Integrated Pest Management
University of Missouri

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Why Your 5 Minutes Matter: Help Us Plan Better Pest Management Support

By Juan Cabrera-García

We are working to make our pest management (IPM) information and workshops more useful to your farm. Inside this issue you'll find a short survey, only one page front and back with simple check boxes. Your response will guide what we cover in the Missouri Produce Grower Bulletin, which workshops we bring to your communities, and what on-farm support we offer in the future. We want to ensure that the information you receive matches the pest and disease problems you're seeing on your farm.

Farming is busy, and paper piles up fast. That's why we kept this survey short and plain.

With appreciation,
Juan Cabrera-García

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What's inside:

- One page, 8 questions with simple check boxes.
- Space to add a note if something important isn't listed.
- A prepaid return envelope so you can drop it in the mail, no stamp needed.

Why it helps:

- We'll target the crops you grow most.
- We'll focus on the pests and diseases that cost you yield.
- We'll choose topics and locations for workshops that fit your needs.

How to return:

Fill it out with a dark pen, place it in the prepaid return envelope, and mail it by May 15, 2026. That's it. No name is required—answer only what you're comfortable sharing.

Your voice shapes the help we provide. Thank you for taking a few minutes to guide our work.

Clean Start: Sanitation That Actually Matters

A simple checklist for keeping insects and diseases away.

By Juan Cabrera-García and Justin Keay

Growing healthy vegetables starts with keeping your farm clean. Good sanitation does not need to be fancy or expensive. It is about simple habits you do every day. These habits remove places where insects and diseases hide and help your plants stay strong all season.

This guide gives you a clear checklist you can use in fields and high tunnels.

Why sanitation matters?

Pests and diseases need places to live, food to eat, and ways to move from plant to plant. When you clean up plant waste, remove weeds, and keep tools clean, you take away these "homes" and "highways."

Extension experts note that sanitation is the **first step in Integrated Pest Management (IPM)** and helps stop outbreaks before they start.

Clean growing spaces also mean **fewer pesticide sprays** later in the season.

Also in this Issue:

Field sanitation checklist

1. Start with a clean field

- Remove old plants and crop residues. Dead plants can hold insects and diseases for many months.
- Do not compost diseased plants, unless you can track your compost temperatures and ensure that all the material is exposed to at least 131°F for 3 consecutive days. Otherwise, pathogens can survive.

2. Weed early and often

- Weeds can host insects and diseases that can migrate to your crops. They can give pests a place to hide and reproduce.

3. Keep tools and equipment clean

- Wash and disinfect pruning shears, knives, flats, stakes, and harvest bins regularly. Diseases spread easily through tools.
- Clean boots and clothing before moving from fields with known history of diseases and pests to avoid contamination of other fields.

4. Use clean planting materials

- Do not reuse old potting mixes because they may contain pests or diseases.
- Buy healthy, disease-free transplants and seeds.
- If saving your own seeds, consider heat treatment to prevent seed-borne diseases.
- Use disease resistant varieties.

5. Improve air movement

- Good air flow keeps leaves dry. Wet leaves help diseases grow.
- Space plants so air can move easily between rows.
- Mow weeds around the perimeter of your crops.

6. Water wisely

- Water at the soil level, when possible, avoid watering the leaves.
- Morning watering allows leaves to dry faster, lowering disease risk.

High tunnel sanitation checklist

High tunnels create warm, humid spaces. These conditions help crops grow—but they also help diseases like **Botrytis gray mold, powdery mildew, and leaf mold** grow quickly. The good news is that sanitation greatly reduces these problems.

1. Ensure proper ventilation

- Open sides and doors to replace humid indoor air with dry outdoor air.
- Lowering air relative humidity helps prevent diseases; prolonged periods of high humidity (in the range of 70-90%) encourages disease spread.

2. Reduce leaf wetness

- Avoid overhead watering.
- Use drip irrigation to keep leaves dry. Dry leaves mean fewer leaf diseases.

3. Keep the tunnel clean between crops

- After each crop change, remove all crop debris, weeds, old mulch, and plant residues.
- Sanitizing between seasons lowers pest pressure and reduces the number of sprays needed the next season.
- Keep the outside perimeter of the tunnels free of weeds and vegetation. Keep a buffer between 5-10 feet using gravel or landscape fabric.

4. Clean floors and walkways

- Soil and standing water on the tunnel floor can hold pests and pathogens.
- Only water the areas where the crops are located to prevent weeds from growing in walkways.

5. Improve air flow between your crop

- Space plants and prune excessive growth to promote air flow.
- Pruning indeterminate tomatoes improves air circulation.
- Venting the crop to move humid air out, especially at night and during cloudy weather.
- If possible, use horizontal air flow fans on top of the crops to homogenize the air and dry leaves quicker.
- If constructing a new tunnel, orient the tunnel to maximize airflow through the structure and avoid shaded areas.

6. Watch for problems early

- Inspect transplants thoroughly for signs of insects and diseases before planting. Planting transplants with disease and insect problems can cause problems in a tunnel throughout the entire season.
- Scout plants once or twice a week. Catching issues early reduces spread and protects your crop.
- Scout 5 tomato plants per 100 ft. row. Inspect the top and bottom of the leaves and stems to the soil line.
- Regularly remove diseased plants from the tunnel during the growing season.
- Use sticky cards at the crop canopy level to assist with insect pest identification and scouting.

Additional practices to support clean growing conditions

Rotate crops to break pest and disease cycles. Rotation is the oldest and most effective strategy to reduce disease pressure. Growing the same crop in the same spot every year builds up pests and diseases. Rotate crops of different families (Table 1).

Table 1. Botanically related vegetables

Allium	Cucurbit	Crucifer
Garlic Leek Onion	Cucumber Pumpkin Summer squash Watermelon Beet Chard Spinach	Cabbage Cauliflower Broccoli Brussels sprouts Kale Radish

Goosefoot	Legume	Nightshade
Beet Chard Spinach	Dry bean Lima bean Pea Snap bean	Eggplant Pepper Potato Tomato

Choose resistant varieties to minimize yield losses. Some vegetable varieties are bred to resist certain diseases. This makes sanitation even more effective.

Healthy plants can fight off pests and diseases better. Keep them healthy by providing proper nutrients, water, and spacing.

A clean start sets the tone for the whole season. Sanitation is simple, low cost, and one of the most powerful tools you have as a grower. With steady habits and attention to detail, you can greatly reduce insect and disease problems—whether in the field or in your high tunnels.

Don’t Let Your Guard Down: A Winter Scouting Guide for Specialty Crop Diseases By Dr. Peng Tian

For many growers, winter feels like the time to retreat indoors and focus on seed orders or spreadsheets. However, plant pathogens do not simply vanish when the temperature drops; they either hunker down in your field waiting for spring or actively thrive in the cool, humid environment of your high tunnel. Therefore, a "winter walk" can save you time and money to get ready for incoming spring.

If you are growing winter greens, spinach, or overwintering tomatoes, your high tunnel is essentially a "cool, damp box." It provides the optimum environment for specific fungal pathogens that favor high humidity and lack of airflow.

1. **Gray Mold (*Botrytis cinerea*)**

This is the number one winter threat. It thrives in temps between 55–75°F.

- **What to look for:** A fuzzy, gray-brown spore mass forming on wilting and dead plant tissues, pruning wounds, or lower leaves touching the soil.
- **Ghost spots of tomatoes:** Tiny pale white halos or ring spots on the fruit. This symptom indicates an infection that didn't rot the fruit but will ruin its marketability.
- **Action:** Sanitation is key. Remove all diseased and dead plant debris immediately. If you see active sporulation, increase venting to lower humidity.

2. **White Mold (*Sclerotinia sclerotiorum*)**

Also known as Timber Rot, this pathogen is deceptive because it often kills the plant from the inside out.

- **What to look for:** Bleached, bone-white lesions at the base of stems of Solanaceae family plants such as peppers and tomatoes.
- **The signs:** If you split a white, infected stem open, you will often find hard, black irregular structures that look like mouse droppings. These are sclerotia, the survival structures of the fungus.
- **Action:** Remove the entire plant and the surrounding soil immediately. Do not put this in your compost pile.

3. **The Mildews & Leaf Molds**

Winter greens are susceptible to foliar diseases that hide on the underside of leaves.

- **Spinach Downy Mildew:** Look for yellow angular patches on the top of the leaf. Flip it over to see a purplish gray "dirty" fuzz.
- **Tomato Leaf Mold:** Look for bright yellow blotches on the upper leaf surface. Underneath, you will find an olive-green, velvety mold.
- **Action:** Scout the "warm spots" of your tunnel first (near heaters or the sunniest wall), as populations often explode there first.

Diagnostic Notes:

1. **The "Purple Leaf" Imposter**

Don’t panic if your tomato or spinach leaves turn deep purple. In winter, cold soil temperatures often make phosphorus unavailable to the plant roots, even if the nutrient is present in the soil. This is usually a physiological issue, not a disease. As soils warm up, the green color typically returns.

2. **The "Bumpy Leaf" Mystery: Oedema**

When days are cloudy and tunnel ventilation is closed to trap heat, you might spot strange, wart-like bumps on your plants. Before you reach for a fungicide, check if it is Oedema, which is a physiological disorder, not a disease. It happens when the soil is warm and moist but the air is cool and humid. The plant takes up water faster than it can release it, causing leaf cells to rupture and form blisters. It is extremely common in winter **kale, cabbage, spinach,** and sometimes **tomatoes**. Therefore, don’t diagnose it as bacterial disease or mite damage and spray. Watering wisely and increasing the air circulation will help.

Summary Checklist

To get a head start on the season, put these items on your to-do list for this week:

1. **Ventilate:** If your high tunnel has condensation dripping, it is too wet. Open the vents.
2. **Sanitize:** Remove dead leaves and "mummy" fruits from all growing areas.
3. **Inspect:** Use a hand lens to check the undersides of leaves in the tunnel and the bark crevices in the orchard.
4. **Differentiate:** Learn to tell the difference between cold stress (purpling) and active disease.

Winter scouting is not about finding problems to worry about; it is about finding problems you can solve before the busy season begins.

Obtaining a New or Renewing a Private Pesticide Applicator License in Missouri

By Sam Polly and Juan Cabrera-García

Beginning in **2025**, Missouri has updated its pesticide laws. Any grower who wishes to **purchase or apply Restricted Use Pesticides (RUPs)** must hold a valid **Private Pesticide Applicator License** issued by the Missouri Department of Agriculture (MDA)

This license is required for farmers using RUPs on land they own or rent, and Amish and Plain growers follow the exact same rules.

What changed in 2025 and why this matters?

Missouri and the U.S. Environmental Protection Agency (EPA) have strengthened training and licensing standards. Key changes include:

- **A private applicator license is required** for all RUP users—supervising unlicensed workers is **no longer allowed** beginning in 2025.
- Applicators must pass **expanded competency standards** and new categories (Category 20 Private Applicator; 21 Soil Fumigation; 22 Non Soil Fumigation; 23 Aerial Application for drones).
- Young family members may now obtain a **Certified Provisional Applicator License** at ages 16–17, if working in the family farm. Under age 16 cannot apply RUPs.
- Training must still be repeated **every five years** to keep the license valid.

Who needs this license?

You must be:

- Directly involved in **producing agricultural commodities** (crops, livestock, produce).
- Planning to **purchase or use Restricted Use Pesticides**.
- Working **only on your own or rented property**, or another grower's land **without compensation**, such as working in trade.

How to get (or renew) a license?

Although self-paced online training is available through MU Extension, individuals without access to technology can complete the process entirely through in-person training. Reach out to your local county extension office or extension specialist about upcoming Private Pesticide Applicator Training events.

Beginning January 1, 2025, a $75 training fee applies. You may pay with cash or check at the local extension office. First-time attendees should have the MU Extension M87: Private Pesticide Applicator Reference Manual and read it before training. Contact your local extension office for information about the manual cost.

You will need to attend the full training, then the instructor will provide you with a Certification Verification Form which must be completed by you, signed in ink, and returned to the county extension office/specialist by hand or mail. The extension specialist signs it and forwards it to the MDA for processing.

Your official license will be mailed to you and it is valid for five years.

To renew your license:

- Pay the $75 training fee
- Attend an in-person MU Extension training again every five years
- Complete and sign updated certification forms

Important notes about RUPs applications

- No unlicensed workers may use or apply RUPs, even under supervision. Each person applying RUPs must have their own license.
- Family members ages 16-17 may apply for the Certified Provisional Private Applicator license if they work on the family farm.
- Anyone under the age of 16 may not mix or apply RUPs.
- The license only allows application on your own farm, not on neighbor's farms for pay.

Understanding Your Soil and Plant Nutritional Status – MU Extension Soil & Plant Testing Laboratory

By Dr. Rasel Parvej and Dr. Juan Cabrera-García

Healthy soil is the foundation of productive crops. Whether you grow vegetables, grains, hay, or specialty produce, knowing what is in your soil is one of the most important steps toward better yields and efficient fertilizer use. The **MU Extension Soil and Plant Testing Laboratory** in Columbia, Missouri provides accurate, research based testing to help growers make well informed decisions about soil fertility and soil amendments. The goal of this article is to explain how to take a soil sample, how to submit it through your county extension office or local specialist, and how to understand the results once they come back.

Why soil testing matters?

Soil testing helps determine the amount of major nutrients available to plants, the soil's acidity level (pH), and the need for lime or fertilizers. The MU Extension lab analyzes soil for nutrient content, fertility status, and provides unbiased recommendations for economical and environmentally safe nutrient management.

Routine soil testing ensures you're applying only what is needed, prevents wasted fertilizer, and helps protect water quality. Many growers test every 2–3 years to track changes over time. Sample when soils are workable and try to sample at a similar time of year each cycle; avoid sampling immediately after fertilizer, manure, or lime applications.

What other services are available through the MU Soil & Plant Testing Lab?

The lab offers testing for:

- Soil fertility: pH, organic matter, and nutrient content (phosphorus, potassium, calcium, magnesium, cation exchange capacity). Additional tests can be requested for sulfur, electrical conductivity, nitrogen, micronutrients (zinc, iron, copper, manganese) and problematic elements like sodium and heavy metals.
- Plant tissue analysis: nutrient content including nitrogen, phosphorus, potassium, calcium, magnesium, copper, iron, manganese, zinc, boron and molybdenum.
- Additional sample types: water, manure, compost, and greenhouse media analysis for agricultural use.
- The laboratory also provides tailored fertilizer and lime recommendations based on test results.

Samples may be submitted directly to the lab or delivered through your local county extension office, where staff can help you complete forms and prepare your submission.

How to take a good soil sample?

A soil test is only as accurate as the sample you collect. Follow these guidelines to ensure the sample truly represents your field. For detailed sampling guidance, refer to the MU Extension Publication G9070 "Soil Sampling Depth and Collection Techniques for Soil Fertility and Soil Health Testing" which can be accessed online or requested through your local extension office and Extension Field Specialists.

Sampling tools

- A soil coring device such as a probe or auger are preferred. Shovels can work, but make sure to make a hole at the proper depth, then shave a slice of the soil profile from one side of the hole.
- Bucket
- Bags with markers

Where to take a sample?

Divide your field into areas that share similar soil type, crop history, and management. Sample each area separately.

Getting a soil sample

Walk the area in a zig-zag pattern and collect soil from many points to create a composite sample. Use the bucket to collect at least 10 cores for small plots, and 15–20 cores for larger fields. Collect samples that are 6 inches deep and remove any plant or organic residue from the top.

Mix all the soil cores thoroughly; the composite mixture is the sample you submit. Let the soil air-dry at room temperature (do not oven-dry). The amount of soil is approximately 1 pint, which is the same amount in the sample boxes (Figure 1) available through your local extension office or Field Specialists.

Figure 1. Soil sample boxes provided by the MU Soil and Plant Testing Laboratory, available through your local extension office

Submitting a sample

The county extension offices provide soil sample boxes, and the local staff can guide you through the process of filling out the submission forms. The county extension offices can also submit the samples to the laboratory. Local extension specialists can also help through this process.

Making sense of the soil test report

County specialists understand local soils and can help interpret your report. They can explain which recommendations are most important for your crop, how to apply amendments, and how frequently to retest your fields. However, soil test reports typically include soil pH and nutrient ratings (e.g., Very Low, Low, Medium, High, Very High) and provide lime/fertilizer recommendations based on crop and yield goals.

For questions you can contact the staff at the MU Soil and Plant Testing Laboratory:

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