

Indiana Small and Urban Farm Guide to Soil Health and Conservation Planning

A Guide for Indiana Conservation Partnership Employees



Amanda Kautz, USDA Natural Resources Conservation Service, District Conservationist, Goshen

Kevin Allison, Urban Soil Health Specialist, Marion County Soil and Water Conservation District

Elli Blaine, Soil Health Outreach Coordinator, Marion and Hendricks County Soil and Water Conservation Districts

Important: This document is not intended for use by the general public. It is not an official manual but an internal educational guide to be used for Indiana Conservation Partnership staff and Earth Team Volunteers. Conservation planning is a dynamic process and will be unique with each person you work with.

ACKNOWLEDGEMENTS:

Thank you to the following writers, contributors and reviewers:

Tony Bailey, Agronomist, USDA NRCS, Indianapolis

Cara Bergschneider, District Conservationist, USDA NRCS, Bloomington

Rebecca Fletcher, State Public Affairs Specialist, USDA NRCS Indianapolis

Deb Jimison, Conservationist, Elkhart County Soil and Water Conservation District

Deb Knepp, District Conservationist, USDA NRCS, South Bend

Sarah Longenecker, County Conservationist, St. Joseph County Soil and Water Conservation District

Troy Manges, District Conservationist, USDA NRCS, Plymouth

Stephanie McLain, State Soil Health Specialist, USDA NRCS, Indianapolis

Michael O'Donnell, Organic and Diversified Agriculture Educator, Purdue Extension

Dan Perkins, District Director, Jasper County Soil and Water Conservation District

Victor Shelton, State Agronomist, USDA NRCS, Indianapolis

Harold Thompson, Soil Conservationist, Marion, Boone and Hendricks County Soil and Water Conservation Districts

Kris Vance, Public Affairs Specialist, NRCS, Indianapolis

Charlotte Wolfe, Prairie Winds Nature Farm, Lakeville

Photo Credits:

Amanda Kautz, USDA NRCS

Berrien County Conservation District (Michigan)

Blue Yonder Farm

Dan Perkins, Jasper County Soil and Water Conservation District

Elkhart County Soil and Water Conservation District

Flame Weeders, Glenville, WV

Grow Organic www.groworganic.com

Kevin Allison and Elli Blaine, Marion County Soil and Water Conservation District

Michael O'Donnell, Purdue Extension

USDA Natural Resources Conservation Service

TABLE OF CONTENTS

INTRODUCTION AND GOALS.....	5
Goal of This Guide	5
Focus on the Four Soil Health Principles.....	6
Why Soil Health for Small and Urban Farms?.....	7
Opportunities at the Small and Urban Scale.....	8
COMMON CUSTOMERS AND GOALS	8
Types of farmers/growers that actively produce food on small acreage	8
Reasons for Producing Food	8
Examples of Common Growing Systems	9
Production Challenges	11
RESOURCE CONCERNS	12
ADDITIONAL CONSIDERATIONS	12
Heavy Metals and Other Toxins.....	12
Food Safety	16
Legal Considerations: Zoning, Ordinances, etc.....	17
Land Ownership/Tenure	18
Economics	18
Staff Time Management	20
ADDRESSING RESOURCE CONCERNS	22
Conservation Planning	22
Conservation Practices.....	22
SOURCING CONSERVATION MATERIALS.....	31
SMALL FARM AND GARDEN EQUIPMENT.....	33
Hand Tools	33
PROGRAMS	39
USDA NRCS Environmental Quality Incentive Program (EQIP).....	39
Clean Water Indiana Grants (CWI).....	39
Farm Service Agency	40
Indiana State Department of Agriculture	41
Other Grant Sources	41
PARTNERSHIPS	42

Indiana’s Conservation Partnership	42
Local Resources	42
Leveraging Existing Networks and Connections	43
EDUCATION: DEMONSTRATIONS AND OUTREACH	45
Workshops/Field Days	45
Working with Partners	46
Promotional Material.....	47
ADDITIONAL RESOURCES	48
Equipment for Demonstrating Small-Scale Soil Health Systems	48
Recommended Trainings and Learning Resources	48
GLOSSARY OF TERMS	53
APPENDICES	57
Appendix A. Lasagna Garden Description	58
Appendix B. Cover Crop Packet Insert Examples (source: Marion County SWCD)	59
Appendix C. Cover Crop Handout Examples (source: Jasper County SWCD)	60
Appendix D. Cover Crop Mixes for Microfarms and Gardens (Source: Marion County SWCD)	64
Appendix E. Cover Crop Seeding Table for Microfarms and Gardens (Source: Marion County SWCD)	65
Appendix F. Recommended Trainings and Resources for Farmers and Growers.....	66
Appendix G. Examples of Signs Used at Demonstration Sites (Source: Marion County SWCD).....	70

INTRODUCTION AND GOALS

The Indiana Urban and Small Farm Soil Health and Conservation Planning Guide is a resource for conservation partnership staff to assist urban and small farmers and gardeners with addressing their resource needs and achieving their conservation goals. The focus of this guide is on the principles of soil health and the basic principles of conservation planning regardless of farm size. Many of the same resource concerns and conservation practices that address them are common for both small and large-scale farms.

Goal of This Guide

To provide Indiana Conservation Partnership staff and Earth Team Volunteers with a guide that helps them provide better conservation planning and technical assistance on conservation cropping systems, soil health, and water quality education to:

- Vegetable growers
- Gardeners
- Small farmers with a variety of annual and perennial crops
- Urban land users
- Community organizations
- Schools
- Community and Elected officials
- General public

This guide is not intended for distribution to the public.

Focus on the Four Soil Health Principles

1. Minimize Disturbance
Disturb the soil as little as possible.



2. Maximize Soil Cover
Keep the soil covered as much as possible.



3. Maximize Biodiversity
Using crop rotation and cover crops.



4. Provide Continuous Living Roots
Keep plants growing throughout the year.



Why Soil Health for Small and Urban Farms?

All people who use the land have an impact on our water and soil quality. Traditionally, there have been strong outreach efforts and resources put toward large-scale farmers. At the same time, there is a growing trend of increased food production and small farms in the urban and peri-urban landscape. These land users can have an impact on natural resources and it is increasingly important to provide them with sound information about soil health practices and general conservation concepts that leads to better land use decisions.

The small farm and urban farm sectors are two of the fastest growing in the agriculture industry. Much of this growth is due to the fact that consumers want local and sustainably grown food, and to know where their food comes from. This necessitates the creation of small/urban farms to fill this market gap. As conservationists, we want this food to be produced using good conservation practices that promote sustainability and soil building.

In order to serve these new and diverse customers, Indiana's Conservation Partnership employees must be aware of their needs and prepared to help as efficiently as possible these operations with their conservation needs, especially as it relates to soil health.

Working with small/urban farms allows us to touch a greater audience and to reinforce that improved soil health results in multiple benefits, including:

- Increasing organic matter
- Increasing aggregate stability
- Increasing water infiltration
- Increasing water-holding capacity
- Improving nutrient use efficiency
- Enhancing and diversifying soil biology



The above photos were taken at an urban farm in Indianapolis. **LEFT:** Growing beds after heavy spring rains (2015). The significant erosion was due in part to multiple cycles of tillage with minimal conservation practices. **RIGHT:** Growing beds at the same farm, after beds were cover cropped in fall (2017). This conservation cropping strategy will reduce the impacts of wind and rain erosion, improve aggregate stability and water infiltration, and result in many of the other benefits listed above.

Opportunities at the Small and Urban Scale

- Small farms often have a shorter response time, so they may be able to implement or try a soil health technique that is new to them within the same growing season.
- Innovations and successful methods used on small farms can be scaled up for use on larger farms that also impact soil and water quality.
- The social network of small/urban growers is typically robust, allowing for knowledge-sharing amongst many individuals that can have a positive impact on soil and water quality. However, depending on location, the opposite may be true and some small farmers are more isolated. We need to identify opportunities to reach these farmers with the information they need and connect them to other small farmers.
- Some individuals and organizations who farm on a small scale have an educational component to their work that reaches a broad audience youth and adults and furthers our efforts to teach soil health practices.

COMMON CUSTOMERS AND GOALS

Small farmers and gardeners use a variety of inputs, both organic and conventional. This guide may be used to work with either, but many of the references included refer to organic production.

Types of farmers/growers that actively produce food on small acreage

- Market Gardeners/Small Farmers
- Community Centers and Associations
- Community Gardens
- Schools
- Churches
- Non-Profits
- Backyard Gardeners
- Large-Scale Producers with Gardens
- Partner Organizations
- Institutions and Commercial Sector

Reasons for Producing Food

- Profit through farmers' markets, direct sales, and community supported agriculture
- Food pantry donations
- Improve worth of unused urban land
- Community development
- Education
- Food insecurity and food access
- Demand for high quality, nutritious and local food
- Personal consumption

Examples of Common Growing Systems

1. Several 30-inch wide earthen raised beds are separated by narrow walkways. A rotary plow is used in the walkways for weed management and to form the growing beds. A power harrow and/or broad fork is used to shallow till the raised bed and create seed beds. The earthen raised beds can assist with garden organization, amending the growing area, and decreasing compaction.



Butler University's Center for Urban Ecology (CUE) farm. 30" beds are used for diverse crops, which includes many conservation practices maintained by Farm Manager Tim Dorsey

2. This community garden offers free or rentable 4' x 8' wooden raised beds to the public. Some community gardens have bylaws requiring organic production.



Master Gardener's raised-bed plot located at Marion County Fairgrounds

3. An institution, such as a school, may have a combination of raised and in-ground beds that include a variety of crops.



Paramount School of Excellence in Indianapolis has 16 raised beds with one or two crops and a few 30" in-ground beds

4. A high tunnel is installed to extend the growing season. Raised beds can be installed or crops can be planted into natural soil beds. Beds are typically 30 inches wide with walkways in between in either scenario. Crops may be maintained throughout the year, and with the extra heat provided by the high tunnel, farmers can grow crops such as carrots or greens well into or throughout the winter. The high tunnel may have roll up sides that can be used to vent it in hot summer weather to prevent overheating.



High tunnel used by Sara Creech at Blue Yonder Organic Farm, North Salem

5. A small farm has an orchard, several fields for vegetable crop production, and a small pasture for livestock production. Chickens are kept in an area around the vegetable production fields to

provide natural pest control and use the manure as a soil amendment. The pasture is used for dairy goats who keep brush and weeds under control and also provide a source of fresh milk. Dairy cattle or beef cattle may also be integrated into the pasture to help keep up with forage growth and provide milk or meat.



Examples of chickens and goats that are used on urban farms for weed and pest control, for their products (milk, eggs), and to educate volunteers and the community (See section on food safety for additional considerations when incorporating animals/manure into a garden area or crop field)

Production Challenges

Conventionally-tilled gardens are showing low aggregate stability and high phosphorous levels, the result of tillage and unbalanced inputs. With degraded soils, lack of moisture retention and diminished nutrient cycling leads to weak plants and diseases. Tillage also poses an additional concern in the urban environment by possibly exposing gardeners to lead that may be bound to soil particles. The pH in urban soils could be high because many base growing mediums are disturbed or subsoil. Water and fertility sources can also affect the soil's pH.

When urban areas are developed, topsoil is often completely removed and the remaining subsoils are heavily compacted from urban construction activities. What you are left with is soil with a high clay content, little to no organic matter and substantial compaction issues. The result is low water infiltration and rain water that runs off a lawn similar to the way it runs off other impervious surfaces. Carrying with it fertilizers, pesticides and other by-products into surface waters. Soil health systems that improve and build soil organic matter will increase the water infiltration and water holding capacity of these urban soils allowing for less runoff than in typical public and private green spaces.

According to a survey conducted by Purdue Extension Service, poor soil structure was listed as one of the biggest challenges for urban farmers, second only to on-farm infrastructure. Intense cropping throughout long seasons, unbalanced inputs selected for convenience or availability, and tillage passes put pressure on soil and water quality. Soil health cropping systems in vegetable production can strengthen the food system through plant productivity, water management, input reduction and efficiency, and climate resiliency.

Weed management is a huge challenge, particularly if the farmer is using natural and/or organic methods of weed control. It takes a lot of labor to deal with weeds, especially when trying to transition to conservation tillage, since tillage is commonly used as a form of weed control. Acreage also plays a

role in the amount of labor needed to control weeds. The difference in work required for successful weed management from a quarter acre to a half acre is huge, and can make the difference between success and failure of conservation practices.

Marketing is costly for some small/urban farms and finding what will sell in the markets available is a challenge, especially for new farmers. The number one question new farmers ask conservation partnership staff is what they should grow for market. This should always be the customer's decision, as it is a business decision rather than a soil health and/or conservation question, but staff can provide or help them find soil data or help connect them to other growers. For local market data, refer them to the local Purdue Extension educator.

RESOURCE CONCERNS

Many of the resource concerns found on large farm operations are also found small/urban farms as well. Below is a list of common resource concerns that may be present and can be addressed with conservation and soil health practices. This list is not comprehensive and additional resource concerns may be present depending on the location and type of operation. For example, livestock production limitations may be present on a farm with an animal component.

- Soil Erosion: Sheet, Rill, and Wind
- Soil Erosion: Gully, Ephemeral Gully
- Soil Quality: Organic Matter Depletion
- Soil Quality: Compaction
- Water Quality Degradation: Excess Nutrients in Surface and Ground Waters
- Water Quality Degradation: Excessive Sediment in Surface Waters
- Water Quality Degradation: Excess Pathogens and Chemicals From Manure, Bio-solids or Compost Applications
- Degraded Plant Condition: Undesirable Plant Productivity and Health
- Degraded Plant Condition: Plant Pest Pressure

ADDITIONAL CONSIDERATIONS

Heavy Metals and Other Toxins

A key issue of growing food and other plants in an urban environment is the prevalence of toxins in urban soils. Toxins enter the environment in numerous ways—air, water, and soil pollution, transportation emissions, industrial activities, illegal dumping, pesticide use, etc. Land use activities, such as urban gardening can affect people's risk of exposure to contaminants.

One of the primary concerns when gardening in an urban setting is lead contamination in soils. Lead poisoning is a serious human health hazard. Lead acts as a neurotoxin in the body and exposure can damage the nervous system, cause brain disorders, and result in developmental delays and short and long-term learning difficulties.

Lead contamination has a long history in urban environments, especially in cities that have or had a large industrial economy. It is considered a persistent bioaccumulative toxic (PBT) chemical, due to the way it behaves in the environment and its impact on human health.

The primary sources of high lead levels in the soil are from leaded gasoline, leaded paint and industrial wastes (from smelters, etc.). Lead piping has also been used historically in both residential and

commercial properties. Residue from pipe may also exist. Lead was banned from commercial use in paints in the 1970s, and from gasoline in the 1990s.

An important consideration is that lead poisoning falls within the realm of environmental justice concerns. Socio-economic factors affect how likely people are to be exposed to lead. In cities throughout the country, the burden of contamination falls predominantly on communities of lower economic status, due to historical and current social and environmental factors. When gardens are started in these communities to help provide fresh produce it can lead to increased exposure if not handled correctly.

Working around and with urban soils is the most common way of being exposed to lead particulates today. That is why it is such an important factor to consider when helping with agricultural activities in an urban environment.

There are a host of additional toxins that can be present in urban soils. The chart below lists common contaminants and their sources. Conservationists who work in urban areas should become familiar with this list generally, and refer customers to local health departments for additional information about action steps that should be taken to avoid health hazards.

General Source	Examples of Previous Site Uses	Specific Contaminants
Paint (Before 1978)	Old residential buildings; mining; leather tanning; landfill operations; aircraft or automobile component manufacturing	Lead
High traffic areas	Next to heavily trafficked roadways or highways; near roadways built before leaded fuel was phased out	Lead, zinc, polycyclic aromatic hydrocarbons (PAHs)
Treated lumber	Lumber treatment facilities	Arsenic, chromium, copper
Burning wastes	Landfill Operations	PAHs, dioxins
Contaminated manure	Copper and zinc salts added to animal feed	Copper, zinc
Coal ash	Coal-fired power plants; landfills	Molybdenum, sulfur
Sewage sludge	Sewage treatment plants; agriculture	Cadmium, copper, zinc, lead, persistent bioaccumulative toxins (PBT)
Petroleum spills	Gas stations; residential/commercial/ industrial uses (anywhere an aboveground or underground storage tank is or has been located)	PAHs, benzene, toluene, xylene, ethyl benzene
Pesticides	Widespread pesticide use, such as in orchards; pesticide formulation, packaging and shipping	Lead, arsenic, mercury, chlordane and other chlorinated pesticides
Commercial/industrial site use		PAHs, petroleum products, solvents, lead, other heavy metals (such as arsenic, cadmium, chromium, lead, mercury and zinc)
Dry cleaners		Stoddard solvent and tetrachloroethene
Metal finishing operations		Metals and cyanides

Source: EPA Brownfields Program. *Urban Agriculture and Soil Contamination*

Where Contaminants Are Found

The first step to understanding what and where contaminants, especially lead, may be located on the property is to learn about the land use history of the property. This can be done by looking at old maps, conducting web searches, talking with the previous landowner and neighbors, etc. An example is that customers within Indianapolis can refer to Maps.Indy.Gov to view aerial and street maps for most properties dating back to 1937.

Due to how lead was historically used, concentrations will typically be highest along the roads and streets, along the dripline of a house or building, or along fence lines, if built prior to 1970. If the property is currently vacant, refer to historical maps to determine if a structure was ever built on the property.

Generally speaking, if people are farming around industrial areas, or on formerly industrial land, they should learn as much about the previous land use and/or the type of industry conducted there as possible. Encourage landowners and users to take precautionary steps.

Determining If Toxins Are Present

The second step to determine potential toxic hazards is to perform soil tests. Soil tests are most often used by farmers for nutrient analysis. Additional tests for heavy metals and contaminants are advised. The current and historical use of the property can direct the customer on where to test. Soil samples should be collected 1) where contaminants are likely the highest, 2) from areas that are representative of the property (baseline), and 3) any areas that the grower plans to use for farming or other activities. As mentioned previously, the areas with expected highest levels of lead will most likely be along the road/street, along the dripline of a house/structure or near fence line. Soil samples should be collected from these areas. These samples can be used to test for additional toxins as well.

The results of soil tests can be used to help the customer plan for how the land will be used. If soil tests reveal contaminants, steps will need to be taken to provide safe conditions. Some steps for avoiding lead exposure are listed later in this guide. Seek additional consultation from a specialist regarding what should be done for specific contaminants and levels of toxicity.

Labs That Commonly Perform Heavy Metals Tests:

Many labs that perform nutrient analysis for soil samples also offer heavy metals testing. There is an additional cost for this analysis, and sometimes an additional form is needed (or an option selected on the form). Below is a list of labs that are commonly used. This is not a comprehensive list and not to be considered an endorsement of any specific lab.

- Kansas State University - Department of Agronomy - Soil Testing Lab. <http://www.agronomy.k-state.edu/services/soiltesting/>
- UMass Amherst - Center for Agriculture, Food, and Environment - Soil and Plant Nutrient Testing Laboratory <https://ag.umass.edu/services/soil-plant-nutrient-testing-laboratory>
- Cornell University - College of Agriculture and Life Sciences - Comprehensive Assessment of Soil Health <https://soilhealth.cals.cornell.edu/testing-services/individual-soil-analyses/>
- A&L Great Lakes Laboratories - Soil Analysis. (The customer may need to request heavy metals testing as an additional service, as this lab's primary services are in nutrient analysis.) <https://algreatlakes.com/pages/soil-analysis>

- Center for Urban Health, Marion County - Dr. Gabe Filipelli's lab at IUPUI will perform free soil lead testing through the Safe Urban Gardening Initiative. Instructions to submit samples are found on the webpage <http://indytilth.org/Links/Safe%20Urban%20Gardening%20Initiative.pdf>
- Consult with your local health department to determine their testing request process. Some may offer soil and additional household lead testing, as is the case for the Marion County Health Department.

Understanding Lead Levels

The Environmental Protection Agency (EPA) specifies standards for human safety for soil lead levels. Lead is considered a hazard when equal to or exceeding 400 parts per million (ppm) in bare soil in children's play areas, or 1,200 ppm for bare soil in the remainder of yard (the part that people do not use often). Read more [via the EPA](#). Children, especially those under 5 years old, are the most vulnerable to negative health outcomes due to lead poisoning.

Exposure Pathways

The main way people are exposed to lead in urban areas is through the dust particulates in soils. The pathways for exposure are inhalation and ingestion. Pets can track soil dust into homes, it can blow into the house through open windows, be tracked in on people's clothes and shoes, and can be in the air (especially in dry areas when dust is kicked up).

Actions to Limit Exposure, Garden Safely, and Remediate Soils

The practices listed below reduce the health risks of exposure to lead in soils. Different lead levels require different levels of action (see additional information below).

- Locate gardens away from old painted structures and heavily travelled roads.
- Cover bare, contaminated soils. Keep dust in the garden to a minimum by maintaining a well-mulched, vegetated, and/or moist soil surface. Use grass, bark mulch, or other material that covers the soil. Make sure to re-apply regularly to keep areas covered.
- Wash produce thoroughly. Leafy greens and other crops grown close to soils will likely accumulate dust on leaves - either by wind, or rain splashing soil onto them.
- Discard outer leaves before eating leafy vegetables. Peel root crops. Wash all produce thoroughly.
- Wash hands and exposed skin upon returning from the garden and prior to eating.
- Put gardening clothes in a bag upon entering the house, and wash these clothes separately.
- Leave gardening shoes outside, and knock off excess soil
- Hose down garden and bare soil when it is very dry to stop dust from blowing in the air and potentially leading to lead exposure.
- Protect the garden from airborne particulates by using a fence or hedge. Fine dust has the highest lead concentration.
- Give planting preferences to fruiting crops (tomatoes, squash, peas, sunflowers, corn, etc.).
- Incorporate organic materials, such as high quality compost, humus and peat moss.
- Use lime as recommended by soil test. A soil pH of 6.5 to 7.0 will minimize lead availability.
- Limit exposure to children. Be especially careful of children under 5 years old playing in the garden and working with soils.
- Lasagna gardening can also be used to reduce toxic exposure, and improve the capacity and safety of a garden. This gardening technique builds new, healthy soil above contaminated soils. Lasagna gardening builds raised beds by layering. It is best if these layers can sit for a month (or

as long as a season) before planting. Add compost and cover crops to keep the soil in optimum shape. See the Appendix A for more information on lasagna gardening.

Depending on the level of lead found in the soil, different actions will need to be taken. At less than 200 ppm the area is considered safe for gardening, as these levels have not yet been linked directly to negative health effects. If lead levels are higher, such as between 400 and 600 ppm, raised beds are recommended and certain types of vegetables, such as leafy greens and root vegetables will need extra care and cleaning before they are consumed.

Lead is bound to the smallest dust and soil particles, so the contaminant (with the fine soil) tends to get “caught” on the root hairs of a plant, and on the leaves that are close to the ground, making root vegetables and greens possible vectors for lead consumption. Root vegetables should be peeled to remove the part of the vegetable that was in direct contact with the soil, and all leafy greens should be carefully washed. If lead is higher than 600 ppm, the producer may want to consider re-locating the garden, or be prepared to take significant steps to lower the contamination in the soils, and reduce exposure to those soils.

To read more about recommended actions at different lead levels and more information on heavy metals in urban garden areas, consult the [Safe Urban Gardening Initiative’s “Garden Safe, Garden Well”](#) pamphlet.

Additional Considerations

Keep in mind that the organic matter of soils, pH level, and microbial health can affect the mobility of lead. This means that depending on additional factors of soils, the lead particulates are more or less able to impact human health, even if the levels are at the same concentration in the soil.

During the development and construction of housing, businesses, roadways, parks, and other aspects of the built environment, native soils are removed and re-distributed. Fill dirt and other non-native soils are often found throughout residential and commercial lots—parcels that may be turned into community and backyard gardens, or urban farms. Fill dirt is a rough, sandy subsoil that often contains some gravel. It is not intended to be used as a planting soil, and starting a garden on top of fill will likely require many amendments. If gardening on a vacant lot, fill is often found beneath where a house foundation once was, and can be compacted. It may be advised to garden on a different portion of the lot if there is an area with better soils.

Food Safety

Because small/urban farms are producing fruits and vegetables that are consumed directly by humans (as opposed to field corn and soybeans that will be processed), food safety is something the customer needs to consider and it may play into conservation planning.

Compost is a very easy source of contamination if it is not handled correctly. To kill pathogens and be considered safe, compost must be processed at over 130 degrees Fahrenheit for at least five days. If it comes in contact with fruit or vegetable crops before this safety level has been reached, the potential for contamination exists.

The National Organic Program has strict standards on what can be composted, how long temperature must be maintained, how often it should be turned (if an active pile), etc. It is important to be aware of

the carbon to nitrogen ratio of compostable items to allow for proper composting. Following all of these guidelines is important to produce a product that is safe to use on crops.

When planning a compost storage facility or other compost-related practices, it is best to keep the compost as far from the garden as possible and also to mitigate any runoff that may occur. This may mean adding a roof over the compost storage or making sure there is a vegetated buffer to filter any runoff that may occur. Also, make sure to consider the position of the storage area in the landscape. Do not locate the compost storage in an area that floods or ponds. The compost will wash away when the water recedes.

For more information on compost, a good reference is [ATTRA Sustainable Agriculture Tip Sheet: Compost](#). A good general reference for food safety for gardens is [Food Safety for School + Community Gardens](#) by North Carolina State Extension Service. Even though it specifically references school/community gardens, it is a good reference for all types of small farm and garden situations.

Chickens and other small livestock may be part of the an operation and used in grazing systems where they are rotated through a field using fencing to manage where the animal is and for how long. The manure from these animals or applying manure without composting requires special consideration to avoid transferring pathogens. There should be at least 120 days between the time manure is applied (or animals are grazed) and the time the crop is harvested. For more information see the [ATTRA Tip sheet: Manure in Organic Production Systems](#).



Chickens and turkeys are rotated to various plots of the farm at Blue Yonder Organic Farm, North Salem - they are kept enclosed by a temporary fence, and a mobile chicken coop

When selling produce, there may be additional certifications required to ensure food safety. The Good Agricultural Practices (GAP) Certification is the most common. GAP principles can be summarized as follows: clean soil, clean water, clean hands, and clean surfaces. These GAP principles cover both growing of the produce and post-harvest handling, distribution, and storage. For more information on GAP, talk to the local Purdue Extension educator or visit [Food Safety for Fruit and Vegetable Farms](#).

Legal Considerations: Zoning, Ordinances, etc.

Implementation of conservation farming practices may be more difficult in some areas due to local zoning ordinances, homeowner associations (HOA), plant height restrictions, and other local laws.

Before planning any conservation practices in an urban setting, it is important for the farmer and planner to check for these restrictions and learn how they may affect what practices can be implemented.

Consult with the local planning/zoning agency and code enforcement to learn of possible regulations, and if working in an area with a HOA, consult the organization's bylaws or speak with the board of directors. Sometimes exceptions or variations can be made for the farmer/gardener if the purpose and positive effects can be explained and the community is educated about the benefits of conservation and soil health. Some communities have already amended their zoning/ordinances to better serve urban agriculture, and this has removed many barriers to the implementation of soil health and other conservation practices on small/urban farms.

Keep in mind that property line and road setbacks must be considered when planning practices. Each conservation practice lists the required setbacks in the standard. Also, remember that utilities have easements under powerlines, over pipelines, etc. to allow them access to maintain the utility and reduce risk to their infrastructure. These easements take precedence over any other property use, so remember to take them into consideration when siting conservation practices to avoid later conflict.

Land Ownership/Tenure

In an urban setting, land tenure can be unsure especially if the land is not owned by the farmer or a group. If vacant lots are being rented or donated for community gardening, the farm will only exist as long as the lot is vacant or does not sell. This type of situation is similar to rural farmers that operate rented ground. If money needs to be invested for conservation practices on rented land, often the cost becomes a more limiting factor than it would be on owned ground. If a practice is considered a significant financial investment, it may not be suitable for a leased situation where the farmer does not have a guarantee they will be farming the same ground next year.

That being said, urban agriculture can have many positive impacts on the community, including increased property values. It can provide better aesthetics than a weedy overgrown lot, a place to educate youth and adults on a variety of topics, possible recreational aspects, and has been shown to increase a sense of community. Urban agriculture can provide a source of local food in an area where access to healthy options may be limited. With these factors in mind, some civic-minded property owners are glad to host urban farms on their land and welcome the investment in conservation.

Economics

As in any other business, a budget and business plan are one of the keys to success on small/urban farms. It is important that both the farmer and the conservation planner be well-informed about the cost of conservation and how it fits into the farm budget. Conservation planners should be aware of the cost and value of conservation practices, in addition to how they may affect changes in labor and farm tasks. Three bales of mulch may cost \$15 and take twenty minutes to apply on a 50-foot row, but its impact on weed suppression can decrease the time spent weeding, overall cost and need for tillage passes, making it a good investment. Terminating cover crops to create mulch can require passes with a crimper, flail mower or hand tools, but decreases the need for buying mulch and fertilizer. It is helpful to remember to look at the big picture, not just the initial cost of the practice to get a true estimate of its value.

Investing in nutrient management can assist growers in using compost and amendments more efficiently. Routine soil tests are inexpensive (approximately \$50 per test), but growers may opt for

more comprehensive tests and recommendations from consultants due to their specific crops or growing environments.

Planting and inoculating a diversity of cover crops in multiple windows throughout the seasons can result in a high cost per acre. An intensive one-acre farm may spend \$150 for seed, and organic can double or triple that cost. In urban areas that lack access to local seed dealers, shipping can also greatly increase the total cost. For a 1,000 square-foot garden, one might spend \$50 from an online seed store, with a portion being shipping costs. To help increase the adoption of cover crops, some Soil and Water Conservation Districts and other partners have had success making seed packages that cover 100 square feet to sell or donate to community or backyard gardeners.

Square straw bales used for mulching can cost \$3 to \$7 each. Alfalfa bales often cost more. With one bale covering approximately 60 square feet, mulch costs can add up quickly on a small farm. One small farmer in Hendricks County utilizes over two hundred bales per year, making the initial cost of mulching approximately \$1,400, but they also spend little to no additional money on weed control where the mulch is used.

Also, remember that soil health practices lead to increased organic matter. There are approximately 4,000 pounds of soil in the top six inches of a 100 square-foot area. Distilling down the numbers from an estimate based on one acre, it is estimated each 1 percent of organic matter in this 100 square-foot garden area contains approximately 20 pounds of carbon, 2 pounds of nitrogen, 0.2 pounds of phosphorus, and 0.2 pounds of sulfur. As organic matter increases and the healthy soil functions are restored, a portion of these nutrients become available for plants to use, thereby decreasing the cost of inputs.

In addition to the cost of conservation practices, it is helpful for the conservation planner to understand the costs of setting up and managing a small/urban farm. For example, being able to estimate that the construction of a raised bed could cost \$100 is helpful. More detailed budgets can be found in Appendix B of the [Urban Agriculture Toolkit](#). These budgets include the cost of site preparation, structures, and marketing costs.

Material	Cost Range*	Coverage
Straw Mulch	\$3 - \$11	60 - 80 square ft.
Hay Mulch	\$5 - \$17	40 - 60 square ft.
Soil Testing	\$12 (Basic) - \$50 (Comprehensive and Recommendations)	1 zone
Cover Crop Seed	\$4.75 - \$10 online (before shipping)	1 pound Hairy Vetch ~ 800 square ft.
	\$95 - \$178 online (before shipping)	50 pounds Hairy Vetch ~ 1.5 ac.
	\$0.50 - \$6 online (before shipping)	1 pound Oats ~ 500 square ft.
	\$10 - \$48 online (before shipping)	50 pounds Organic Oats ~ 1.5 ac.

* Costs change for a variety of reasons: organic vs. non-organic, region, season availability, source (local, online), etc.

* Bulk purchasing can result in cost reduction, but remember do not store excess seed in plastic bags.

Staff Time Management

Time management is essential to every job in the conservation partnership. Sometimes that is easier said than done! Some customers take longer than anticipated and the planner did not budget enough time. Do not be surprised if half a day or more is spent on one small/urban farm. In order to avoid under-budgeting time when working with small or urban farmers here are a few things to keep in mind.

- Some small/urban farmers are new to farming and will have many questions, as with any other beginning farmer. Be prepared to offer more in-depth resources. Sometimes it is more time effective to go over the basics and give them references for the details. Also, do not hesitate to refer them to someone else with more knowledge on a particular subject (like organics). Always remember to follow up after they have had time to review the resources, as this could help answer questions that have come up since the last meeting and will avoid time-consuming misunderstandings or mistakes later.
- Depending on the type of operation, a variety of education levels and needs will be found. It is always good to come prepared with resources, and it helps to do a follow up letter/email after the field visit, listing in writing what was talked about. This gives the farmer something to study and serves as documentation of the meeting so everyone is on the same page. It may be helpful for the planner to develop a short description of conservation practices commonly used to be able to cut and paste into these letters. These can then be edited to fit the specific situation as needed. During the visit, more hands-on demonstrations of conservation practices, such as showing how to seed the cover crops, may be needed to make sure a real understanding of the practice has been reached.
- Remember conservation partnership employees are there to treat resource concerns. As a site visit progresses, it is sometimes necessary to distinguish between landscaping and soil health or water quality projects. You may need to ask yourself if there is a true resource concern to meet the objectives of the cost share program or technical assistance you are providing. If not, it might be best to refer them to another agency or business that can provide the services they need. Remember the conservation partnership cannot promote a specific business, but can give several names of places for them to contact (e.g., contractors list, seed companies, etc.).
- Many small/urban farmers are new customers and have had little to no contact with the conservation partnership organizations. It may take a little extra time to explain what the partnership does and if financial assistance programs are being discussed, how those operate. These details can be cumbersome and overwhelming for new customers, so again be prepared for questions and with extra resources. Do not use acronyms or assume they know what we do. As with earlier scenarios, spending the time now will save ill save time later.
- Remember that subsistence farmers are customers, as well as those farms that sell their crops. It may be tempting to pass over these farms because they do not fit the norms of our usual customer base and can take a lot of time to plan. However, they are eligible for technical assistance and possibly farm bill programs. The 2014 Farm Bill removed the requirement that the farmer had to make \$1,000 in farm income to be eligible for the Environmental Quality Incentive Program (EQIP).

The conservation partnership must always be prepared to service any customer, large or small, that walks in the door. But, any office looking to expand small/urban farm outreach and conservation programs beyond walk-in customers should be conscious of staff time, technical capability, and technical and administrative support. A technician versed in soil health cropping systems may be able to

conduct a program related to vegetable gardening, but attempting a more general urban conservation program adds to the complexity and time commitment. Better lawn care, native plantings, reforestation efforts, water edge enhancements, and rain gardens might be needed for storm water management and ecosystem services, but the technical diversity and demand can overwhelm staff time.

RESOURCES:

- Indy Tilth, Safe Urban Gardening Initiative.
<http://indytilth.org/Links/Safe%20Urban%20Gardening%20Initiative.pdf>
- EPA Hazard Standards for Lead in Paint, Dust and Soil <https://www.epa.gov/lead/hazard-standards-lead-paint-dust-and-soil-tsca-section-403>
- Indy Maps
<http://maps.indy.gov/MapIndy/>
- Soil Lead: Testing, Interpretation, and Recommendations
<https://ag.umass.edu/soil-plant-tissue-testing-lab/fact-sheets/soil-lead-testing-interpretation-recommendations>
- Safe Urban Gardening Initiative
<http://www.indytilth.org>
- Garden Safe, Garden Well Pamphlet
https://www.hamiltonswcd.org/uploads/3/7/2/3/37236909/garden_safe_garden_well_booklet.pdf
- ATTRA Sustainable Agriculture Master Publication List: <https://attra.ncat.org/publication.html>
- NC Cooperative Extension Food Safety for School + Community Gardens
<https://growingsafergardens.files.wordpress.com/2012/10/foodsafetywebcurriculum-10-24-12.pdf>
- Purdue University/University of Illinois Extension Food Safety for Fruit and Vegetable Farms
www.ag.purdue.edu/hla/foodsafety
- USDA Urban Agriculture Toolkit: <https://www.usda.gov/sites/default/files/documents/urban-agriculture-toolkit.pdf>

ADDRESSING RESOURCE CONCERNS

Conservation Planning

Conservation planning on small/urban farms follows the familiar steps of planning as on any farm. There may be some situations or challenges unique to these farms and a few of these were mentioned earlier in this guide. Here are a few other things to think about:

- Detailed planning maps with more definition are needed at a much larger scale for small scale operations. To get the best planning document, use high resolution imagery. Since most urban farms are small acreages the basic low resolution photos typically used in conservation planning just won't work. The local GIS division of county government may have high resolution maps that can be used. Also, the land use could have changed since the last set of aerial images available, so the planner may have to wing it even if they come prepared with a high resolution map.
- Soils maps may not be as detailed in urban settings due to the soils being labeled an "urban land complex." However, the details of what soil type the urban complex is in conjunction with are still useful and can be used in planning just like in a rural setting. In most cases this is the soil type that would have been there pre-urbanization. Detailed information can be obtained on [Web Soil Survey](#). An urban soil survey has been done in Detroit to better serve urban customers. There are plans to do this in other cities, so there may eventually be more detailed information available. Also remember there may be fill or other non-native soils in place that may not fit the soil survey description. Any urban site has most likely been greatly disturbed.
- Most soil health conservation practices that would fit on a large scale farm can be applied to a small/urban farm setting. They just need to be scaled down. It may also require some specialized equipment due to growing different types of crops. However, as in most cases with large farms, if the customer is interested everyone can work together to make it happen.
- Remember urban landscapes possibly come with constraints of local ordinances or laws, as we have touched on in this guide, but there are also neighborhood opinions to consider. In order to keep the peace with all, adjustments to aesthetics or locations of the planned practices may need to be made to fit within what the neighbors are willing to "tolerate" outside of what they are used to seeing. However, as always, sound conservation principles should apply to anything partnership employees are recommending. Planners do not want to make aesthetic or location changes that will compromise the effectiveness of the conservation practice. Encourage open communication.

Conservation Practices

Many of the same conservation practices that apply to larger farms apply to small/urban farms. They just need to be scaled down to the appropriate level. Currently some of NRCS standards and specifications can be hard to specifically apply to some situations, so when in doubt, contact the NRCS state office to clarify.

Common practices that can apply to these farms are:

- Conservation Crop Rotation (328)
- Reduced Till/No-Till (345/329)
- Mulching (484)
- Nutrient Management (590)
- Integrated Pest Management (595)

- Cover Crops (340)
- Conservation Cover (327)
- Tree/Shrub Establishment (612)
- Hedgerow Planting (422)
- Windbreak/Shelterbelt Establishment (380)
- Brush Management/Herbaceous Weed Control (314/315)
- Seasonal High Tunnel (798)
- Roof Runoff Structure (558)
- Stormwater Runoff Control (570)

This is not a comprehensive list, since the conservation practices will vary from operation to operation. Additional practices can be identified through the conservation planning process. For more detailed information, reference the Indiana NRCS standards and specifications on the [electronic field office technical guide](#) (eFOTG).

Conservation Crop Rotation (328)

The rotations used in small/urban farms will be much more diverse than a typical corn/soybean rotation. There will be many crops in rotation, and in some scenarios more than one crop per growing season. Many of these rotations will include early, mid, and late season crops allowing for more complete utilization of the small space that the farm has to offer. This crop rotation may also offer different cover crop seeding windows, which will be discussed under cover crops. For example crop rotation scenarios, view the SARE publication [Crop Rotation on Organic Farms](#) or the [Midwest Vegetable Production Guide for Commercial Growers](#).



Reduced Tillage/No-Till (345/329)

Traditionally fruit and vegetable production has relied heavily on tillage to control weeds and for ease of planting. In order to facilitate reducing tillage or using no-till in this system, mulch and cover crops are commonly used. This will be a major change in management and will take labor and time to accomplish. It may also require equipment modifications or new equipment to be able to accomplish this conservation practice. The larger the production area the harder it will be to make the switch. Depending on the labor available and the crops grown, it may not be possible to completely remove tillage, but any reduction will have positive soil health effects.



Mulching (484)

Mulching can be used to cover the bare soil surface or to supplement cover crop residue. A general rule of thumb for optimal mulch thickness is four inches for the purpose of weed suppression. Mulch examples include straw, hay, leaves, newspaper, and compost. They provide erosion prevention and can also provide a source of nutrients for the crop. Remember that anything added to the soil can affect the C:N ratio. For example straw can immobilize nutrients while legumes readily decompose and can provide nitrogen to a crop. However, some farms do not incorporate their mulch but at the end of season move it to walkways between beds to provide cover. If the mulch is handled in this way, the C:N ratio is not as crucial because it is not being incorporated into the area where crops will be grown. For examples of relative C:N ratios and more information on the cycle see the NRCS publication [Carbon to Nitrogen Ratios in Cropping Systems](#). Inorganic materials like black plastic and fabrics are also considered mulches, and growers should consider potential effects on soil health when using inorganic mulches for long periods of time.



Mulch material, to the extent practical, should be free of disease, pesticides, chemicals, noxious weed seeds, and other pests and pathogens in order to avoid problems later. Mulch can also provide a habitat for ground burrowing rodents, so scouting and control will be key. It can also change weed management strategies; different types of weeds may become more common with this management change.

Nutrient Management (590)

As with all production systems, soil tests and nutrient management are key to getting the right rate and right type of nutrients to the crops when they need them. It is important to get the level of testing that is useful to the farmer. Soil testing for vegetable crops is more than just looking at macronutrients Nitrogen, Phosphorus and Potassium (N, P, K). In vegetable crops micronutrients are just as important as macronutrients. Raising organic matter in the soil can help with the availability of micronutrients.

Some may want more detailed results or may need specific information due to the site, such as inside a seasonal high tunnel. In high tunnels that have the cover on year round, high salt and nutrient concentrations can occur. Testing for these specific issues is important since they can injure plants or stunt plant growth.

Also, be aware of environmental influences, such as karst topography on the pH of water. Water pH can affect the pH of soil over time, and in turn the availability of nutrients. It is important to discuss the site characteristics with the lab before the test along with the desired



information as they may want to use a “non-traditional” test, such as a saturated media extract test, to get the results that the farmer needs.

There are a variety of amendments that can be used in small/urban farms that are not normally used in larger production. There is a good reference table in the document [Nutrient Management Plan \(590\) for Organic Systems](#). It is important that nutrient information is obtained (via labels, testing, etc.) on any amendments, compost, or manure to make accurate recommendations based on the soil test. Some soil labs and consultants will give detailed amendment recommendations along with the test results. A good overall guide to nutrient management on small farms and gardens is Pacific Northwest Extension’s [Soil Fertility in Organic Systems: A Guide for Gardeners and Small Acreage Farmers](#).

Integrated Pest Management (595)

Pest control can be a challenge for any farm, large or small. Because urban agriculture happens in close proximity to people and residences, it is even more important to find the right type of pest management that is safe and effective. As with all integrated pest management (IPM), there are biological, cultural, mechanical, and chemical control options depending on the pest. The best control is achieved by using a combination of these.



Photo Credit: Kevin Allison, Marion Co. SWCD

On most small/urban farms scouting for and removing the pests by hand are the keys to good control. Floating Row covers are also used frequently to try and exclude pests from an area. A good reference for IPM in specific crops is the [Resource Guide for Organic Insect and Disease Management](#) by Cornell University which can be obtained in PDF form or ordered in paper form. The local Purdue Extension educator is also a good resource. Purdue also has a [Plant and Pest Diagnostic Lab](#) to help identify plant problems and diseases. Another important part of pest management is keeping habitat available for beneficial insects, which can be addressed using the conservation cover practice standard. [Farming with Native Beneficial Insects](#) is also a good reference for what can be done to increase the effectiveness of natural predators on pests.

Cover Crops (340)

Cover crops are as beneficial on small/urban farms as they are on large farms. In addition to many other benefits, they keep a living root growing and cover on the soil surface before and after harvest. However, they may be grown at many times throughout the year, not only in the late fall, winter or early spring. Some crop rotations will leave a gap during the summer/fall for cover crops to be grown before winter/early spring crops are planted. For example, buckwheat can be planted in between early and late vegetables. Cover crops that winter kill are ideal to plant early spring crops into and high biomass covers are better for May crop plantings. Many of the cover crops that are planted in larger operations can be used in these smaller operations as well, but obviously seeding windows will be different in some situations. The Midwest Cover Crops Council has a seeding calculator for vegetable crops that is useful to determine seeding windows. Currently the data is only available for Michigan, but the Indiana data was being compiled at the time of writing this guide. It should be available soon.

Some common cover crops used in small/urban farms include oats, cereal rye, crimson clover, hairy vetch, sorghum-Sudan grass, and buckwheat. These plants provide good mulch once they have been killed and can be mixed in a variety of ways. Mixes for fall planting include:

- Oats/Crimson Clover
- Oats/Hairy Vetch
- Oats/Radish
- Cereal Rye/Hairy Vetch



Usually cover crop recommendations come in pounds/acre, but many small farms need smaller amounts for their fields or gardens.

Seeding recommendations may need to be made in ounces/100 square feet or ounces/1,000 square feet. See the [Sample Mixes](#) information from the Marion County SWCD included in the appendix for more information on seeding rates and mixes. The SARE book *Managing Cover Crops Profitably* also lists seeding rates in ounces/100 square feet on [Chart 3B: Planting](#).

Cover crop termination on a small/urban farm is similar to that on larger farms, including winter-kill species, crimping, tillage, and herbicides. Some options more unique to small acreages are mowing, weed-eating, or scything at critical growth stages, and also tarping.

Mowing/Weed-eating/Scything: Some cover crops can be killed by mowing/cutting after they reach certain growth stages. Annual grain cover crops, such as winter wheat and cereal rye, will die by mowing after they have produced a seed head (half of the head needs to have put on anthers). Some species of broadleaves, like Austrian winter pea and hairy vetch can be cut and killed after flowering.



Cut down hairy vetch. A weed-eater or garden shears work well to cut vetch at root base



Cut down rye, at flower

Tarpping is exactly what it sounds like, putting a plastic tarp over the growing cover crop to deprive it of light. This will kill off the cover crop in a couple of weeks (depending on time of year). Using this method leaves all of the cover crop residue on the surface to provide a mulch to suppress weeds, much as it does if the cover crop were crimped.

Conservation Cover (327)

Many small/urban farms need habitat for beneficial insects and pollinators. They are often surrounded by a typical urban landscape which offers little in the way of habitat. These areas can be an important part of the Integrated Pest Management strategy of a small/urban farm. They can be generalized native plantings or targeted toward a specific type of pollinator or beneficial insect. A good resource for more about planting for beneficial insects and pollinators is [Farming with Native Beneficial Insects](#) by the Xerces Society. Remember, when working in urban areas, there may be zoning regulations, HOA codes, or other laws that need to be investigated before planting something that could be considered “unsightly” by uninformed neighbors.



Conservation cover can also be used to add beneficial habitat between rows in orchards or other bushy/tree crops. This cover can provide habitat and nectar for pollinators that are needed for the crop, as well as reduce labor on the farm by not requiring regular mowing.

Tree/Shrub Establishment (612)

Trees and shrubs can provide habitat for native pollinators and beneficial insects, just as any other native plants. Native trees provide a great source of nectar and habitat, especially when flowering. It is important that if the trees are being planted as beneficial/pollinator habitat that they are protected from insecticides by a buffer or setback. Also remember trees grow out, not just up, so they will need to

be set back from property lines by at least eight feet to avoid growing onto the neighbors' property. It is also important to remember to check for power lines or other easements before planting to prevent issues with easements and right of ways. A tree/shrub planting can also help to sequester carbon. Trees can also be added in pasture areas to provide shade for livestock while helping to provide food for wildlife and products such as nuts and fruit. To learn more about the practice of silvopasture, see the [Working Trees for Livestock](#) fact sheet from the [USDA National Agroforestry Center](#).

Hedgerow Planting (422)

These plantings can consist of erect bunch type grasses and woody plants that have heights that are at least three feet tall throughout the winter. They can be one to three rows wide, and be a mix of conifer and deciduous. Uses include pollinator/beneficial insect habitat and nectar source, living fence, screen for dust and noise, and increased carbon storage. Each of these uses has specific considerations that can be found in the practice standard. Native plants should be used whenever possible, as that increases the practice's usefulness to native pollinators and beneficial insects. Again a good resource is [Xerces Society's Farming with Native](#)



[Beneficial Insects](#). Hedgerow plantings fit well on a farm that is interested in permaculture techniques, as products such as nuts, fruit, and coppice could be harvested.

Windbreak/Shelterbelt Establishment (380)

Windbreaks can be used for a variety of purposes. They not only keep wind down (which prevents erosion), but can also provide a visual screen, habitat for pollinators/beneficial insects, and create a “sun trap” to keep an area warmer to promote better growing temperatures. Many windbreaks can provide more than one of these features if planned correctly. The considerations listed above under tree/shrub establishment apply here as well. It is important to remember trees grow up and



out so be careful of property lines and power lines. The goals of the farmer need to be considered as well. For example *Thuja* (cedar) species need trimmed. If the farmer is looking to produce a value-added product, these trimmings can be used for wreaths and sashes. For more on how a windbreak can add additional cropping options and products, a good resource is the Working Trees Info factsheet “[Can windbreaks do more than slow the wind?](#)” from the USDA National Agroforestry Center.

Brush Management/Herbaceous Weed Control (314/315)

Many invasive plants got their start as landscaping plants, so it is possible that these invasives have made their way to the urban farm. Woody invasives are often found along property lines or in unused areas. Both herbaceous and woody invasives can be found in landscaping and gardens and make their way via seeds, runners, or stolons into the farm area. These plants can be treated using the practice standards in this guide, similar to a pasture or wooded area on a larger farm. Because urban agriculture is located in close proximity to people and residences, it is important to pick the method of control that is appropriate for the situation and will not cause harm to neighbors or pets. A good place to start is with the [Indiana Native Plant & Wildflower Society \(INPAWS\)](#). They keep a list of species that are considered invasive in Indiana and have fact sheets on control of commonly found invasives.

Seasonal High Tunnel (798)

Seasonal high tunnels are popular with many vegetable production systems because they can extend the growing season and increase plant productivity and health. They also help to save energy, since their warming source is heat from the sun instead of man-made heaters. The high tunnel must be constructed to withstand snow load or the plastic cover will need to be removed during snow season. When planning a high tunnel, be sure to check for zoning restrictions to make sure it is compatible with the practice. Some residential areas may not allow for the construction of high tunnels due to zoning or home owners' association regulations. Also be sure to address the runoff that will be created with the installation of the high tunnel. A rock trench and associated outlet may be needed, or gutters could be installed. Water from the high tunnel could become an asset rather than a nuisance if the producer wants to collect it for irrigation or other purposes.



Roof Runoff Structure (558)

Roof runoff structures might be needed on existing buildings or for new planned conservation practices. Many conservation practices, such as manure/compost storage buildings and high tunnels need a system installed to manage the runoff created by the roof of the building. Common roof runoff structures include rock trenches (French drains) and gutters. These systems must always have an outlet that directs the water away from any possible sources of contamination. The water may also be collected in a water-holding device, such as a cistern, if the farmer wishes to use it for irrigation or other purposes. However, precautions should be taken to minimize the risk of contamination from substances on the roof or high tunnel, such as bird



feces, if the water will be used for fresh produce irrigation. [Iowa State University](#) has a helpful publication about guttering seasonal high tunnels, storing water in cisterns, and irrigation.

Stormwater Runoff Control (570)

Since urban farms are in an area where stormwater can impact neighbors, it is important to think about how what is done on the land impacts water runoff. When impervious surfaces are added, such as a roof on a high tunnel, the planner and farmer should factor in that water will now run off instead of infiltrating. This practice standard could be used to design rain gardens and other various best management practices to mitigate the effects of stormwater. *Rain garden planted adjacent to high tunnel, to manage roof runoff water*



RESOURCES:

- Web Soil Survey www.websoilsurvey.nrcs.usda.gov
- NRCS eFOTG https://efotg.sc.egov.usda.gov/efotg_locator.aspx?map=US
- SARE Crop Rotation on Organic Farms <http://www.sare.org/Learning-Center/Books/Crop-Rotation-on-Organic-Farms>
- Midwest Vegetable Production Guide for Commercial Growers 2017 <https://ag.purdue.edu/btny/midwest-vegetable-guide/Pages/default.aspx>
- Indiana NRCS Soil Health and Publications https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/in/soils/?cid=nrcs144p2_031079
- Nutrient Management Plan (590) for Organic Systems <https://attra.ncat.org/attra-pub/summaries/summary.php?pub=465>
- Soil Fertility in Organic Systems: A Guide for Gardeners and Small Acreage Farmers:
 - <http://cru.cahe.wsu.edu/CEPublications/PNW646/PNW646.pdf>
- Resource Guide for Organic Insect and Disease Management <http://web.pppmb.cals.cornell.edu/resourceguide/pdf/resource-guide-for-organic-insect-and-disease-management.pdf>
- Purdue Plant and Pest Diagnostic Lab <https://ag.purdue.edu/btny/Extension/Pages/PPDL.aspx>
- SARE Managing Cover Crops Profitably <http://www.sare.org/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition>
- Working Trees for Livestock, National Agroforestry Center <https://nac.unl.edu/documents/workingtrees/brochures/wtl.pdf>
- USDA National Agroforestry Center <https://nac.unl.edu/>
- Xerces Farming with Native Beneficial Insects <https://xerces.org/farming-with-native-beneficial-insects/>
- Working Trees Info: Can windbreaks do more than slow the wind?, National Agroforestry Center https://nac.unl.edu/documents/workingtrees/infosheets/WTInfoSheet_WindbreaksDoMore.pdf
- Indiana Native Plant and Wildflower Society (INPAWS) <http://www.inpaws.org/>
- Iowa State University Rainwater Catchment from a High Tunnel for Irrigation Use <https://store.extension.iastate.edu/product/13734>

SOURCING CONSERVATION MATERIALS

Implementing conservation practices often requires the sourcing of materials. Accessibility and the economy of scale can impact the material cost and in turn, factor into how quickly conservation practices are adopted.

Growers often buy **cover crop** seed and inoculant at online farm stores or through local farm supply stores. Some online stores sell various quantities of seed (i.e., ¼ pound, 50 pounds), but shipping can drastically increase the cost of seed. Some local farm retailers are willing to sell small quantities of seed, and some are not. However, access to local farm supply stores that sell cover crops can be an obstacle in urban centers. Many online stores and some local stores sell cover crops that are Variety Not Stated (VNS).



Mulches like straw and alfalfa hay are sourced through local farm stores or local farmers. Mulch material should be free of disease, pesticides, chemicals, noxious weed seeds, and other pests and pathogens, to the extent practical. Seeds introduced through mulch can be detrimental on a small farm. Many growers think that hay is more seedy than straw, but grain harvesting methods can affect straw quality and grain seed can be present in straw. High quality legume hay has a carbon to nitrogen (C:N) ratio that is often conducive to mulching in vegetable production. Pure legume stands often have less seeds than legume/grass hay. The best way to know this is to talk to the farmer or see the field. Mulches like black plastic, newspaper print rolls, and landscape fabric can be sourced at online farm stores or through local farm supply stores. Newspaper can also be recycled and sometimes obtained through leftover end rolls at newspaper printing companies.



Many growers buy **amendments and fertilizers** at online stores or local farm supply stores. Certain soil fertility consultant companies make soil test recommendations and also sell amendments. Growers often look for specific organic amendments that cannot be found at box stores.

Trees and shrubs are a common practice on small farms. Sources include state nurseries and local vendors. If a large amount is being ordered, the two state tree seedling nurseries operated by the Indiana Department of Natural Resources, Jasper-Pulaski (Northern Indiana) and Vallonia (Southern Indiana), are a cost-effective option. There is a minimum order of 100 trees of the same species when ordering from a state nursery. Some SWCDs offer tree sales to make small numbers of trees available to landowners for conservation practices.



SWCD employee helps to deliver trees from state nursery.

SMALL FARM AND GARDEN EQUIPMENT

Hand Tools

Most of the time when people think of agricultural equipment, they tend to think on the large scale, but when dealing with small/urban farms much of the equipment may be hand tools. A trowel, shears, sickle, rake, hoe, and shovel may be all the tools needed for a small farm or one with mostly raised beds, which is common in the city or town. Hand tools are also less expensive, which is helpful when establishing a farm and creating an initial budget.

A **measuring wheel** is useful to measure distance when laying out new beds.



A **bed preparation** rake is used to prepare and level seed beds.



A **sickle** will cut down those cover crops that can be terminated by mowing.



Weed-Eaters can be used to cut down those cover crops that can be terminated by mowing.



A **rake** helps prepare seed beds, remove rocks, and can also be used to distribute mulch or cover crop residue.



A **broad fork** breaks up densely packed soil and aerate during bed preparation. It can also be used to harvest root vegetables.



Trowels/Shovels are used to dig the holes for seeds and to help work beds when needed.



A **pointed hoe** is used for furrowing to establish rows for planting.



A **paddle hoe** is a regular garden hoe, used to dislodge weeds by the root or mound and shape soil.



A **stirrup hoe** helps with weeding and can break up shallow layers of soil compaction before cover crop seeding.



A **wheel hoe** has a variety of attachments and can be used for many tasks including furrowing, weeding, and breaking up compaction.



A **wheel seeder** precisely plants seeds using plates, just as planters do for corn or soybeans.



Flame Weeder: A Flame Weeder is a wand connected to a propane tank that uses the heat of flame to kill the weeds. It is commonly used to kill weeds that emerge after seeds are sown but before the seedlings emerge, and in between rows.



There are many different types of tools available for each task, and depending on the specific goals and preferences of the farmer, it is possible that a different type of tool is used from operation to operation. To become familiar with the array of hand tools available, conservation partnership employees can visit with a local small/urban farmer and/or visit a retailer in person or online. ATTRA has a great overview of both hand and mechanized equipment used on small farms in its [“Equipment and Tools for Small-Scale Intensive Crop Production”](#) publication.

Walk-Behind Tractors

On some “larger,” typically 1-2 acre farms or those without raised beds, a walk-behind (two wheel, single axle) tractor may be useful. It has many different implements that can be attached, such as a flail mower or spreader, to get tasks done faster than by hand. Some of these tools can be used to make the transition to a soil health system with cover crops more successful. The flail mower can be used to terminate and mulch the cover crops, providing residue to prevent weeds, which can help to reduce tillage passes and soil disturbance. There are also crimpers that have been made for walk-behind tractors, which can be used to terminate cover crops like cereal rye.



Walk-behind tractor with flail mower terminating cover crops



Roller crimping cover crop with walk behind tractor

RESOURCES:

- ATTRA Equipment and Tools for Small-Scale Intensive Crop Production
http://blog.uvm.edu/groundwk/files/2014/04/EquipmentTools4SmallScale_PressmanATTRA-tools-1.pdf
- Purdue Small Farm Team Webinar Series: Walk-Behind Tractors and Their Applications on Small Farms by Michael O'Donnell
https://mediaspace.itap.purdue.edu/media/Roy+Ballard%27s+Meeting+Room-20160224+1659-1_47763307/0_i44tpo38

PROGRAMS

USDA NRCS Environmental Quality Incentive Program (EQIP)

The practices discussed in this guide and other practices, such as a rotational grazing and pasture planting, are available through EQIP. If the farmer decides to go with this program option, here are a few things specific to EQIP to think about.

- **USDA Program Eligibility:** Refer to the factsheet “[Establishing Eligibility for USDA Programs](#)” available from Indiana NRCS. This will take the customer through the forms they need to be able to set up a customer record in the USDA system. This process starts with the Farm Service Agency (FSA), so interagency communication will be key to complete this process.
- **Farm/Tract Number:** A farm and tract number will need to be created in the USDA system in order for it to have a reference number for EQIP and to be input into planning software. This process also starts with the FSA. The customer will need a deed or other proof of land ownership to draw out the property on the map.
- **Resource Concerns:** Remember EQIP can only address existing resource concerns, like the ones listed earlier in this document. If the farm is not up and running yet there is nothing that can be done programmatically; however, providing technical assistance is still an option.
- **Payments:** Aside from high tunnels, practices are paid on a square-foot basis, which may be minimal depending on the site. Conservation planning for the practice encourages adoption, but be aware that current EQIP rates pay a small percentage of practice cost. For example, a 4,356 square foot (0.1 acre) mulching practice would pay \$24.20 using the 2017 EQIP payment rate. The mulch material alone would cost the grower \$360. Another example, again using the 2017 payments, EQIP only pays \$50.70 for a 0.1 acre field border, a practice that can be very costly in the urban environment.

Clean Water Indiana Grants (CWI)

An SWCD cost-share program entails site visits, application processes, ranking processes, cost-share tracking and administration, receipts, check writing, signature chasing, technical assistance, technical resources, conservation planning, standards and specifications, site specific customization, CWI data entry and reporting, and ongoing communication with participants. If the SWCD is ready to take on these responsibilities and more, it might be time to apply for a [Clean Water Indiana \(CWI\) grant](#).

- CWI is administered by Indiana State Department of Agriculture’s State Soil Conservation Board.
- Grant money is provided and local matching funds must be provided by the SWCD.
- Marion County has a current CWI grant that focuses on urban agriculture. This has been a very successful program. Some key points are listed below for other SWCDs to consider:
 - A solid one acre farm contract has an approximate value of \$1000.
 - Cost share is offered for 75% of the cost of soil tests, cover crops, vegetative mulch, native plants, and 50% of equipment purchase or rental.
 - Some community gardens are under 500 square feet. In this case it may be easier for the SWCD to buy some cover crop seed and other materials in bulk and distribute them. This will help to reduce the high prices grant recipients may incur due to the economy of scale and encourage adoption. However, SWCDs must be careful not to be considered competition to local retailers.

- Not all practices will be reported. Technical assistance may be given to an individual, and they install a conservation practice on their own without financial assistance.
- As with EQIP, if the farm is to be put into the NRCS planning software it will need to be assigned a Farm/Tract number by the Farm Service Agency (FSA). See the section above for details on how to accomplish this task.

Farm Service Agency

- **Certification Reimbursement.** Beginning January 2017, certified organic producers and handlers can receive a reimbursement for up to 75% of certification costs each year up to \$750 per certification scope. To learn more [click here](#).
- **Financial assistance to establish conservation buffer zones.** This financial assistance helps organic farmers with the cost of establishing protective natural borders along fields that produce organic crops. The Conservation Reserve Program (CRP) provides funds to agricultural producers so that environmentally-sensitive land is not farmed or ranched, but instead used for conservation benefits. Funds are available for establishing shrubs and trees, or supporting pollinating species, and can be planted in blocks or strips. Contract duration is between 10 and 15 years. Interested organic producers can offer eligible land for enrollment in this initiative at any time. To learn more, visit www.fsa.usda.gov/crp. Also, FSA provides [conservation loans](#), with low interest and long-term repayment periods that can help organic producers finance conservation measures to help transition to organic agricultural practices.
- **Financial assistance for crop losses due to natural disasters.** The Noninsured Crop Disaster Assistance Program provides financial assistance for 55 to 100 percent of the average market price for organic crop losses between 50 to 65 percent of expected production due to a natural disaster. New farmers, and traditionally underserved or limited resource farmers are eligible for free catastrophic coverage and discounted premiums on higher coverage. To learn more, visit www.fsa.usda.gov/nap.
- **Interim financing after harvest.** Marketing assistance loans are available that provide interim financing to help organic producers meet cash flow needs without having to sell crops during harvest when market prices are low. Deficiency payments are also available to producers who forgo the loan in return for a payment on the eligible commodity. For more information on commodity loans and deficiency payments, visit www.fsa.usda.gov/pricesupport.
- **Loans for storage facilities.** Farm Storage Facility Loans provide low-interest financing to build or upgrade storage facilities for organic commodities, including cold storage, grain bins, bulk tanks and drying and handling equipment. For more information on facility loans, visit www.fsa.usda.gov/pricesupport.
- **Low-interest Loans** (including microloans and conservation loans) to transition to organic production, help purchase or enlarge real estate, construct or improve buildings, soil and water conservation, routine operating expenses, fuel, insurance, equipment, repairs, and more! For more information, visit www.fsa.usda.gov/farmloans.
- **Services** such as mapping farm and field boundaries, and reporting organic acreage, that can be provided to a farm's organic certifier, or crop insurance agent.

Indiana State Department of Agriculture

- ISDA may have grants and other funding opportunities from time to time, such as the Specialty Crop Block Grant Program (SCBGP) which has a goal of enhancing the competitiveness of specialty crops. Specialty crops are defined as “fruits, vegetables, tree nuts, dried fruits, horticulture, and nursery crops (including floriculture). Check their website <http://www.in.gov/isda/2474.htm> for more information.

Other Grant Sources

- **Natural Resources Conservation Service Conservation Innovation Grant (CIG):** “Conservation Innovation Grants (CIG) are competitive grants that drive public and private sector innovation in resource conservation. CIG uses Environmental Quality Incentives Program (EQIP) funds to award competitive grants to non-Federal governmental or nongovernmental organizations, American Indian Tribes, or individuals. Public and private grantees develop the tools, technologies, and strategies to support next-generation conservation efforts on working lands and develop market-based solutions to resource challenges. Grantees leverage the federal investment by at least matching it.”
- **North Central SARE:** There are various grants available through SARE targeted at different types of people and organizations. The one that is probably most applicable to partnership agencies is the Research and Education Grant. Projects funded by these grants “include a strong outreach component and significant farmer/rancher or other end user involvement from inception of the idea through implementation of the project.”
- **Local Grants:** Many community foundations, chambers of commerce, and other local organizations offer grants to better the community. The case could be made that small/urban farms within the community, especially those using soil health practices, would fit this scenario. Some Soil and Water Conservation Districts also offer grants for projects they feel can help advance the mission of the SWCD.

RESOURCES:

- Indiana NRCS Environmental Quality Incentive Program: <https://www.nrcs.usda.gov/wps/portal/nrcs/main/in/programs/financial/eqip/>
- Clean Water Indiana Grant: <https://secure.in.gov/isda/2374.htm>
- North Central SARE Grant Programs: <http://www.northcentralsare.org/Grants/Our-Grant-Programs>
- NRCS Conservation Innovation Grant: <https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/cig/>

PARTNERSHIPS

Indiana's Conservation Partnership

Several organizations of the Indiana Conservation Partnership have resources to help small/urban farms.



- **Purdue Extension:** Many extension educators are willing to help read soil tests, and there are specific Extension websites that can help with resources for [urban](#), [small](#), and [beginning farmers](#). These websites can be training tools for the partnership, as well as a resource to the farmers they advise. Extension educators also often have a good idea of local markets. They also run the Master Gardener program which has connections to the gardening community.
- **USDA NRCS:** Nationally NRCS has started to put together a list of [resources for urban agriculture](#). These resources are more geared toward farmers, but can be used as employee training tools as well. There is also a similar list of [resources for small farms](#) and organic growers.
- **Various SWCDs:** Several SWCDs throughout Indiana have great urban agriculture programs. [Marion](#) and [Hamilton](#) counties recently received urban agriculture grants from NACD so their programs plan to expand.
- **Conservation Cropping Systems Initiative:** CCSI has offered and plans to continue offering various small and urban farm trainings to both the conservation partnership and farmers. CCSI has developed a cover crop training for specialty crops which will be expanded and offered in the future.
- **Indiana State Department of Agriculture:** ISDA provides funding for the Clean Water Indiana grant program described earlier in this document. They also keep track of the results of conservation in the partnership, providing estimates of nutrient and sediment reduction achieved by the implementation of these practices.
- **USDA Farm Service Agency:** FSA offers financial assistance, loans and services that can benefit minority farmers/ranchers and landowners/operators, new or beginning farmers (including youth and veterans); and small specialty crop farmers, organic farmers and other farmers with production practices that are different from most farmers in the area

Local Resources

There are other organizations outside the field office setting that may be able to help connect to small/urban farms and to reach an audience that normally would not interact with the conservation partnership.

- **Master Gardeners:** [Master Gardeners](#) are familiar with Purdue Extension, but many times not with other agencies that make up the conservation partnership. They tend to be very involved with community gardens and other community efforts. Most are also avid gardeners at home (or want to be), and it is a great way to spread information about soil health practices to small home gardens. Even something as simple as offering to teach the soils portion of the program during their training will provide an opportunity to teach soil health and network. Many counties also have “Lunch and Learn” webinars and these can be another avenue to reach gardeners with soil health.

- **Cooperatives and Community Groups:** There are many farmer-run groups that are a good networking resource. Events like a farmers’ market put many small/urban growers in one place and may be a good starting point for networking. However, take into consideration when markets are open is a busy time for the farmer, as this is their time to talk to the public and sell their crops.

Leveraging Existing Networks and Connections

When establishing communications with or a network of small/urban farmers, some of the work may have already been done by others. Each farmer trusts a different group of people to help them make decisions. They may turn to friends and family, agricultural retailers, a partnership agency, or a combination of these sources. Knowing this, it is important to make connections with people who most influence farmers. Networking with people the farmer trusts and relies on for advice can provide potential partnership information and names from a trusted source. There is no need to “go it alone” when making outreach attempts!

When working with fruit and vegetable growers, Purdue Extension is most likely well known and a trusted source of information. Working with the local Purdue Extension educator to network with small/urban and other specialty crop farmers is a good way to get conservation information out through a source that farmers trust. Purdue Extension also runs the Master Gardener program, which usually has connections to local community gardens and the local food network.

If the county or region has a local food council or growers guild, many small/urban farmers are either members or are on their contact lists. In an urban environment, many non-profit organizations, churches, and schools may have gardening and farming initiatives. They may use farming to conduct outreach activities, community and youth development, and education. Visiting places like a farmers market or a community garden will put you in touch with farmers. Often, community gardens will be listed on Google or other search engines, and a quick search can provide results.

Small/urban farms seem to be very connected in an area, so it’s all about finding the right person that will trust what you have to say and who can pass your name on to others in the community as a reputable source of information.

Here is a list of potentially useful connections to reach out to in order to build a customer base:

- Master Gardener Program (Purdue Extension)
- Local and regional governmental sustainability offices
- Local agricultural retailers
- Community gardens
- Non-profits that work in urban agriculture and ecology, youth development, food security, etc.
- Farmers market vendors
- Hoosier Young Farmers Coalition
- Churches
- Schools
- Youth or civic clubs



Kevin Allison, Marion County SWCD demonstrates cover crops to various interested citizens, backyard growers, and farming non-profits.



Marion County SWCD staff enjoy a site visit with the Garden Coordinator at Paramount School of Excellence, Indianapolis.

RESOURCES:

- Purdue Extension Urban Agriculture <https://www.purdue.edu/dffs/urbanag/>
- Purdue Extension Small Farms <https://www.purdue.edu/dffs/smallfarms/>
- Purdue Extension Beginning Farmers <https://www.purdue.edu/dffs/beginningfarmers/>
- USDA NRCS Urban Agriculture <https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/urbanagriculture/>
- USDA NRCS Small Farms <https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/about/?cid=stelprdb1249066>
- Marion County SWCD <http://marionswcd.org/agriculture/>
- Hamilton County SWCD <http://www.hamiltonswcd.org/urbanagriculture.html>
- Purdue Master Gardeners <https://www.purdue.edu/hla/sites/master-gardener/>

EDUCATION: DEMONSTRATIONS AND OUTREACH

Small farms and community gardens have a significant place in their communities. Building partnerships with key small farmers, community leaders and groups like churches, schools and club, and then developing workshops around those partnerships, can be effective ways to promote and teach soil health. Giving solid technical assistance to just one small farm can have big impacts, as small farmers often network, share experiences, and visit each other's farms. Developing soil health farmer-experts is as critical on the small scale as it is in large-scale agriculture.

Workshops/Field Days

Providing on-farm technical assistance to a beginning farmer can sometimes be difficult when there are no conservation practices to be viewed. Workshops and field days can be very effective. Providing growers with an opportunity to visit a demonstration garden or a small farm that is already implementing conservation is beneficial in that *seeing is believing*.



A topic that has been found to express this point is soil biology, and how this interacts and entwines with conservation practices. This is an easy topic to work into any workshop. Termination clinics in the spring, planting clinics in the fall, and taking advantage of teaching opportunities through existing workshops or networks are all avenues for technical training and outreach that have been very effective.

When scheduling workshops, it is recommended to host them at a variety of times and in a variety of formats. Doing so allows conservation staff to reach more diverse audiences. By offering a variety of times, you can reach those that may have full time jobs and other commitments in addition to farming. Here are some examples of different formats and timeframes:

- A brief two to three hour workshop on a Saturday
- A “happy hour” event from 4-6 in the evening
- A two to three hour breakfast workshop in the morning
- A half day workshop on various days of the week

Short tours will add a lot to these events and carpooling works well.

Not all workshops allow for hands-on activities or an outdoor experience due to a number of factors, such as weather, time of year, venue, or length of presentation. Remember if the presentation is in a format such as a webinar or an indoor training, it is important to have lots of pictures to help the audience visualize what is being discussed. The soil health demonstrations are effective in any presentation to give the participants a chance to grasp soil health concepts. As said earlier, “seeing is believing!”

Also plan around known events, like farmers’ market days. Don’t plan a workshop for small farms the day before market day because they will be busy getting ready to sell, and most likely will not have time to attend a workshop.



Spring cover crop termination workshop with Kevin Allison, Marion County SWCD at Fall Creek demonstration gardens in Indianapolis



Amanda Kautz and Derek Thompson with USDA NRCS use soil health demonstrations to help the audience visualize soil health principles

To more easily facilitate workshops and provide direct technical assistance, as well as to gain hands on experience, it is beneficial for conservation partnership staff and volunteers to maintain demonstration gardens. It is key to have a good site to demonstrate conservation practices. Options include renting space in a community garden or creating a garden at the agency's office. One 4' x 16' raised bed is enough space to demonstrate conservation practices including soil testing, cover crops, mulch, and crop rotation.

Remember to provide signage that explains the conservation practices being applied in the garden, identifies the cover crops are planted, etc. This will ensure the garden is a stand-alone educational tool, even when someone is not there to explain it. Also, be sure the signs have the names and/or logos of the partners that are helping to sponsor or manage the garden and some contact information. This will give people an idea of who to contact if they want more information. For examples of signs, see Appendix G.



Working with Partners

The conservation partnership provides an excellent forum for outreach. For example, Purdue Extension Master Gardener groups hold 'Lunch and Learn' events. This is a great audience for these topics or a place to set up a table with an exhibit. Some counties also have demonstration gardens where conservation cropping systems can be implemented and demonstrated. The Marion County Purdue Extension and the Marion County SWCD work together to provide soil health training to Extension's Urban Agriculture Certificate Program and their Urban Farm Incubator Network. Presentations to groups like these often result in requests for on-farm direct technical assistance. It might also be beneficial to do co-farm visits with Purdue Extension, if they are visiting someone who is interested in conservation

and soil health. Both staff participating in the field visit will provide technical assistance in different areas; an introduction by someone they trust can help to build trust in the newly introduced employee.

Promotional Material

Cover crop seed packages that can be distributed to local farmers and organizations are a useful outreach tool. Providing small farmers, gardeners, schools, and churches with small seed packets allows them to easily try out cover crops. Packages with seed that cover 100 sq. feet are enough to cover an entire garden. If any agency wants to develop seed packets, there are a few things to keep in mind. Conservation partnership entities developing seed packets should carefully



choose a cover crop that can be used in a variety of locations with success. Packets will need to use certified seed with a stated variety. This ensures that the distributed seed is a quality product. Also always check the seed tag for any noxious weed seed that may have been detected when the seed was tested. Include basic cover crop information with the seed, such as seeding rate (seeds/square feet), planting depth, planting date, termination methods, etc. Also remember to include information and instructions for the inoculant that should be included with legumes, such as crimson clover. See the examples of cover crop packet inserts from the Marion County SWCD and examples of cover crop information from the Jasper County SWCD included in the appendix.

This same concept works well for pollinator seed packets. There are some readily mixed and available from various retailers. Be sure to check that the plants are native and, most importantly, not considered invasive. Some SWCD offices have created their own using Earth Team Volunteers or 4-Hers looking for community service opportunities to fill packets. The main drawback of creating a custom mix could be the cost, so local seed dealer costs lists should be consulted to make it affordable. These packets can be a great tool to get farmers and urban residents to try a small area of native planting.

ADDITIONAL RESOURCES

Equipment for Demonstrating Small-Scale Soil Health Systems

Demonstration plots are an effective way to get people out to look at the practices being promoted. Similar to traditional field days and demo sites, these plots will require staff or volunteer time and some equipment to maintain. If an office is considering expanding their program to include a demonstration, here are some useful equipment and supplies to purchase for the office, and to do research on for reliable sourcing options.

- Equipment
 - Trowel
 - Shears and/or sickle
 - Rake
 - Hoe
 - Shovel
 - Soil thermometer
 - Ph meter
 - Soil probe
 - Water source (hose, rain barrel, cistern, etc.)
- Supplies
 - Cover crop seed
 - Vegetable seeds and transplants
 - Alfalfa hay
 - Straw
 - News print
 - Quality compost and/or amendments

Recommended Trainings and Learning Resources

These trainings and resources will expand upon the resources listed in this guide. They are less topic-specific and more of an overall view of small/urban farms, soil health, and conservation practices. A resource list for material to give farmers and other customers can be found in the appendix. Some of the recommendations may overlap and keep in mind, neither is comprehensive.

Online

Webinars

- NACD Urban and Community Conservation: Held at 1 P.M. the third Thursday of every month. Variety of topics and most webinars are archived at this site: <http://www.nacdnet.org/general-resources/webinars/>
- NRCS Science and Technology Training Library: Webinars held on a regular basis on a variety of topics, including those relevant to small/urban farms. Webinars are also archived at this site. <http://conservationwebinars.net/>
- Organic webinars available through NRCS Science and Technology Training Library - Over 50 topics related to organics: http://www.conservationwebinars.net/search?breakoutSubject=Conservation%20Webinars%3A%20Organic%20Agriculture&portal_type=Webinar&review_state=published&sort_on=title_or_id
- **Purdue Small Farm:** Archived webinars held on a variety of small farm topics, including equipment, marketing, and farm planning. <https://www.purdue.edu/dffs/smallfarms/resources/sf-webinars/>

- Extension.org: Webinars by eOrganic: A range of useful webinars including Jan-Hendrik Cropp's must-watch "Rotational No-till and Mulching Systems for Organic Vegetable Farms." <http://articles.extension.org/pages/25242/webinars-by-eorganic>

Websites

- USDA New Farmer Website: <https://newfarmers.usda.gov/>
- [NRCS Organic SharePoint for Tech Staff](#)
- NRCS Organic website: www.nrcs.usda.gov/organic
 - Soil Health
<https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/organic/?cid=nrcseprd1363633>
 - Biodiversity
<https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/organic/?cid=nrcseprd1367828>
 - Water Management and Irrigation
<https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/organic/?cid=nrcseprd1367235>
 - Weed and Pest Management
<https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/organic/?cid=nrcseprd1370653>
 - High Tunnels
<https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/organic/?cid=nrcseprd1364702>
 - Pasture Management
<https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/organic/?cid=nrcseprd1365253>
- USDA Organic website: www.usda.gov/organic
- Allowed and Prohibited Substances - <http://www.omri.org/>
- Farm Service Agency - [Organic Certification Cost Share Program \(NOCCSP\)](#) reimburses producers for up to 75% of their certification costs. Producers can also access information on nonfederal agricultural resources, and get referrals to local experts, including organic agriculture, through USDA's Bridges to Opportunity service at the local FSA office
- USDA Agricultural Marketing Service - <https://www.ams.usda.gov/services/organic-certification>
- Unlock the Secrets in the Soil
<https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/soils/health/>
- Clear Choices Clean Water - Soil Health Pledge and Supporting Resource Pages - <http://indiana.clearchoicescleanwater.org/soils/take-a-pledge>
- Indiana Conservation Cropping System Initiative - <http://ccsin.iaswcd.org/>
- The Xerces Society for Invertebrate Conservation has a number of resources related to pollinator habitat assessment and design on organic farms <http://www.xerces.org/pollinator-conservation/organic-farms/>

YouTube and Videos

Four-part video series with Marion County SWCD Urban Soil Health Specialist Kevin Allison on various aspects of urban farming and soil health.

- Volume 1 – Soil Health with Kevin Allison - Intro to Urban Growers Soil Health
https://www.youtube.com/watch?time_continue=20&v=yvW4HEv-OgY

- Volume 2 - Soil Health with Kevin Allison – Talking to Local Growers
<https://www.youtube.com/watch?v=-r2d2-79IOQ>
- Volume 3 - Soil Health with Kevin Allison – Fall Creek Community Gardens
<https://www.youtube.com/watch?v=6cE26ZGOJQE&t=56s>
- Volume 4 – Soil Health with Kevin Allison - Weed suppression
<https://www.youtube.com/watch?v=6Rnpbsr1WUc>

Growing Organic Series (If you want to put these videos on a thumb drive for use at a meeting (instead of using the online versions), all are posted and available for download in the “[Videos for downloading](#)” folder on our Sharepoint.)

- Healthy Soil
https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=stelprdb1269171&ext=pdf
- Biodiversity
<https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/organic/?cid=nrcseprd1367828>
- Water Management And Irrigation
<https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/organic/?cid=nrcseprd1367828>
- Weed and Pest Management
<https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/organic/?cid=nrcseprd1370653>
- High Tunnels
<https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/organic/?cid=nrcseprd1364702>
- Pasture Management
<https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/organic/?cid=nrcseprd1365253>

Facebook

- **Soil Health Garden:** A component of Marion County SWCD’s Soil Health Initiative. Includes useful information about conservation in urban gardens.
<https://www.facebook.com/soilhealthgarden/>
- **Various Master Gardener Facebook Pages:** Find your local county’s Purdue Extension Master Gardener Group and follow them on Facebook for information on gardening and events. Many groups are beginning to adopt soil health practices.

Workshops/Classroom

- **Purdue Extension’s Indiana Small Farms Conference:** Annual educational and farmer-to-farmer networking event for the Indiana small and diversified farm community. Also a good place to network with farmers and other resource professionals.
<https://www.purdue.edu/dffs/smallfarms/>
- **MOSES Conference:** For the northern half of Indiana the conference hosted by the Midwest Organic and Sustainable Education Service (MOSES) is a resource for learning about organic and sustainable farming. It is more applicable to the northern half of the state because it is hosted in Wisconsin and many presenters have climate similar to northern Indiana. It is the largest event in the US on this subject. <https://mosesorganic.org/conference/>
- **Southern Sustainable Agriculture Working Group (SSAWG):** For the southern half of Indiana the conference hosted by SSAWG is applicable because it focuses on organic and sustainable farming in a more southern climate. There are also pre-conference courses and field trips offered. <http://www.ssawg.org/>

Books

- **SARE Building Soils for Better Crops:** Guide to ecological soil management (soil health) with step by step information on soil health practices and case studies from the farms that use them.
- **SARE Managing Cover Crops Profitably:** In depth information on cover crops and their use on any size farm. Includes charts with seeding rates listed in oz. per 100 sq. ft. which is helpful in small/urban farm areas.

Resource Guides/Fact Sheets/Technical Notes

- **USDA Urban Agriculture Toolkit:** Educational tool targeted at urban farmers to help them get started and make them aware of available resources. Also a good reference for employees with little urban agriculture experience. <https://www.usda.gov/sites/default/files/documents/urban-agriculture-toolkit.pdf>
- **USDA NRCS Organic Farming Handbook (eDirectives)** developed for NRCS and other agricultural professionals as they work with organic producers. The handbook describes organic systems and identifies key resources to guide conservation planning and implementation on organic farms. Producers and other audiences may also find the handbook useful, particularly the resources listed in various sections. <http://directives.sc.egov.usda.gov/viewerFS.aspx?hid=37904>
- **Urban Agriculture Technical Notes:** National NRCS technical notes on several aspects of urban soil health/quality, including heavy metals. <https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/resource/#utn>
- **Marion County Purdue Extension New Farmer Resource Guide:** Comprehensive listing of resources divided by topic with links to those available online. Good for finding resources for farmers or for information for conservation partnership employees wanting to further their small farm knowledge. <https://extension.purdue.edu/Marion/Pages/article.aspx?intItemID=19079>
- **ATTRA NCAT:** ATTRA is a program developed and managed by the National Center for Appropriate Technology (NCAT). Their website hosts a variety of resources, including a huge list of publications helpful in small/urban farming. These include a range of topics from composting to food safety to high tunnels on urban farms. There is also a specific section of resources dedicated to urban farming. <https://attra.ncat.org/index.php>
- **USDA NRCS Organic Factsheet and Guides**
 - Transitioning to Organic - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=stelprdb1269170&ext=pdf
 - Growing Organic - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1386649&ext=pdf
 - Technical Assistance for Organic Producers - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd394818&ext=pdf
 - Resources for Conservation Planning on Organic and Transitioning-to-Organic Operations https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1213608&ext=pdf

- Common NRCS Practices Related to Pest Management on Organic Farms
https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1213209&ext=pdf
- Cover Crop in Organic Systems
https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1212809&ext=pdf
- Nutrient Management in Organic Systems
https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1213208&ext=pdf
- EQIP Organic Initiative Fact Sheet
https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=stelprdb1269171&ext=pdf
- **USDA NRCS Organic Practice Factsheets :**
 - Organic Cover Crops -
https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=stelprdb1043183&ext=pdf&ext=
 - Organic Crop Rotations -
https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=stelprdb1043184&ext=pdf&ext=
- **USDA Farm Service Agency – Organic and Small Farm Factsheets**
 - Help for Organic Farming Factsheet www.fsa.usda.gov/programs-and-services/outreach-and-education/help-for-organic-farming/index
 - Organic Certification Cost Share Program Factsheet - www.fsa.usda.gov/Assets/USDA-FSA-Public/usdfiles/FactSheets/2017/organics_fact_sheet_oct2017.pdf
- **USDA Ag Marketing Service – Organic Grower Factsheets -**
https://www.ams.usda.gov/publications/Fact_Sheets?field_term_program_tid=218&=Filter
- **USDA Ag Marketing Service – Specialty Crop Factsheets -**
https://www.ams.usda.gov/publications/Fact_Sheets?field_term_program_tid=216&=Filter

GLOSSARY OF TERMS

The following terms and definitions are not a comprehensive list of all terms used in this guide. The majority of staff using this guide are familiar with most of the terms, not please contact a member of the Indiana Soil Health Team. Please refer to additional online USDA NRCS glossaries of terms if necessary.

Aggregate stability

The ability of soil aggregates to resist degradation. An aggregate is many soil particles held together in a small mass. In a “well-aggregated soil” the aggregates and pores between them hold up well to forces, such as rain, wind, and compaction. (USDA NRCS)

Amendment

Any material added to a soil to improve its physical properties, such as water retention, permeability, water infiltration, drainage, aeration, and structure.

Assessing soil health

Estimating the functional capacity of soil by comparing a soil to a standard, such as an ecological site description, a similar soil under native vegetation, a reference soil condition, or quality criteria. The objective of the assessment dictates the standard to be used. (USDA NRCS)

C:N Ratio (Carbon to Nitrogen Ratio)

The ratio of the mass of carbon to the mass of nitrogen in a substance. The C:N ratio of everything in and on the soil can have a significant effect on crop residue decomposition, particularly residue cover on the soil and crop nutrient cycling (predominantly nitrogen), it is important to understand these ratios when planning crop rotations and the use of cover crops in agricultural systems. (USDA NRCS)

Conservation Cropping System (CCS, or Soil Health Management System)

A managed system of conservation practices consisting of conservation cropping rotation, no-till/strip-till, cover crops, nutrient management and other supporting practices as needed integrated into a cropping system where each practice complements or enhances the others for overall improvement of the health and function of the soil resource which leads to enhanced environmental protection and production efficiency. (USDA NRCS)

Cover Crop Termination

Methods to kill a cover crop may be biological, mechanical, physical, and/or chemical. Winter kill species, crimping, tillage, and herbicide are all options on any scale of farm.

Disturbance

An event or its change in intensity or frequency which alters the structure or functional status of an ecosystem. Examples of disturbances that can affect soil include drought, fire, harvest, tillage, compaction, overgrazing, or addition of pesticides. (USDA NRCS)

Drift (also known as pesticide drift)

Pesticide spray drift is the movement of pesticide dust or droplets through the air at the time of application or soon after, to any site other than the area intended. Pesticide droplets are produced by spray nozzles used in application equipment for spraying pesticides on crops, forests, turf and home gardens. Some other pesticides are formulated as very fine dry particles (commonly referred to as dust formulations). (US EPA)

Environmental justice

Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation and enforcement of environmental laws, regulations and policies. (US EPA)

Food insecurity

A household-level economic and social condition of limited or uncertain access to adequate food. (USDA)

Food security

Access by all people at all times to enough food for an active, healthy life. Food security is typically considered a combination of food access and food affordability, as well as distribution of food, the stability of the supply of food, the use of food, and the nutrition of food. (USDA)

GIS (Geographic Information System)

A system for capturing, storing, analyzing, and managing data and associated attributes which are spatially referenced to the Earth. (USDA NRCS). Detailed and informative maps showing multiple factors of an area can be created using GIS.

Heavy metal

Any metal heavier than iron; examples of heavy metals are lead, cadmium, and mercury. Heavy metals occur naturally, but rarely at toxic levels. Excess heavy metal accumulation in soils is toxic to humans and other animals. Mining, manufacturing, and the use of synthetic products (e.g., pesticides, paints, batteries, industrial wastes, and land application of industrial or domestic sludge) can result in heavy-metal contamination of urban and agricultural soils. (USDA NRCS)

Indicator of soil health

A quantitative or qualitative measure used to estimate soil functional capacity. Indicators should be adequately sensitive to change, accurately reflect the processes or biophysical mechanisms relevant to the function of interest, and be cost effective and relatively easy and practical to measure. Soil quality indicators are often categorized into biological, chemical, and physical indicators. (USDA NRCS)

Infiltration rate

The rate at which water enters soil. (Compare to hydraulic conductivity.) (USDA NRCS)

Inoculant (aka microbial or soil inoculant)

Agricultural amendments that use beneficial microbes (bacteria or fungi) to promote plant health. Inoculants are used when planting legume cover crops such as hair vetch and clovers, in order to promote nitrogen fixation via plant root nodules.

Nutrient Management

Defined as the management of the 4R's of Nutrient Management:

1. Right amount (rate)
2. Right source
3. Right placement (method of application)
4. Right timing of commercial fertilizers, manure, soil amendments, and organic by-products to agricultural landscapes as a source of plant nutrients while protecting local air, soil and water quality.

Organic matter

Any material that is part of or originated from living organisms. Includes soil organic matter, plant residue, mulch, compost, and other materials.

Persistent Bioaccumulative Toxin (PBT)

Chemicals that are persistent (do not break down / degrade easily or rapidly), bioaccumulate in people and/or wildlife, and are toxic. Lead is considered a PBT. (US EPA)

Peri-Urban

The area immediately surrounding and/or adjoining city or town; between the suburbs and the countryside. (Wictionary)

Permaculture

A contraction of "permanent agriculture." One of the many alternative agriculture systems described as sustainable, permaculture is "unique in its emphasis on design; that is, the location of each element in a landscape, and the evolution of landscape over time. The goal of permaculture is to produce an efficient, low-maintenance integration of plants, animals, people and structure... applied at the scale of a home garden, all the way through to a large farm." [John Quinney, "Permaculture in the United States," The New Alchemy Quarterly (Spring 1986) (USDA National Agricultural Library reference)]

Resource Concern

A resource concern (RC) is an expected degradation of the soil, water, air, plant, or animal resource base to an extent that the sustainability or intended use of the resource is impaired (USDA NRCS).

Slake test

A measure of disintegration of soil aggregates when exposed to rapid wetting. (USDA NRCS)

Soil health or soil quality

The capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation. In short, the capacity of the soil to function. There are two aspects of the definition: inherent soil quality and dynamic soil quality. (Compare to functional capacity.) (USDA NRCS)

Soil health, dynamic

That aspect of soil quality relating to soil properties that change as a result of soil use and management or over the human time scale. (USDA NRCS)

Soil health, inherent

That aspect of soil quality relating to a soil's natural composition and properties as influenced by the factors and processes of soil formation, in the absence of human impacts. (USDA NRCS)

Soil structure

The arrangement of soil particles into aggregates which form structural units. Size, shape, and distinctness are used to describe soil structure. Farmers often describe soil structure with words such as crumbly or cloddy. (USDA NRCS)

Tilth

The overall physical character of soil with regard to its suitability for crop production. (USDA NRCS)

Water-holding capacity

The amount of water that can be held in soil against the pull of gravity. (USDA NRCS)

APPENDICES

- A. Lasagna Garden Description
- B. Cover Crop Packet Insert Examples
- C. Cover Crop Handout Examples
- D. Cover Crop Mixes for Microfarms and Gardens
- E. Cover Crop Seeding Table for Microfarms and Gardens
- F. Recommended Resources for Farmers and Growers
- G. Examples of Signs for Demonstration Sites

Appendix A. Lasagna Garden Description

Below is a diagram and description from the pamphlet Garden Safe, Garden Well showing how to construct a lasagna garden bed. Be sure to cover the entire area from edge to edge with each layer.

Layer 1– Cardboard. 2-3 layers, the more weeds the more cardboard. Be sure to remove any tape or plastic.

Layer 2 – Straw. 12 inches thick for the first layer and 6-8 inches thick for the second layer.

Layer 3 – Green organic matter. 3-5 inches thick. This includes any produce that has just begun to go bad and egg shells (but never add eggs, meat, or dairy products). The smaller the pieces, the faster they will decompose and turn into rich soil. So, for example, break apart a whole head of broccoli.

Layer 4 – Finished Compost or Leaf Humus. 1 inch. Compost is organic matter that has already decomposed. Leaf humus is specifically leaves that have broken down. This may be purchased or you can create your own.

Repeat layers 2-4

Layer 5 – Worms. 4-5 handfuls.

Layer 6 – Fertilizer. Sprinkle at recommended rates. *Organic growers should ensure an organic source.

Layer 7 – Finished Compost or Leaf Humus. 1 inch.

Layer 8 – Top Soil. 3-4 inches. If not purchased at a store, make sure that it has been tested for lead and that the lead levels are below 200 ppm and if you want to grow organically, be sure to read the bags carefully looking for synthetic compounds.



Appendix B. Cover Crop Packet Insert Examples (source: Marion County SWCD)

CRIMSON CLOVER
Legume Cover Crop and Inoculant

Cover crops are grown between vegetable seasons to protect and improve the soil. Their living roots produce organic matter that keep garden soil alive and healthy. Legume benefits include nitrogen contribution, improved topsoil tilth, weed suppression, and soil health. For biodiversity and a longer lasting mulch residue, plant with 1 ounce of oats or cereal rye.

Contact your SWCD or visit *SARE Managing Cover Crops Profitably* free online resource to learn more about this cover crop!

Seed Amount	~ 1 ounce
Planting Area	100 sq. ft.
Planting Rate	10-15 seeds/sq. ft.
Planting Depth	1/2" to 1 1/2"
Recommended Seeding Windows	
Northern Indiana	July 1 - Sept. 15
Southern Indiana	July 1 - Sept. 30

Facebook.com/SoilHealthGarden

CRIMSON CLOVER

Cover Crop Seed Tag: *Trifolium incarnatum*; Dixie; 98.00% Purity; 00.25% Crop Seed; 1.45% Inert Matter; 00.30% Weed Seed; Lot# M9-15-DC-30-1; Germ 90%; Origin: Oregon; Tested 05/16; Noxious Weeds: None Found - IN

Inoculant: N-Dure; for Alfalfa/True Clover; Lot# P185; Use before December 31st, 2017

See inoculant instructions on additional insert included in this seed package.

Planting and Termination Recommendations

1. Eliminate weeds before planting and as needed until cover crop has ample growth.
2. Inoculate and spread seed evenly by hand or in shallow furrows.
3. Add a layer of compost or incorporate seeds 1/2" - 1 1/2" deep to assure good seed to soil contact. Try to minimize soil disturbance!
4. Keep ground moist until germination.
5. In spring (~mid-May), cut or crimp legume at flower and leave plant on garden bed as natural mulch.
6. Create rows or spaces in mulch for crop seeding or vegetable transplants.

INOCULANT

Purpose:
Powdered inoculant is included in this legume seed package to enhance nitrogen production.

Application:
To inoculate seed, dampen with a small amount of non-chlorinated, cool water, add this inoculant package, and mix until seed is uniformly coated. Allow 1 to 3 minutes to dry, then plant as soon as possible.

Avoid prolonged skin contact and inhalation. Gloves are recommended when handling.

*** KEEP OUT OF REACH OF CHILDREN ***

NOTICE:
This product does not meet the hazardous criteria set forth by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200).

Read all label directions carefully before using this product. Use standard protective clothing and equipment including gloves, safety glasses and a NIOSH or MSHA approved nuisance dust mask during product handling and storage. See product SDS for additional health and safety information.

This product contains live organisms that are sensitive to chemicals and harsh environmental conditions. NOT A PLANT FOOD PRODUCT.

Facebook.com/SoilHealthGarden

Appendix C. Cover Crop Handout Examples (source: Jasper County SWCD)

Half page handouts for buckwheat and oat/radish mix:

Buckwheat Cover Crop Sample

Plant between May 15 and Sept 1

Buckwheat is a fast-growing, warm season annual that matures in 40-50 days. It is the ultimate quick cover for late spring to summer planting.

1/4 pound 100 square feet.
2.5 pounds 1,000 square feet.

Benefits of Cover Crops

<ul style="list-style-type: none">• Prevent soil erosion• Conserve soil moisture• Add organic matter• Add nitrogen (with legumes)• Attract beneficial insects• Decrease nutrient loss• Increase infiltration of water• Reduce erosion• Suppress weeds	<ul style="list-style-type: none">• Suppress nematodes• Cut fertilizer costs• Reduce the need for herbicides and other pesticides• Improve yields by enhancing soil health• Protect water quality• Help safeguard personal health• Enhance mycorrhizal numbers
---	--

Buckwheat is a key cover crop tool as great benefits are achieved even with 30 days of growth. If you have bare soil, then seed buckwheat. It is frost sensitive and will re-seed itself easily so unless you want that, kill at flowering right away. It will make your soil very friable and the residue will break down quickly.



Buckwheat growing tall



Buckwheat flowering



Buckwheat seed



JASPER COUNTY
Soil and Water
Conservation District

211 E Drexel Parkway
Rensselaer, IN 47978
219-866-8008 ext. 3
www.jaspercountyswcd.org

Information taken from personal growing experience and www.sare.org
Building Soils for Better Crops, 3rd Edition

Youtube: JCSWCD "Cover Crop Guy"

Seeding Methods

1. **Spread by hand** as evenly as possible. Make multiple passes over the area until you are out of seed.
2. **Lawn fertilizer spreader.** Seed in two passes.
3. **No need to fertilize.**
4. **Rake/cultivate in,** covering 1/4 -1/2 inches deep.
5. **Keep soil moist** until germination.



Pollinator on buckwheat.
Walking-wild.com

When to seed

1. **Late spring to late summer,** once warm.
2. **Seed after spring vegetables,** before fall vegetables
3. **Interseed/Over seeding examples:**
 - Early sweet corn - over seed at last picking seed by walking down rows after stalks start to dry down.
 - Tomato - over seed in middle to late August.
3. **Before fall vegetables.** Late spring seed for quick cover and kill 2-3 weeks before planting your crop.
4. **Fallow area.** Seed in late spring and allow to flower for 2 weeks, then it will reseed itself. Otherwise kill before it flowers as it has viable seed very soon after flowering.



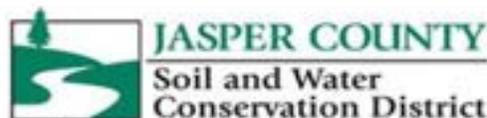
A beneficial tachinid fly on buckwheat.

Spring Management

1. **It will winter kill.**
2. **If planted in May before fall vegetables** mow or crimp right before flowering, residue will take 2 weeks to break down.
3. **Leave flowering** for beneficial and pollinator habitat.
4. **Herbicides** can be used, check label for residual effect on garden crops. Plan to kill 2 weeks before garden crop seeding.



Buckwheat used in strip cropping.



Questions? We have the technical knowledge to assist you. Contact the Jasper County SWCD at 219-866-8008 ext. 3 or www.jaspercountyswcd.org

Oats and Radish Mix Cover Crop Sample Plant between August 1 and September 20

Oats and Radish Mix consists of Jerry Oats and Ground Hog cover crop radish. This mix builds soil and scavenges nitrogen.

1 oz of oats and 1/2 oz of Radish approximately 100 square feet.

Benefits of Cover Crops

- Reduce erosion
- Suppress weeds
- Add nitrogen (with legumes)
- Decrease nutrient loss
- Increase infiltration of water
- Suppress nematodes
- Cut fertilizer costs
- Reduce the need for herbicides and other pesticides
- Improve yields by enhancing soil health
- Prevent soil erosion
- Conserve soil moisture
- Protect water quality
- Help safeguard personal health
- Enhance mycorrhizal numbers
- Add organic matter
- Attract beneficial insects

Oats is a great first time use for cover cropping. They will winter kill. Oats are fast growing and tolerant of several frosts. Fibrous roots hold soil and produce biomass. Tolerant of wet soils and low pH. Excellent for mixing, versatile, available, and cheap.



Oats and Radish



Daikon radish is increasingly used as winter or rotational cover crops in vegetable and specialty crop production, this is not garden radishes! Daikon radish has gained a lot of interest because of its fast growth in late summer and fall, which allows significant uptake of nutrients. It develops a large taproot—1–2 inches in diameter and a foot or more deep—that can break through compacted layers, allowing deeper rooting by the next crop. It will winterkill and decompose by spring, but it leaves the soil in friable condition and improves rainfall infiltration and storage. It also eases root penetration and development by the following crop. It may function as biofumigant, suppressing soil pests, especially root pathogens and plant-parasitic nematodes.



JASPER COUNTY
Soil and Water
Conservation District

211 E Drexel Parkway
Rensselaer, IN 47978
219-866-8008 ext. 3
www.jaspercountyswcd.org

Information taken from personal growing experience and www.nare.org
Building Soils for Better Crops, 3rd Edition

Thanks to CISCO Seed
for donating seed!

Seeding Methods

1. **Spread by hand** as evenly as possible. Make multiple passes over the area until you are out of seed.
2. **Lawn fertilizer spreader.** Seed in two passes.
3. **No need to fertilize.**
4. **Rake/Cultivate in,** covering 1/4-1/2 inches deep.
5. **Keep soil moist** until germination.



3 weeks of radish growth.

When to seed

1. **After Harvest.** Seed anytime and at least 5 weeks before first hard frost. Latest is mid September in NW Indiana.
 - After peas, potatoes, broccoli, cabbage, spinach and onions works great.
2. **Interseed/Over seeding.** Some examples:
 - Tomato - over seed in middle to late August.
 - Spring crops finishing up as long as seeding after July 1st.
 - Broadcast at 3-5 weeks before final harvest in most early to summer vegetables. Try it!



60 days of radish growth.

Spring Management

The oats and radish will winter kill and you can plant right into it.

1. **Winter kill** will occur when nights are below 20 F for 3 nights in a row or more.
2. **Fine seeded vegetables** like lettuce may need light tilling or raking of residue away before planting.



Infiltration tunnel left by radish. Will be filled in.



Questions? We have the technical knowledge to assist you. Contact the Jasper County SWCD at 219-866-8008 ext. 3 or www.jaspercountyswcd.org

Appendix D. Cover Crop Mixes for Microfarms and Gardens (Source: Marion County SWCD)



MARION COUNTY SWCD FAVORITE COVER CROP MIXES AND STRATEGIES					
Species Common Name	Type	Winter Survival	Optimum Depth (inches)	Surface Broadcast Potential	Rate (Ounces / 100 Sq. Ft.)
OATS			Fall Planted • Winterkill > Strip Farrow > Early Spring Seeded Vegetables		
Oats	Nonlegumes	Seldom	1/2-1	+	4.0
CEREAL RYE			Fall Planted • Spring Crimp > Bush Beans • Spring Incorporation when 6" – 8" tall > Wait 20 days > Direct Seed		
Rye, Winter Cereal	Nonlegumes	Expected	1/2-1 1/2	+	3.7
HAIRY VETCH AND OATS			Fall Planted • Spring Chop/Drop > Strip Farrow > May Direct Seed • Spring Chop/Drop > May Transplants		
Vetch, Hairy	Legumes	Expected	1/2-1 1/2	+	1.1
Oats	Nonlegumes	Seldom	1/2-1	+	1.0
HAIRY VETCH AND CEREAL RYE			Fall Planted • Spring Chop/Drop or Crimp > May Transplants • Spring Crimp > Strip Farrow or Make Spaces > May Direct Seeding • Direct seeding of some crops can be difficult with cereal rye biomass		
Vetch, Hairy	Legumes	Expected	1/2-1 1/2	+	1.0
Rye, Winter Cereal	Nonlegumes	Expected	1/2-1 1/2	+	0.9
CRIMSON CLOVER AND OATS			Fall Planted • Spring Chop/Drop > Light Incorporation > May Direct Seed • Spring Chop/Drop > Supplemental Mulch > May Transplants		
Clover, Crimson	Legumes	Expected	1/2-1 1/2	+	0.7
Oats	Nonlegumes	Seldom	1/2-1	+	1.0
SORGHUM-SUDANGRASS			Summer Planted • Early Vegetables > Sorghum-sudangrass > Late Vegetables or Fall Cover Crop		
Sorghum-sudangrass	Nonlegumes	Never	1/2-1 1/2	-	3.0
EXAMPLE ROTATIONS					
Fall Cereal Rye Spring (Crimp) Bush Beans Fall Oats + Hairy Vetch Spring (Chop/Drop + Strip Farrow) Sweet Corn		Fall Cereal Rye + Hairy Vetch Spring (Chop/Drop) Peppers Fall Oats Spring Lettuce + Spinach + Peas		Mid-Fall Oats + Radishes (Winterkill) Late Fall Strip Till or No-till Direct Plant Garlic Spring Supplemental mulch Summer Sorghum-sudangrass	
Results may vary with soils, climate, and weed pressure. Contact your local USDA-NRCS or SWCD to learn more.					

Appendix E. Cover Crop Seeding Table for Microfarms and Gardens (Source: Marion County SWCD)




COVER CROP SEEDING TABLE FOR MICRO-FARMS AND GARDENS

Species Common Name	Type	Life Cycle	Min. Germ Temp	Winter Survival	Optimum Depth (inches)	Surface Broadcast Potential	Rate: Ounces / 100 Sq. Ft.
							Normal Low High
Barley, Spring	Nonlegumes	Cool Season Annual	35F	Never	3/4-1 1/2	+	3.2 1.6 6.4
Barley, Winter	Nonlegumes	Winter Annual	35F	Expected	3/4-1 1/2	+	3.2 1.6 6.4
Buckwheat	Nonlegumes	Summer Annual	50F	Never	1/2-1	-	1.1 0.5 2.1
Millet, Japanese	Nonlegumes	Summer Annual	65F	Never	3/4-1 1/2	-	0.1 0.1 0.1
Millet, Pearl	Nonlegumes	Summer Annual	65F	Never	3/4-1	-	0.1 0.1 0.2
Oats	Nonlegumes	Cool Season Annual	38F	Seldom or Expected*	3/4-1	+	2.4 1.2 4.9
Rye, Annual	Nonlegumes	Winter Annual	40F	Seldom or Expected*	3/4-1 1/2	+	0.7 0.3 1.3
Rye, Winter Cereal	Nonlegumes	Cool Season Annual	34F	Expected	3/4-1 1/2	+	2.1 1.1 4.2
Sorghum-sudangrass	Nonlegumes	Summer Annual	65F	Never	3/4-1 1/2	-	1.5 0.8 3.0
Sudangrass	Nonlegumes	Summer Annual	65F	Never	3/4-1	-	0.8 0.4 1.5
Sunflower	Nonlegumes	Summer Annual	65F	Never	1-1 1/2	-	0.7 0.4 1.4
Triticale, Winter	Nonlegumes	Winter Annual	38F	Expected	3/4-1 1/2	+	2.4 1.2 4.8
Wheat, Winter	Nonlegumes	Winter Annual	38F	Expected	3/4-1 1/2	+	2.5 1.3 5.1
Kale	Brassicas	Cool Season Annual	40F	Seldom or Expected*	3/4-1 1/2	-	0.1 0.1 0.3
Radish (diskon type)	Brassicas	Cool Season Annual	45F	Seldom	3/4-1 1/2	+	0.3 0.1 0.5
Rapeseed	Brassicas	Winter Annual or Cool Season Annual	41F	Seldom or Expected	3/4-1 1/2	+	0.1 0.1 0.3
Turnip, Forage type	Brassicas	Cool Season Annual	45F	Seldom	3/4-1 1/2	+	0.1 0.1 0.3
Clover, Berseem	Legumes	Summer Annual	42F	Never	3/4-1 1/2	+	0.4 0.2 0.7
Clover, Crimson	Legumes	Winter Annual	42F	Expected	3/4-1 1/2	+	0.4 0.2 0.9
Clover, Red	Legumes	Short-lived Perennial	41F	Expected	3/4-1 1/2	+	0.2 0.1 0.5
Clover, White/Dutch/Ladino	Legumes	Short-lived Perennial	42F	Expected	3/4-1 1/2	+	0.4 0.2 0.5
Cowpea	Legumes	Summer Annual	58F	Never	1-1 1/2	-	1.8 0.9 3.7
Pea, Field	Legumes	Winter Annual	41F	Rarely	1-1 1/2	-	3.3 1.1 3.7
Pea, Winter	Legumes	Winter Annual	41F	Seldom	1-1 1/2	-	2.3 1.1 4.5
Soybeans	Legumes	Summer Annual	50F	Never	1-1 1/2	-	3.5 1.8 7.1
Sunn Hemp	Legumes	Summer Annual	68F	Never	3/4-1 1/2	-	1.9 1.0 3.9
Vetch, Hairy	Legumes	Winter Annual or Cool Season Annual	50F	Expected	3/4-1 1/2	+	0.7 0.3 1.3

*Seeding Rates based on Broadcast with Incorporation.
Normal Rate is based on 100% canopy cover.

Source: NRCS FOTG / MOOC Selector Tool. Contact the local NRCS / SWCD for additional assistance or recommendations on areas greater than 1 acre.

Appendix F. Recommended Trainings and Resources for Farmers and Growers

Web Based

- **Web Soil Survey:** Web Soil Survey allows users to make a personalized soils map for their area of interest and run various reports on soil properties. It is operated by the USDA Natural Resources Conservation Service (NRCS) and provides access to the largest natural resource information system in the world.
www.websoilsurvey.nrcs.usda.gov
- **Purdue Small Farm Webinars:** Archived webinars held on a variety of small farm topics, including equipment, marketing, and farm planning.
<https://www.purdue.edu/dffs/smallfarms/resources/sf-webinars/>
- **No-Till Vegetables: Harnessing the Power of Cover Crops:** This website was originally started as part of a Northeast SARE grant looking at low-residue winter killed cover crops for no-till vegetable production. It has case studies and research to help with the practical application and management of cover crops in a vegetable system.
<http://notillveggies.org/>
- **NRCS Urban Agriculture:** National NRCS site for urban agriculture including links to local service center information, stories from urban farm customers, and various resources.
<https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/urbanagriculture/>
- **Midwest Cover Crops Council Cover Crop Selector Tool:** Tool hosted by MCCC to help pick what cover crop will fit the goals of a field. The cash crop type that it will follow and goals for the cover crop can be input. The tool will then make a list of what cover crops would be applicable to the situation.
<http://mccc.msu.edu/selector-tool/>
- **Field Watch:** This site is a voluntary communication tool that enables crop producers, beekeepers, and pesticide applicators to work together to protect specialty crops and apiaries through use of mapping programs.
 - **Driftwatch (farmers):** Register specialty crop fields
 - **Bee Check (apiaries):** Register beehives
 - **Field Watch (applicators):** Register to see the map of mapped crops and apiaries before spraying in order to avoid possible drift onto sensitive crops<https://driftwatch.org/>

Workshops/Classroom

- **Purdue Extension's Indiana Small Farms Conference:** Annual educational and farmer-to-farmer networking event for the Indiana small and diversified farm community. Also a good place to network with farmers and other resource professionals.
<https://www.purdue.edu/dffs/smallfarms/>
- **Purdue Beginning Farmer Tours:** Tours by Purdue Extension offered throughout the state. Tours visit various agribusinesses and participants can learn from Purdue Extension educators, producers and other experts about topics ranging from organic produce to aquaponics.
- **Purdue Urban Agriculture Certificate Program:** A yearlong program that combines classroom learning with field trips to prepare urban agriculture leaders for success with their project. This certificate follows a curriculum designed by Purdue Extension and is tailored to the dynamics of urban agriculture which occurs at a very small scale (usually an acre or less), at close proximity to non-agriculture land uses, and often in partnership with other individuals or organizations. The audience for this curriculum includes for-profit and non-profit market farmers and

gardeners, community garden organizers, school garden leaders, urban homesteaders, and other urban agriculture project leaders.

<https://www.purdue.edu/dffs/urbanag/urban-ag-cert-registration/>

- **Purdue Urban Farm Incubator Network:** A supportive network for new urban farmers that meets 1-2 times per month to support one another, learn together, and continue developing their urban farms. This program also gives access to professional development opportunities and to explore market opportunities for crops.

<https://www.purdue.edu/dffs/urbanag/programs/purdue-urban-farm-incubator/>

Books

- **SARE Building Soils for Better Crops:** Guide to ecological soil management (soil health) with step by step information on soil health practices and case studies from the farms that use them.
<http://www.sare.org/Learning-Center/Books/Building-Soils-for-Better-Crops-3rd-Edition>
- **SARE Managing Cover Crops Profitably:** In depth information on cover crops and their use on any size farm. Includes charts with seeding rates listed in oz./100 sq. ft. which is helpful in small/urban farm areas.
<http://www.sare.org/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition>
- **SARE Crop Rotations on Organic Farms:** This planning guide provides an in-depth review of the applications of crop rotation-including improving soil quality and health, and managing pests, diseases, and weeds. Consulting with expert organic farmers, the authors share rotation strategies that can be applied under various field conditions and with a wide range of crops.
<http://www.sare.org/Learning-Center/Books/Crop-Rotation-on-Organic-Farms>
- **Xerces Farming with Native Beneficial Insects:** This book discusses the ecology of native beneficial insects and how to increase their numbers on your farm through conservation strategies. There are photos and profiles of 20 beneficial insects to help identify them and step by step instructions on how to build habitat through conservation.
- **Compact Farms by Josh Volk:** An illustrated guide with 15 farm plans for five acres or less. These plans explain how to harness an area's water supply, orientation, and geography in order to maximize efficiency and productivity while minimizing effort. There are also real farmer profiles of both urban and rural farms to give real life scenarios and advice.
- **The Winter Harvest Handbook by Eliot Coleman:** If a hoop house is going to be part of the growing system, this book is full of information it has details on construction and maintenance, planting schedules, crop management, harvesting practices, and marketing methods.
- **The Earth User's Guide to Permaculture by Rosemary Marrow:** A step-by-step guide on how to assess and then design a permaculture garden of any size, whether it is a small inner-city balcony, a garden in the suburbs, or a large rural property. Included are chapters on seed saving, permaculture at work, integrated pest management, information about domestic as well as rural water usage, a non-destructive approach towards dealing with weeds and wildlife, and designing to withstand a disaster.
- **The Intelligent Gardener: Growing Nutrient Dense Food by Steve Solomon and Erica Reinheimer:** To grow produce of the highest nutritional quality, the essential minerals lacking in our soil must be replaced. This practical step-by-step guide and the accompanying customizable web-based spreadsheets are tools for any serious gardener who cares about the quality of the produce they grow.

Resource Guides/Fact Sheets/Technical Notes

- **USDA Urban Agriculture Toolkit:** Educational tool targeted at urban farmers to help them get started and make them aware of available resources. Covers everything from starting a farm to sustainable farm practices.
<https://www.usda.gov/sites/default/files/documents/urban-agriculture-toolkit.pdf>
- **Marion County Purdue Extension New Farmer Resource Guide:** Comprehensive list of resources divided by topic with links to those available online. It includes many broad as well as specific topic resources for small/urban beginning farmers, as well as those looking to learn more about conservation and farm management.
<https://extension.purdue.edu/marion/Pages/article.aspx?intItemID=19079>
- **ATTRA NCAT:** ATTRA is a program developed and managed by the National Center for Appropriate Technology (NCAT). Their website hosts a variety of resources, including a huge list of publications helpful in small/urban farming. These include a range of topics from composting to food safety to high tunnels on urban farms. There is also a specific section of resources dedicated to urban farming.
<https://attra.ncat.org/index.php>
- **Gardening on Brownfields:** This Kansas State University site has information that should be considered when working in an area that may have soil contamination. There are guides on how to test the soil for contaminants and information on how crops may take up soil contaminants.
<http://www.gardeningonbrownfields.org/>
- **Midwest Vegetable Production Guide:** This guide is a collaboration of land-grant universities from eight states. It provides vegetable production information that is valid in the participating states for the current year. This includes fertility, variety, cultural, and pest management recommendations.
<https://ag.purdue.edu/btny/midwest-vegetable-guide/Pages/default.aspx>
- **Resource Guide for Organic Insect and Disease Management:** This guide was developed to provide a useful and scientifically accurate reference for organic farmers and agricultural professionals who are searching for information on best practices, available materials, and the efficacy of materials that are allowed for use in organic systems.
<http://web.pppmb.cals.cornell.edu/resourceguide/pdf/resource-guide-for-organic-insect-and-disease-management.pdf>

Organizations

- **Midwest Organic and Sustainable Education Service (MOSES):** MOSES is a nonprofit organization that promotes organic and sustainable agriculture by providing the education and resources to farmers. Their website includes links to publications, webinars, and other useful information. They also host workshops and classes for new farmers and organic farmers near their Wisconsin headquarters. <https://mosesorganic.org/>
- **Ohio Ecological Food and Farm Association (OEFFA):** OEFFA was formed in 1979 and is a dedicated to promoting and supporting sustainable, ecological, and healthful food systems. OEFFA's membership includes farmers, consumers, gardeners, chefs, teachers, researchers, retailers, and students. Together, we are working to recreate a regionally-scaled farming, processing, and distribution system that moves food from farm to local fork. OEFFA offers workshops, conferences, and educational material, much of which is available on their website. <http://www.oeffa.org/>
- **Sustainable Agriculture Research and Education (SARE):** The SARE program is a competitive grants and education program. They provide funding for research and education and many

educational materials on sustainable farming. Many of their educational materials are available for free on their website.

<http://www.sare.org/>

- **Conservation Cropping Systems Initiative (CCSI):** CCSI is a partnership between numerous organizations in Indiana all working toward improving soil health and soil productivity. Its goal is to carry out farm scale agronomic and economic research on soil health and educate farmers and those who interact with farmers on the benefits of soil health and conservation agricultural practices. They host a variety of workshops and partner with other organizations to promote their soil health workshops.
<http://ccsin.iaswcd.org/>
- **Xerces Society:** An international non-profit organization dedicated to the conservation of invertebrates (insects) and their habitats. Xerces focuses on habitat conservation and restoration and protecting pollinators. Their books and courses are a tool to learn about farming with native beneficial insects. They also offer the Bee Better Certification. A certified farm uses production practices that are pollinator friendly.
<http://www.xerces.org>
- **Indiana Conservation Partnership Agencies**
 - **USDA Natural Resources Conservation District (NRCS):** NRCS helps farmers, ranchers and forest landowners conserve their soil, water, air and other natural resources. They provide technical assistance to implement conservation practices, and through the programs authorized by the Farm Bill, can provide financial assistance with these practices.
<https://www.nrcs.usda.gov> & <https://www.in.nrcs.usda.gov>
 - **Indiana Association of Soil and Water Conservation Districts (IASWCD):** Each county in Indiana has a soil and water conservation district. These SWCDs work at the local level in both rural and urban settings to develop solutions to natural resource concerns. These SWCDs can help to provide technical and sometimes financial assistance for conservation practices and host a variety of educational events.
<http://wordpress.iaswcd.org/>
 - **Purdue Extension:** Extension provides the link between Land Grant research and Indiana citizens. They can answer a variety of questions and host educational days and programs on various agricultural issues, as well as health sciences and community development. They also run the state's 4-H program.
<https://extension.purdue.edu/Pages/default.aspx>

Appendix G. Examples of Signs Used at Demonstration Sites (Source: Marion County SWCD)

Soil Health Benefits

- Increased organic matter
- Increased aggregate stability
- Increased water infiltration
- Increased water-holding capacity
- Improved nutrient use efficiency
- Enhanced and diversified soil biology



Minimize Disturbance

Disturb the soil as little as possible.



Maximize Soil Cover

Keep the soil covered as much as possible.



Maximize Biodiversity

Use crop rotation and cover crops.



Provide Continuous Living Roots

Keep plants growing throughout the year.



