SECTION FOUR

NUTRIENT MANAGEMENT FOR WATER QUALITY

Many hobby farmers measure success by the abundance of their harvest of fruits and vegetables or their forage crops. This achievement can often be traced back to healthy soil and nutrient management practices.

SOME HOBBY FARMERS ARE FORTUNATE TO HAVE SITES WITH A THICK LAYER OF FERTILE SOIL RICH IN MICROORGANISMS. HOWEVER, EVEN GOOD SOILS CAN BECOME NUTRIENT DEPLETED OR ERODE OVER TIME. REGARDLESS OF WHAT YOU ARE GROWING, SOILS WILL GENERALLY NEED TO BE MANAGED TO RETURN NUTRIENTS INTO THE SOIL TO SUPPORT HEALTHY PLANT GROWTH.

THE HOBBY FARMER SHOULD CONSIDER THE FOLLOWING QUESTIONS IN DEVELOPING A HEALTHY SOILS MANAGEMENT PLAN:

- Why does annual soil testing help save time and money?
- What nutrients are needed for plant health? (Hint: It's not just about nitrogen, phosphorus, and potassium)
- What's the difference between fertilizers and soil amendments? Organic and synthetic?
- How can you improve nutrient retention in your soil through crop rotation, succession planting, intercropping, and companion planting?
- What are the best techniques to compost and to recycle and reuse materials you likely already have?
- How should you apply fertilizers, manure, and soil amendments for best results?

While nutrients are an essential component of many natural environments, an overabundance in our surface water can cause a reduction in water quality.

Phosphorus and nitrogen from fertilizers can result in:

- excessive aquatic plant growth choking waterways and making them impassable;
- depletion of dissolved oxygen which is essential for fish; and
- creating an ideal environment for toxic algal blooms that can be a health threat to people and pets, often causing recreational areas to close.

Section 4 contains the following Fact Sheets on how to manage nutrients on your hobby farm and how to keep them out of nearby waterways to protect surface water quality.

- FACT SHEET 4-1 Understanding Your Soil
- FACT SHEET 4-2 The Importance of Annual Soil Testing
- FACT SHEET 4-3 Essential Plant Nutrients
- FACT SHEET 4-4 Understanding Fertilizer Types
- FACT SHEET 4-5 Fertilizer: What's in the Bag
- FACT SHEET 4-6 Keeping Nutrients in Your Soil
- FACT SHEET 4-7 Plant Material Composting
- FACT SHEET 4-8 Nutrient and Soil Application
- CHECKLIST 4A Nutrient Management for Water Quality

By following the above fact sheet recommendations, not only can you improve your soil and overall harvest, but you'll be helping to prevent stormwater runoff containing fertilizer, nutrients, and bacteria from entering nearby water resources.

FACT SHEET 4.1

UNDERSTANDING YOUR SOIL

The soils that help support your hobby farm serve as more than just the physical medium needed to grow healthy crops. The most productive soils are alive with microbial activity that work together with the soil structure, nutrients and your plants to provide the balanced environment needed for a successful garden.

Your soil is an ecosystem that cycles nutrients between the organisms in your soil and your plants to ensure a healthy garden and a high-quality harvest. Soil is composed of:

- Minerals
- Water
- Gases
- Organic matter
- Microorganisms

Healthy soils that support good microbial activity need the right amount of:

- Dark organic matter
- Microbial life
- Aeration
- Drainage
- Water retention

GET TO KNOW YOUR SOIL

COLOR	Soils dark in color are generally rich in organic matter that support microbial activity; light and grey soils often lack organic material and proper drainage.
TEXTURE	Soil texture regulates how water, air, nutrients, microorganisms and plants interact in the soil and is determined by the amounts of sand, silt, clay and organic matter. Healthy soils have an ideal texture of 30-50% sand, 30-50% silt, 20-30% clay and 5-10% organic material.
STRUCTURE	Soil structure impacts the movement of air and water through soil. Healthy soil structure is generally loose and crumbly. Overly compacted soils can inhibit root growth and prevent infiltration of water, limiting water available for plant growth and potentially causing erosion.
SMELL	Healthy soils should have an earthy smell while soil with an offensive odor can indicate a disruption in its microbial balance.
PH	Soil pH on a scale of 1-14 measures the acidity and alkalinity of the soil with 7 being neutral, less than 7 being acidic, and greater than 7 being alkaline. Most home garden plants prefer soil that is neutral or slightly acidic, however, there are exceptions and it's best to research the individual plant's preference to ensure the soil pH is correct for optimal health.

WATER QUALITY BENEFIT
Healthy soils have good water retention capabilities and improve drainage resulting in reduced erosion and stormwater impacts to nearby surface waters.

Microorganisms are the primary decomposers of organic material in soil. Decomposers generally include:

- Bacteria
- Algae
- Fungi
- Earthworms
- Nematodes

Healthy balanced soils are more likely to:

- Be less susceptible to erosion and stormwater runoff that can impact nearby waterways.
- Contain the water retention capabilities needed to support plants, particularly during dry conditions.
- Have the ability to adapt to changes in environmental conditions.
- Be able to adjust to changes in nutrient availability as plants grow.
- Defend against the threat of disease and pests.

BY EVALUATING AND UNDERSTANDING THE PHYSICAL AND BIOLOGICAL COMPONENTS OF YOUR SOIL YOU SHOULD BE ABLE TO MORE ACTIVELY AND EFFECTIVELY IMPLEMENT YOUR NUTRIENT MANAGEMENT PROGRAM TO PRODUCE A HIGH-QUALITY HARVEST.

DID YOU KNOW?
One teaspoon of healthy soil can contain 100 million to 1 billion healthy bacteria.

HELPFUL LINKS
www.ag.umass.edu/crops-dairy-livestock-equine/fact-sheets/healthy-soils
www.nrcs.usda.gov/wps/portal/nrcs/main/national/soils/health

FACT SHEET 4.2

THE IMPORTANCE OF ANNUAL SOIL TESTING

Periodic soil testing is critical in determining what nutrients your soil may need to grow healthy plants. No matter what size your garden is or what you are growing, annual soil testing is recommended as the basis for a successful crop and nutrient management program.

DID YOU KNOW?
Adding material to your soil based on annual soil test results may: Save money · Save time Produce higher crop yields · Produce healthier crops · Protect nearby waterbodies

In most cases, a routine soil analysis or standard fertility test is all you need and can be analyzed by your local Natural Resources Conservation Service (NRCS) Cooperative Extension laboratory, typically for under $20. With the results, you will receive recommendations for nutrient and pH adjustments specific to your soils and type of crop you wish to grow.

WHY DO A SOIL TEST?

- Nutrient needs of gardens can differ depending on what you grow. A soil test can help determine exactly what nutrients your soil already has and what it needs for the specific crop(s) you wish to grow. Test results are provided with fertilizer and pH adjustment recommendations.
- Soil needs can change from year to year as different plants and crops consume different nutrients in varying amounts. Soil test results can help quantify how much of each nutrient should be applied each year.
- Adding too much fertilizer to your garden can result in the transport of those nutrients to the nearest waterbody via stormwater runoff, resulting in water quality impacts. Soil testing can play a role in reducing pollution from stormwater runoff by providing you with a detailed report of the soil's specific needs, reducing the over-application of fertilizer, manure and soil amendments.
- Knowing what you need to add each year and in what quantities can significantly reduce the over-application of products, saving you time and money.
- Too much or too little of a nutrient can harm plants.
- Crops receiving the right type and quantity of fertilizer can result in higher quality plants and yields.
- Healthy plants can better defend against pests, disease, and also environmental stressors such as flooding, drought and sudden temperature changes.

CAUTION!
Retail soil tests kits that provide immediate results are often unreliable. It is recommended that soil samples be sent to your nearest NRCS Cooperative Extension for a more accurate analysis, plus they can often provide follow-up support should you have any questions.

WATER QUALITY BENEFIT
Soil testing is one of the most important steps to help ovoid over-application of nutrients which can be a major surface water contaminant resulting from hobby farm stormwater runoff.

HOW DO I COMPLETE A SOIL TEST?

Soil samples are relatively easy to collect and can be analyzed by your nearby NRCS Cooperative Extension. Directions for soil collection and preparation prior to testing can vary so be sure to obtain specific collection directions prior to submittal to help ensure accurate results. The following are general steps:

Step 1

Determine the area you want to test – soil sample collection locations should be representative of the typical garden or field conditions (avoid atypical areas).

Step 2

With a clean bucket and spade, collect 6 or more subsamples to a depth of six to eight inches and mix together in the bucket.

Step 3

Break up any lumps and remove any stones, roots, and debris.

Step 4

Spread the required sample amount (usually about 1 cup) on a clean piece of paper to dry.

Step 5

Submit the air-dried sample along with any other specific directions provided by your NRCS Cooperative Extension. Be sure to include information on the crop you will be growing (usually called the Crop Code) so the lab can provide site specific recommendations for you.

CONTACT

The NRCS has partnered with the University of Massachusetts Amherst Soil and Plant Tissue Testing Lab to offer soil testing in Massachusetts. Routine soil analysis typically takes 5 to 10 business days.

UMASS-AMHERST SOIL LAB • West Experiment Station
203 Paige Laboratory • 161 Holdsworth Way • Amherst, MA 01003
Phone: 413-545-2311 • soiltest@umass.edu • http://soiltest.umass.edu

HELPFUL LINKS
www.ag.umass.edu/services/soil-plant-nutrient-testing-laboratory/ordering-information-forms
www.ag.umass.edu/soil-plant-tissue-testing-lab/fact-sheets/interpreting-your-soil-test-results

FACT SHEET 4.3

ESSENTIAL PLANT NUTRIENTS

Believe it or not, there are 17 elements or nutrients essential for plant life. Nutrients required in greater quantities are referred to as macronutrients, while those required in smaller quantities are referred to as micronutrients. No one nutrient is more important than another, they are just required in different quantities and concentrations.

Optimal yields can only be produced when all of the nutrients are in proper supply. If one or more nutrient is lacking in the soil, crop yields will be reduced, even though an adequate amount of other nutrients are available. This can also occur if there is too much of a particular nutrient. Any nutrients not used by the plant are considered excess and can travel through stormwater runoff to nearby surface waters. Here they can reduce the quality of water and habitats through excessive aquatic plant growth and algal blooms. Nutrient balance is needed for healthy plants and successful yields.

NUTRIENT CONTENT

The nutrient content of fertilizers and other soil additives are often presented using the nutrient's elemental symbol. For example, fertilizers display Nitrogen-Phosphorus-Potassium ratios as N-P-K ratios.

WHAT ARE THE 17 NUTRIENTS ESSENTIAL FOR PLANT HEALTH?

DEVELOPING AND FOLLOWING AN ENVIRONMENTALLY SOUND NUTRIENT MANAGEMENT PROGRAM THAT CONSIDERS THE ACTUAL NEEDS OF YOUR SOILS AND PLANTS THROUGH SOIL TESTING WILL NOT ONLY RESULT IN A HEALTHY, BOUNTIFUL HARVEST, BUT WILL HELP TO MINIMIZE EXCESS NUTRIENTS FROM CONTAMINATING NEARBY SURFACE WATERS.

The 17 nutrients essential for plant health, along with their elemental symbol (e.g., the elemental symbol for nitrogen is N), are provided below:

NON MINERAL ELEMENTS	Hydrogen (H), carbon (C) and oxygen (O) are the three primary elements that plants use in the largest amounts. Plants can obtain these elements from water, air or both. As such, the soil does not need to provide these nutrients, so they are not sold as fertilizers.
PRIMARY MACRONUTRIENTS	The following three nutrients are considered primary nutrients because they are needed in larger quantities and they are most often limiting from a crop production standpoint. Generally, they are managed by the addition of fertilizers, compost or manures to soils. • Nitrogen (N) is responsible for the growth of leaves. • Phosphorous (P) promotes root development. • Potassium (K) promotes flower and fruit development.
SECONDARY MACRONUTRIENTS	Secondary macronutrients are also needed in larger quantities, but are considered secondary nutrients because they are rarely limiting, and more rarely added to soils as fertilizers compared to nitrogen, phosphorus and potassium. These include: • Calcium (Ca) improves general plant vigor and promotes growth of young roots and shoots. • Magnesium (Mg) helps regulate the uptake of other plant foods and aids in seed-making. • Sulfur (S) helps encourage vigorous plant growth.
MICRONUTRIENTS	Micronutrients are nutrients used by plants in very small amounts in proportion to macronutrients, but are still essential to plant health. These include: boron (B), chlorine (Cl), manganese (Mn), iron (Fe), nickel (Ni), copper (Cu), zinc (Zn) and molybdenum (Mo).

WATER QUALITY BENEFIT

Understanding and identifying the specific nutrients that are needed by your crops will result in healthier plants while helping to protect surface water quality from nutrient contamination.

HELPFUL LINKS

www.ag.umass.edu/vegetable/fact-sheets/vegetable-crops
www.worldcrops.org

FACT SHEET 4.4

UNDERSTANDING FERTILIZER AND SOIL AMENDMENT TYPES

Most plants require 17 essential elements or nutrients for growth and overall plant health. Three of these (carbon, hydrogen and oxygen) can be obtained from air and water through the process of photosynthesis, however, the remaining 14 elements are derived from soils. Of these, Nitrogen (N), Phosphorus (P), and Potassium (K) are most often limiting from a crop production standpoint and require management through the addition of fertilizers, compost or other amendments to soil. The best way to determine your soil's nutrient needs is to test your soil annually.

If your test reveals that your soil needs additional nutrients, recommendations are usually provided on the quantity of nutrients to add. There are different types of soil amendments and fertilizers that can be considered, and while the nutrients will generally be processed the same way, there are several other factors that should be considered. Here we provide a description of the two most common categories of fertilizers to help you understand why fertilizers are not created equal and how your selection may provide additional benefits to your plants while reducing impacts to the environment.

FERTILIZERS VS. SOIL AMENDMENTS

We often hear the words fertilizer and soil amendment used interchangeably. Throw in the terms compost and manure and you have yourself a confusing mix of gardening terms. Fertilizers and soil amendments have two different jobs. Fertilizer is meant to feed plants – generally with one or more of the 17 essential plant nutrients. A soil amendment is used to improve the condition or structure of soil. This might be increased water retention, aeration or drainage – all making a better environment for plant roots and for soil microorganisms to thrive. Examples include compost, animal manures, worm castings, fall leaves, gypsum, straw and grass clippings. Keep in mind that some organic soil amendments such as compost and animal manure can also add nutrients to your soil and are considered to be both a fertilizer and a soil amendment.

ORGANIC OR NATURAL FERTILIZER

Organic or natural fertilizers are typically derived from plant or animal waste or powdered minerals, with minimal processing and are more likely to originate from renewable and sustainable resources. These types of fertilizers are naturally broken down over time by microorganisms found in your soil, making nutrients available over a longer period of time as opposed to all at once. Since organic or natural fertilizers need to be broken down, they can also improve the overall structure of your soil and help support microorganisms. The 'slow release' of nutrients provided with organic fertilizers can help eliminate the need for multiple applications and reduce the chances of overfertilizing plants. Compost and manure can contain a wide variety of other beneficial microbes that can also help to control plant pathogens, resulting in hardier plants.

Pros

- Environmentally friendly since often originating from renewable and sustainable sources
- Improves soil structure by promoting microorganism growth
- Slow release, less likely to "burn" grass and to runoff into waterbodies
- Often fewer applications are needed due to 'slow release' quality

Cons

- Due to slow release, may not "release" fertilizers when you want
- Generally tied to soil temperature, so effectiveness may be limited during cooler months
- Can be more expensive

CAUTION!
Just because a product is natural or organic doesn't mean it can't become a source of water pollution. Correct application techniques are essential in helping to ensure the protection of nearby surface waters.

CHEMICAL OR SYNTHETIC FERTILIZERS

Chemical or synthetic fertilizers are typically manufactured or man-made compounds, such as from by-products of the petroleum industry. Examples include ammonium nitrate, ammonium phosphate, superphosphate, and potassium sulfate. Although they are occasionally made from organic sources, they are generally water soluble, releasing nutrients to plants very quickly rather than over time. Unlike organic fertilizers, chemical or synthetic fertilizers don't support microbiological life in the soil and can actually kill off beneficial microorganisms. These types of fertilizers generally don't provide any benefit to the soil structure or overall soil health, and typically don't contain trace elements needed by plants that can become depleted after repeated plantings. While there are some synthetic slow-release fertilizers on the market, some research has found that synthetic fertilizers can contribute to a soil chemistry that discourages the natural microorganisms important to healthy soil and plant health.

Pros

- Immediate release of fertilizer, become effective quickly
- Relatively inexpensive
- Exact and consistent makeup since chemically manufactured

Cons

- Non-environmentally friendly
- Generally does not improve soil structure and can cause toxic buildup of chemicals
- Can harm microorganisms
- Don't always contain necessary soil micronutrients

QUICK RELEASE VS. SLOW RELEASE FERTILIZERS

Quick release or fast acting fertilizers are often water soluble chemicals that provide plants with immediate access to nutrients. Quick release fertilizers are usually made from synthetic material, and because they are water soluble, can easily leach into groundwater and surface runoff. Because of this they require repeated applications and as a result, become a threat to water quality. Slow release fertilizers are water insoluble and release nutrients over time making only small amounts of nutrients available at a time but over a longer period of time. Slow release fertilizers are often made from natural products and some can also contain synthetic materials.

Hobby farming with water quality in mind requires you to select and apply fertilizers and soil amendments with care. You will need to take into consideration a number of factors based on your specific site, soil and plant needs. The recommended choice is to use natural products for fertilizers and soil amendments. Overall, natural products tend to support healthy soil microorganisms while releasing nutrients a little at a time. These often can be produced right on your hobby farm in the case of compost and/or animal manure and should be considered a long-term investment in the health of your plants, soil and water resources.

WATER QUALITY BENEFIT
Natural fertilizers and soil amendments tend to pose fewer threats to water quality as long as they are applied correctly. However, even natural products can become a water quality problem if applied incorrectly or too much is used.

FACT SHEET 4.5

FERTILIZER: WHAT'S IN THE BAG

Once you have your soil test results and identify what nutrients your soil needs (if any) it is time to select a source for these nutrients. Both organic and synthetic fertilizers can supply your nutrient needs; however, many soil amendments, including compost and manure, offer several additional benefits that can make them a better choice.

CAUTION!
Whether you choose to use an organic or synthetic fertilizer – never exceed the application rate recommended in your soil test results or on the product label.

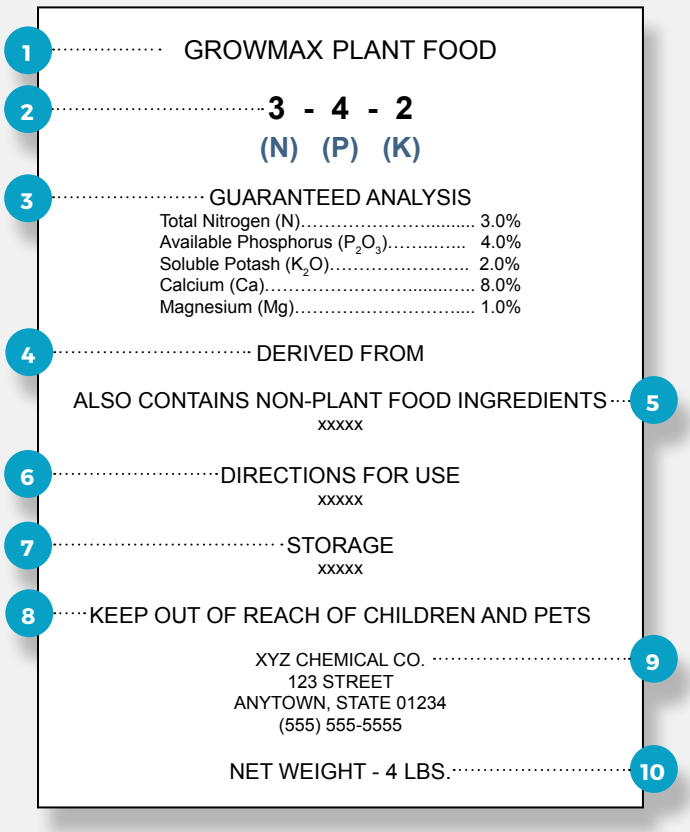
Since organic fertilizers need to be broken down by microorganisms in the soil, they are slowly released into the environment. This 'slow release' process naturally protects plants from overfertilization. It also supplies the nutrients plants need over a longer period of time compared to chemical or synthetic products that often lack this 'slow release' mechanism.

- This slow release process helps reduce the chance of nutrients leaching into groundwater or coming into contact with stormwater runoff, offering greater protection to nearby water resources. It can also decrease the number of applications needed annually, saving time and money.
- As organic fertilizers break down, they can help improve the soil structure by increasing its ability to retain water and promote healthy soil.
- Organic fertilizers are often renewable, biodegradable, sustainable, and environmentally friendly.

The following sample provides guidance on how to read fertilizer labels.

DID YOU KNOW?
Just one pound of phosphorus reaching a surface water can produce 10,000 pounds of algae and aquatic plants.

1. **BRAND NAME** – Lists the name of the product provided by the manufacturer.
2. **N-P-K RATIO OR FERTILIZER GRADE** – Fertilizer labels generally have 3 bold numbers prominently displayed that represent the minimum percentage by weight or proportion of the three primary macronutrients. Also known as the fertilizer grade, these numbers give the percentage of total nitrogen (N), available phosphorus (P) and water-soluble potash (K). Our sample label indicates that the fertilizer contains 3% total nitrogen, 4% available phosphorus and 2% water-soluble potash. Separated by a hyphen, these numbers are always in the same order and are often referred to as the N-P-K Ratio.
3. **GUARANTEED ANALYSIS** – States the minimum percentage by weight of plant nutrients in the fertilizer claimed by the manufacturer. The guaranteed analysis is industry standard information and, by law, is required to be provided on every commercial product. Note that the percentages generally will not add up to 100% since there are often other nutrients and filler products in the fertilizer. Fillers are inactive or inert ingredients that can include material to help prevent the fertilizer from drying out or reduce odor.
4. **DERIVATION STATEMENT** – Lists the sources for the nutrients in the guaranteed analysis. Look for natural organic sources such as manures and meals as well as controlled release ingredients that are often identified as pelletized, coated or called out as 'slow-release'.
5. **NON-PLANT FOOD INGREDIENTS** – Identifies material in the fertilizer that are non-plant food ingredients. For organic fertilizers, this often includes a list of good bacteria. These bacteria are important to soil health and generally are not found in chemical-based fertilizers.
6. **DIRECTIONS FOR USE** – Details how to apply the fertilizer including where, when and how much. If you have completed a soil test you may find that you need less than the recommended rate on the label. Many labels will also say where and when NOT to apply the product. This may include not applying the fertilizer if heavy rain is expected or near water, storm drains or drainage ditches.
7. **STORAGE** – Provides details on fertilizer storage such as store in a dry place.
8. **PRECAUTIONARY STATEMENT** – Includes information related to safety and product warnings.
9. **CONTACT INFORMATION** – Lists the contact information for the manufacturer, registrant or distributor of the product.
10. **NET WEIGHT OR VOLUME** – Gives the net weight or volume of product in the fertilizer container or bag.



Sample Fertilizer Label

BIGGER IS NOT ALWAYS BETTER

Fertilizers with larger numbers are often purchased by consumers with the thought that a higher N-P-K ratio means a better fertilizer. Fertilizers with big N-P-K numbers such as 30-10-15 or 18-24-12 are often synthetic in origin with much of the product wasted since plants cannot completely utilize all of the nutrients. This unused fertilizer can leach unto groundwater or runoff into nearby surface water. Lower N-P-K products that are organic in origin or slow-release can feed plants slowly over time and are less likely to impact groundwater or surface water. Remember that the best fertilizer is one that is selected based on your soil test results so that it can meet all your soil and plant needs.

COMBINATION PRODUCTS

Never use combination products such as those that contain fertilizers with pesticides or fertilizers with herbicides (sometimes called 'Weed and Feed'). Although most often marketed for lawncare, combination products can sometimes be found in the general garden section in stores. If you happen to need a fertilizer along with an herbicide or pesticide, carefully select these products separately. This gives you greater control over the individual product along with how much, when and where you apply it.

SKIP THE BAG

Better yet, skip the fertilizer bag and consider using compost and/or aged animal manure instead of commercially purchased fertilizer to add nutrients to your soil. These types of materials might be available right from your own hobby farm or can often be purchased locally. Using compost or manure can recycle material and provide tremendous boosts to soil health and the living microorganisms within, as well as improve water quality by reducing the potential for erosion of excess nutrients into waterbodies.

NUTRIENT	COMMONLY AVAILABLE ORGANIC SOURCES
NITROGEN (N)	blood meal, composted chicken manure, soybean meal, cottonseed meal, alfalfa meal
PHOSPHORUS (P)	rock phosphate, bone meal, bat guano
POTASSIUM (K)	potash (of muriate or sulfate), greensand, granite dust, seaweed/kelp meal, sul-po-mag

WATER QUALITY BENEFIT
Fertilizers can be a major source of water pollution. Basing fertilizer applications on soil test results and using organic sources helps protect nearby surface waters.

FACT SHEET 4.6

KEEPING NUTRIENTS IN YOUR SOIL: ALTERNATIVE PLANTING METHODS

While fertilizers provide a great source of nutrients to your soil and plants, if used incorrectly, they can have detrimental impacts to both your plants and nearby water resources. The first step in determining your nutrient and fertilizer needs is to perform an annual soil test. This provides you with your soil's nutrient needs based on the types of crops you plan on growing.

A NEW SOIL TEST SHOULD BE CONDUCTED EACH YEAR TO DETERMINE THE APPROPRIATE AMOUNTS AND APPLICATION RATES OF FERTILIZERS TO MEET YOUR GROWING NEEDS. THIS IS IMPORTANT, BECAUSE AS YOUR CROPS GROW, THEY WILL DEPLETE THE SOIL OF CERTAIN NUTRIENTS REQUIRED FOR THAT PLANT TO THRIVE. THESE NUTRIENTS WILL NEED TO BE REPLENISHED FOR FUTURE SUCCESSFUL HARVESTS.

By incorporating some simple cultivation practices into your hobby farm nutrient management plan, you can reduce the depletion of nutrients in your soils. This in turn can reduce the amount of fertilizer you need to add each year, saving you time and money, while helping to protect our environment and water resources. Consider keeping nutrients in the soil by using one or more of the following methods.

CROP ROTATION

Crop rotation is the practice of growing plants in different areas of your garden or field each year. Growing the same types of plants or plant families in the same place each growing season can deplete your soil of the nutrients preferred by that crop on a yearly basis. By rotating where you plant your crops, they are better able to utilize the different types and amounts of nutrients in the soil and have a better chance of interrupting any type of disease or pest cycle. Additionally, some plants routinely leave behind nutrients in the soil which can often be used by other types of crops. For example, it makes sense to plant crops like lettuce that use lots of nitrogen in an area where nitrogen fixing legumes like peas were planted the year before. Similarly, heavy feeders like tomatoes can be followed by light feeders such as herbs and root crops.

DID YOU KNOW?

The 'three sisters' is a Native American companion planting technique where corn, beans and squash are grown together. Each crop or 'sister' contributes to the planting. Corn provides support for the climbing beans; beans add nitrogen to the soil; and the large prickly squash leaves near the ground help keep out predators while shading the soil, keeping it moist and preventing weeds.

ALTERNATIVE PLANTING METHODS SUCH AS THESE CAN:

- **Increase plant health, soil fertility, soil structure and yeilds**
- **Reduce fertilizer use, pests, stormwater runoff and erosion**
- **Maintain a small fruit orchard**
- **And many more...**

SUCCESSION PLANTING

Succession planting works similarly to crop rotation as it introduces several types of plants into one area, using different nutrients and boosting soil structure. Succession planting is the practice of replacing short season crops with a new crop in the same location. For example, quick growing lettuce and radishes can be harvested early in the growing season and immediately replaced with a longer growing crop such as tomatoes. Another way to keep nutrients in your soil is to consider planting a cover crop after you harvest, such as clover or alfalfa. This crop will help prevent soil erosion and add nutrients back into your soil.

INTERCROPPING

Similar to succession planting, intercropping involves planting a short season crop together with a long season crop. Instead of planting them one after another like succession planting, they are grown next to each other with the idea that the short season crop will be harvested prior to the long season crop that requires more space and nutrients for growth. For example, you may want to consider planting quick growing lettuce adjacent to pumpkin plants; the lettuce can be harvested early, freeing up room for pumpkin plants.

COMPANION PLANTING

Companion planting involves the planting of two or more different crops close to each other for their mutual benefit. It is thought that certain plants work well with others with the idea that their specific properties will benefit one another. For example, planting different but carefully selected crops in proximity to one another can assist in nutrient uptake, pest control, pollination, and/or other factors necessary for reducing pest damage and/or increasing crop productivity.

HELPFUL LINKS

www.ag.umass.edu/resources/home-lawn-garden/fact-sheets/vegetable
www.ag.umass.edu/home-lawn-garden/fact-sheets/companion-planting-in-vegetable-garden

FACT SHEET 4.7

PLANT MATERIAL COMPOSTING

As a hobby farmer, you may find yourself with an abundance of organic material throughout the year. Spoiled fruit, vegetable waste, spent garden plants, animal bedding, grass clippings and autumn leaves are just a few of the sources of organic material that can be found on a hobby farm. All of this can add up to a lot of material on a daily, weekly and monthly basis creating a significant amount of work, time, and often money to dispose of. One way to recycle this material is composting.

WHAT IS COMPOSTING?

Composting is the process of decomposing organic material by combining specific ingredients in an ideal environment for microorganisms to break down. As a result, organic material is turned into a nutrient rich soil amendment that you can spread in your garden or farming areas. Composting and decomposition are the same process – both occurring naturally when living materials die, except composting takes place in a controlled environment where material can be collected and reused. Compost is often highly sought after since it is generally organic in nature, builds soil structure and is high in nutrients. Composting organic material can:

- Recycle organic material
- Reduce your overall solid waste volume and disposal costs
- Help keep organic yard waste out of waterways
- Kill disease causing pathogens
- Create a valuable soil amendment
- Enrich soil structure that can increase water retention and reduce soil erosion
- Decrease your fertilizer budget

BUILDING A COMPOST BIN

There are many different ways to compost your organic material. Homemade compost bins can be made of recycled material you might already have around your hobby farm such as discarded wooden pallets, chicken wire, mesh screens or concrete blocks. Compost bins are also available from local garden centers and online catalogs with dozens of different sizes and designs commercially available.

Additionally, many Massachusetts municipalities have compost bin programs, where they sell compost bins to residents at or below retail costs. See the following link to see if your community participates in a compost bin distribution program (www.mass.gov/eea/agencies/massdep/recycle/reduce/get-a-low-cost-rodent-resistant-compost-bin.html).

When deciding on how large of a compost pile you would like to maintain, keep in mind how much time, space and material you will have to dedicate to composting.

LOCATION, LOCATION, LOCATION

It's important to locate your compost bin in an area that is flat, dry and easily accessible so that you can add material and manage your pile easily. If it's not in a convenient location or if you need to carry your organic material long distances to your bin, you'll be less inclined to manage your pile. In any case, make sure your compost area is away from both groundwater wells and surface water and preferably covered.

HOW DO I COMPOST?

Composting is all about creating an environment for good microorganisms to thrive so they can help decompose your organic material. To do this your decomposers need the following:

- **Food** – your compost should be made up of organic material with layers of 'brown' – high carbon organic material and 'green' – high nitrogen organic material. Ideally use approximately three-parts of brown material to one-part green material.
- **Air** – the microorganisms in your compost pile need air. Turn or mix your compost pile often - weekly or even a couple times per week to speed up the process.
- **Moisture** – your compost pile needs moisture to work – it should be damp but not dripping wet. If your compost pile becomes dry – just mix in some water.
- **Heat** – sunlight provides the heat needed to help create that perfect environment for decomposition and to help make sure that any harmful organisms are eliminated. This is why the composting process tends to slow down during the winter months.

WHY COMPOST?

Composting organic material on your hobby farm can significantly reduce the volume of solid waste that may otherwise need to be disposed of while generating a nutrient rich material that you can reuse. It's recycling at its best!

CAUTION!
DO NOT COMPOST diseased plants; food scraps containing meat, fat, oil or butter; hazardous material; pressure treated lumber; inorganic material; weeds or invasive plant species; plants/clippings containing herbicides; or pet waste. It is possible that some of the above materials can be composted however very specific temperatures, intensive compost management and alternative methods are often needed. It is recommended that these materials not be used in a typical hobby farm compost system to help ensure a healthy and safe compost.

Common Compost Material

COMMON 'GREEN' MATERIAL	Spent plants, fruit and vegetable waste, grass clippings, seaweed, blood meal, egg shells, coffee/tea grounds, animal manure* (cow, horse, pig, sheep, chicken, rabbit), hair and feathers, nut shells
COMMON 'BROWN' MATERIAL	Dried leaves, shredded newspaper, animal bedding*, straw/hay, wood chips/ash, cornstalks, saw dust, pine needles

* Note that if you are composting animal manure with bedding, you may need to add an additional source of nitrogen such as grass clippings, blood meal or chicken manure.

Smaller material composts quicker so consider breaking up any larger material in your compost pile if you're looking to speed up the composting process.

Basic Composting Steps

The following are basic composting steps:

Step 1

Select your composting location.

Step 2

Build (or buy) your bin.

Step 3

Add your green and brown organic material.

Step 4

Turn your pile often.

Step 5

Keep it moist and covered.

WATER QUALITY BENEFIT
Composting organic material not only keeps it out of waterways but recycles material into a valuable soil amendment for your garden.

Plan ahead and build a compost bin that has a removable top - this is where you'll add new materials for compost. Have one side of the bin that is open towards the bottom - this is where you'll take your completed compost from. Make sure you can fit a shovel in through the opening!

HOW DO I KNOW WHEN I'M DONE?

Finished compost is generally a crumbly, dark brown soil that is light in weight with an earthy smell. You can screen your compost and return the larger material to start your next batch of compost. The amount of time it takes to create finished compost will vary depending on the volume and type of organic material you use, climate, and how often you turn your pile. Most compost can be ready to use in 3-6 months.

HOW CAN I USE MY FINISHED COMPOST?

Compost is a rich organic material that is high in nutrients which is why it's sought after by gardeners. Compost can be used in all types of gardens throughout the year. Using compost can often reduce or eliminate the need to use certain fertilizers. Completing a yearly soil test can help you determine what nutrients your garden crops need. Adding compost can also help build healthy soil structure that can support soil microorganisms that are important in keeping pests and disease away.

BE INNOVATIVE

Did you know that one pound of worms can eat up to ½ pound of organic material per day? Ideal for those looking to compost in small areas or even indoors, vermicomposting is the process where worms digest organic material and the products – worm castings – are highly nutritious compost. For more info on vermicomposting, visit: http://www.mass.gov/eea/agencies/massdep/recycle/reduce/vermicomposting-indoor-composting-with-worms.html#Wherecanlgetawormbin.

HELPFUL LINKS

www.ag.umass.edu/crops-dairy-livestock-equine/fact-sheets/waste-management-composting
www.howtocompost.org
www.mass.gov/eea/agencies/massdep/recycle/reduce/composting-and-organics.html

FACT SHEET 4.8

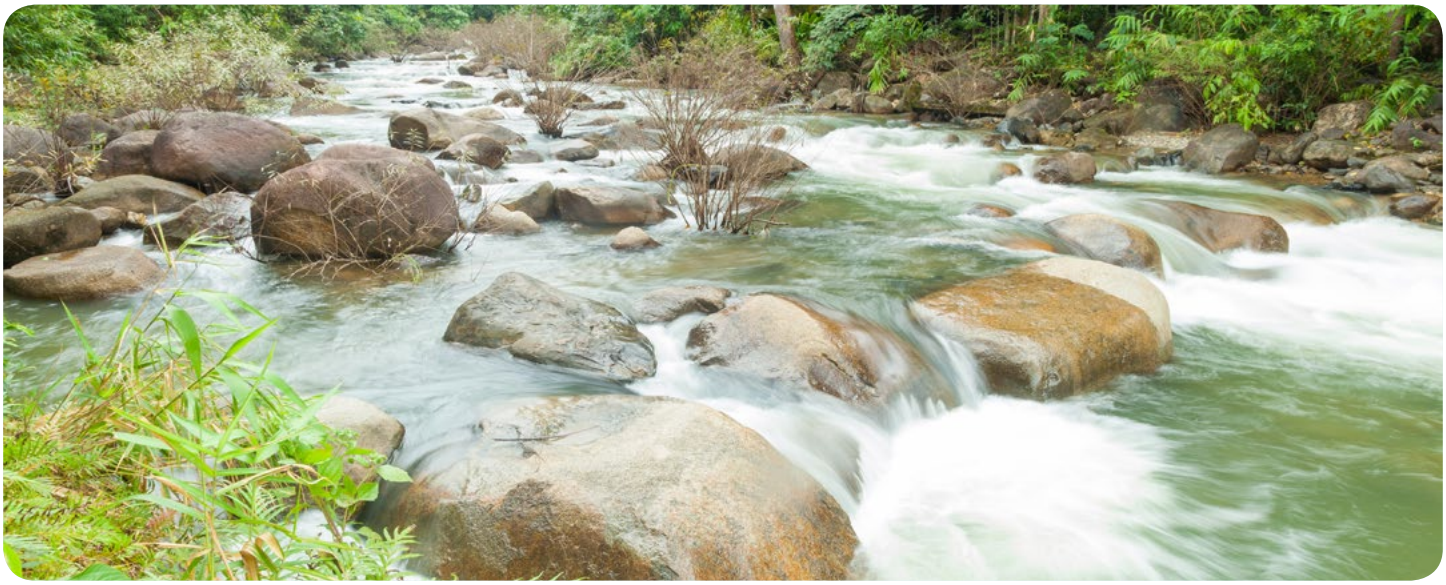
NUTRIENT AND SOIL AMENDMENT APPLICATION

Hobby farmers growing crops may find the need to add nutrients and amendments to the soil. Fertilizers directly affect plant growth by adding nutrients to the soil, while soil amendments improve the physical condition of soil.

Fertilizers and soil amendments are available in both organic and synthetic varieties and include manure and composted garden material. Depending on the source, some of these materials can provide both nutrients and improved soil structure when applied. No matter what type of crops you are growing, the addition of fertilizers and soil amendments may be necessary for healthy plants and a successful harvest.

SURFACE WATER PROTECTION

Fertilizers and soil amendments are valuable to your plants and soil, but if applied improperly can become a source of significant water pollution. If transported to nearby wetlands and waterways, these materials can become a source of water contamination.



REGULATORY CHECK

Many communities and some state agencies now have regulations limiting nutrient application near surface waters. Contact your local Conservation Commission for additional information.

STAY ON TRACK
Annual soil testing is essential in determining what your soil and crops need for a successful harvest.

Consider the following when applying a nutrient source or soil amendment to your garden or fields:

Quantity

Hobby farmers are encouraged to complete a soil test prior to the application of any nutrient source or soil amendment regardless if it's for your vegetable garden or forage crops. Soil test results will specify what type of nutrient or soil amendment is needed for your crop or field and how much you need. Over-application of these products can harm plants, reduce good microorganisms in the soil that help fight pests and disease, and lead to nutrient and pathogen transport into nearby water bodies. Read product labels and carefully apply quantities according to recommended amounts in your soils testing report.

Weather Conditions

Timing your application is important since current and future weather conditions can dramatically influence the chances of erosion and runoff. Do not apply fertilizer or soil amendments prior to or during significant rain events. Similarly, avoid heavy winds where odor and material can be blown off-site.

Time of Year

The application of nutrients and soil amendments should not be done during the winter months when the ground is frozen or snow covered. These conditions can increase the risk of contamination in stormwater runoff and prevent the incorporation of applied material into the soil.

Slopes

Steeply sloping areas are particularly vulnerable to erosion and runoff, so be sensitive to the quantity of fertilizers and soil amendments you're applying to these areas. Consider planting vegetative buffers between slopes and water resources.

Buffers

Vegetated land between your area of nutrient application and surface water can help intercept stormwater runoff. These buffers become particularly important in sloped areas. The closer fertilizer and soil amendments are applied to water resources, the higher the risk of contamination. Maintaining vegetated buffers between these areas is essential to protecting nearby water quality.

Avoid nutrient and soil amendment over-application by following these tips:

- Conduct an annual soil test and follow the recommendations
- Carefully read fertilizer and soil amendment labels
- Calibrate and test application equipment settings
- Discard excess fertilizers and soil amendments according to label instructions – avoid the temptation to use what's leftover unless needed
- Develop a comprehensive and realistic management plan for manure (if you have animals)

NEVER DUMP EXTRA FERTILIZER OR SOIL AMENDMENTS ON YOUR FIELDS, IN A STORM DRAIN OR WATERBODY!

DID YOU KNOW?
Fertilizers add nutrients to the soil while soil amendments improve the physical condition of the soil.

COMPOSTED VS. UNCOMPOSTED (FRESH AND AGED) MANURE

Using manure as a fertilizer source is a great way to recycle nutrients back into the earth and improve soil structure. Composted, fresh, and aged manure can achieve this and all are often readily available to hobby farmers. There are a number of advantages and disadvantages that should be considered when deciding which is right for your hobby farm. Notably, most composted manure has been through the carefully controlled process of decomposing fresh manure at high enough temperatures to kill harmful pathogens. Since fresh and aged manure typically have not been brought to temperatures high enough to eliminate harmful pathogens, it is not recommended that they be applied to areas in edible plant gardens. In contrast, the above forms of manure in most cases can be safely used on hayfields as long as the recommendations regarding quantity, weather, time of year, buffers and slopes are considered.

FRESH OR AGED (UNCOMPOSTED) MANURES SHOULD NOT BE USED NEAR EDIBLE CROPS.

HELPFUL LINKS
www.extension.unh.edu/resources/representation/Resource002114_Rep3119.pdf
www.ag.umass.edu/crops-dairy-livestock-equine/fact-sheets/prioritizing-fields-for-manure-application

CHECKLIST 4A

NUTRIENT MANAGEMENT FOR WATER QUALITY

Use the following questions to help guide your hobby farm nutrient management decisions:

1. Do you test your soil annually through the UMass Amherst Soil Lab (or similar NRCS Extension lab)?

☐ YES ☐ NO If NO, see Fact Sheet 4.2 for sampling method and lab contact information.

2. Do you base your use of fertilizers and/or soil amendments on the results of a recent soil test?

☐ YES ☐ NO If YES, what are the soil test recommendations for fertilization?

_____

If NO, this is highly recommended to ensure an ideal soil nutrient balance and avoid over-fertilization.

3. If fertilizer is recommended by a soil test, do you use organic or natural fertilizers or a soil amendment such as compost or composted manure?

☐ YES ☐ NO If YES, have you selected your organic/natural fertilizer based on the specific nutrient needs of your soil? (See Fact Sheet 4.5 organic fertilizer sources that are best for addressing deficiencies in soil).

_____

If NO, which organic fertilizers would be appropriate for your soil?

_____

4. Which of the following cultivation practices are, or could be, applied to your hobby farm to reduce fertilizer use and better manage soil nutrients? Describe as applicable.

☐ CROP ROTATION ☐ SUCCESSION PLANTING ☐ INTERCROPPING ☐ COMPANION PLANTING

_____

_____

5. Do you produce your own compost?

☐ YES ☐ NO If NO, see Fact Sheet 4.7 for tips on getting started!

6. Do municipal or state regulations restrict the application of fertilizer on your hobby farm?

☐ YES ☐ NO If YES, list the applicable restrictions.

_____

_____

_____