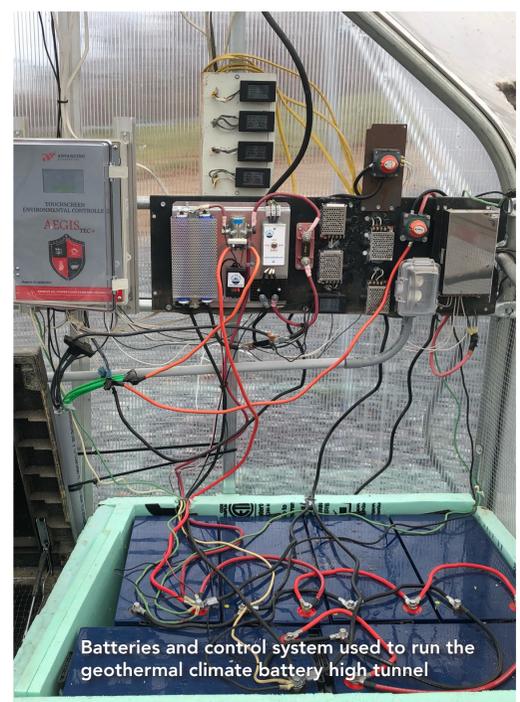
Fans used in geothermal climate battery high tunnel

FINE TUNING:

We are still studying which substrate material is best to use around underground pipes for controlling temperature in a geothermal climate battery system.



Advancing Alternatives control system



Batteries and control system used to run the geothermal climate battery high tunnel

Grant funding for this project provided by Northeast SARE: FNE18-907; FNE20-34

Solar Powered Dry Kiln

Paul & Katie Ann Fisher Farm • Newburg, Cumberland County, PA
submitted by Paul Fuge • paulfuge@certifiedwood.com

This scalable solar dry kiln serves as an off-grid, year-round, high-performance wood dryer. It can be used to dry firewood or cabinet grade wood for home building, and it has the potential to aid in biochar production. It can also be made to fit on a 30-foot-long trailer to be moved seasonally. Many of the materials, including the solar panels, can be sourced from repurposed or salvaged parts.



BENEFITS:

- increases the value and usefulness of cut lumber and other materials
- enables precise and programmable drying rates to professional standards
- operates off the grid and acts as an emergency power source
- provides auxiliary 120 V AC power and battery charging
- can be programmed for drying tasks other than wood

DRAWBACKS:

- initial cost of materials
- requires an accessible location that receives year-round sun

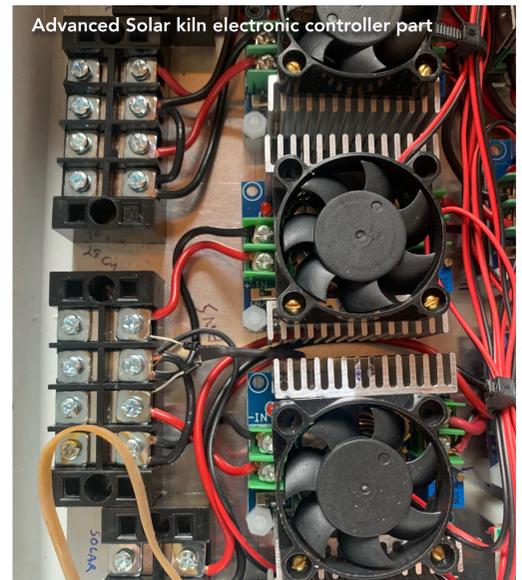
YEARS IN SERVICE: 2

SUPPLY LIST:

- structure materials
- solar glazing
- insulation
- fans
- electronic controls
- heat collector sheet metal

ESTIMATED COST:

\$2,500 – \$7,000



FINE TUNING:

Version 1.3 of the kiln paid for itself in 18 months and has a very low operating cost. All of the electrical energy and heat energy is solar powered. Versions 2.1 and 3.0 incorporate heat storage and wood fired hydronic heat for 24-hour operation.

We'd like to continue to improve the construction procedures, create an instructional guide, and find ways to lower the cost of the operating components.

Wheels & Weights for Dibbler

Grow Pittsburgh • Braddock, Allegheny County, PA • growpittsburgh.org • [@growpittsburgh](https://twitter.com/growpittsburgh)
submitted by Nick Lubecki • nick@growpittsburgh.org

AKA "The Hole Poker," our modified bed roller makes marking plastic mulch for transplanting a breeze. To add weight, which is helpful for breaking through the plastic, we use bricks (plentiful on our urban site) that are ratchet strapped onto the dibbler's platform. The one downside of adding weight is that it's difficult to move. We added wheels, making it easier to maneuver around the farm.



BENEFITS:

- Weight makes it easy to break through plastic mulch.
- Wheels make it easy to maneuver, despite the weight.

DRAWBACK:

- Sometimes a brick falls off, upsetting the weights.

YEARS IN SERVICE: 2

YEAR DEVELOPED: 2019

SUPPLY LIST:

- lawn mower wheels (largest size available)
- two bolts and four nuts for axles
- two ratchet straps
- bricks for weights

ASSOCIATED EQUIPMENT:

- Johnny's Seedbed Roller
- snap-in dibbles

ESTIMATED COST:

\$40



FINE TUNING:

We use bricks for weights because they are plentiful on our urban farm, but solid cinder blocks or another type of weight that bolts on might be more secure.

These lawnmower wheels work on our farm, which is fairly level and where we're mostly moving it on grass and pathways. Larger, pneumatic wheels, like bicycle tires, would make it more mobile on difficult terrain.



DIY VACUUM SEEDER

Grow Pittsburgh • Braddock, Allegheny County, PA • growpittsburgh.org • [@growpittsburgh](https://www.instagram.com/growpittsburgh)
submitted by Nick Lubecki • nick@growpittsburgh.org

Our DIY vacuum seeder, made from relatively inexpensive materials and a regulated Shop Vac, can seed a whole tray much faster than by hand. It uses vacuum suction applied to a wooden vacuum chamber box to hold seeds in place until the vacuum seal is broken and seeds are released into a tray. It works best with pelletized seed.



BENEFITS:

- low-cost
- timesaver

DRAWBACKS:

- This works best if you lock in one tray type (e.g. 128).
- Individual vacuum frames would need to be made for each additional tray size/type.

YEARS IN SERVICE: 1

YEAR DEVELOPED: 2021

SUPPLY LIST:

- 1" thick wood boards
- nails
- wood glue
- plexiglass cut to size
- tiniest drill bit to drill seed holes
- caulk to seal plexiglass
- drain pipe from a sink

ASSOCIATED EQUIPMENT:

Shop Vac

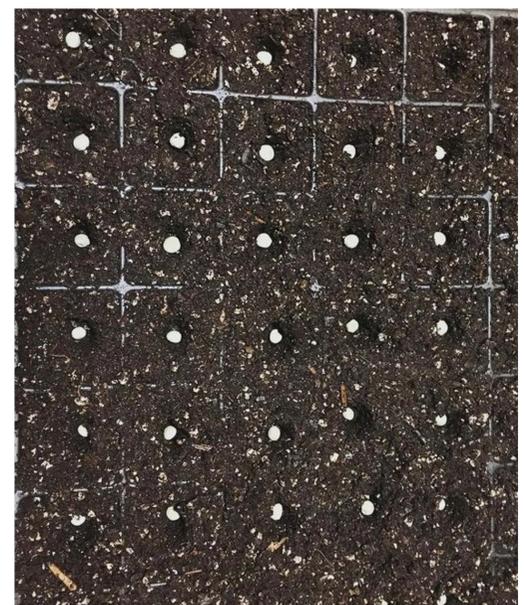
ESTIMATED COST:

\$50



FINE TUNING:

The vacuum box does not need to be so deep. Shortening it to 2" or less would make the seeder lighter. We tried to make it possible to switch out the plexiglass to do multiple tray sizes, but found it was easier to keep the air sealed by sticking to one well-sealed plexiglass sheet.



No-Till Permanent Raised Beds

Fat Peach Farm • Madbury, Strafford County, NH • fatpeachfarm.com
submitted by Jennifer Wilhelm • fatpeachfarmers@gmail.com

Our farm is on marginal soils with a thin organic horizon layer on top of one and half to two meters of sand. Permanent raised beds (PRB) have been shown to provide various agroecological benefits without compromising yields. We built out one acre of no-till PRB. We mowed the sod close to the ground and smothered it using 10 centimeters of hardwood chips. We then constructed beds 10 centimeters high on top of the chips with weed-seed-free compost.



BENEFITS:

- reduces weed pressure effectively
- develops soil organic matter quickly
- labor cost savings
- low barrier to entry and low annual maintenance costs
- increased water holding capacity
- carbon sequestration potential

DRAWBACKS:

- Cash crop production is delayed for a year until hardwood chips break down.
- Establishing beds by hand is labor intensive.

YEARS IN SERVICE: 7

YEAR DEVELOPED: 2014

SUPPLY LIST:

- Ramial wood chips
- weed-seed-free compost
- materials to mark out each bed for development

ESTIMATED COST:

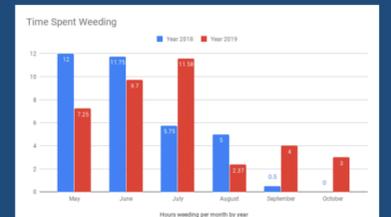
\$200 (per 100' x 32" x 4" PRB)



No-till Permanent Raised Beds



Research Results: Weed Management



Results indicate that our farm has high weed diversity, but low abundance. Annual weed pressure varies (2018 most year for maples).

PRO TIP:

Ramial wood chips are great for quickly building up organic matter in marginal soil. These are made from the branches of deciduous trees and shrubs chipped to 7 centimeters or less in diameter. They offer a great environment for beneficial fungi growth.

However, if you don't allow a season for the wood chips to break down, it will rob nitrogen from soil.

Grant funding for this project provided by Northeast SARE: FNE18-914