



CROP TALK

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**COLLEGE OF AGRICULTURE,
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EXTENSION & PLANT SCIENCE
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Powdery Mildew on Greenhouse Tomatoes

Leanne Pundt, Extension Educator, UConn

One of the advantages of growing tomatoes in the greenhouse is that the tomatoes fruits are of higher quality and the plants are less likely to suffer from diseases common in field production such as early blight and septoria blight. However, because of the humid conditions under protected greenhouse cover, tomato plants can become infected with leaf mold (which best managed using resistant varieties, see resources at the end of this article) as well as powdery mildew. This article will focus on powdery mildew on greenhouse tomatoes which can severely reduce yields.

Symptoms

Symptoms begin as light green to yellow blotches on the tomato leaves followed by the characteristic white spores on the upper leaf surface. The powdery mildew spores quickly spread until the entire leaf is coated white. Petioles and stems can become infected, too. However, the fruit is not infected. The tomato leaves rapidly desiccate and then die. This rapid loss of the photosynthesis producing leaves results in a reduction in both tomato fruit quality and yield.

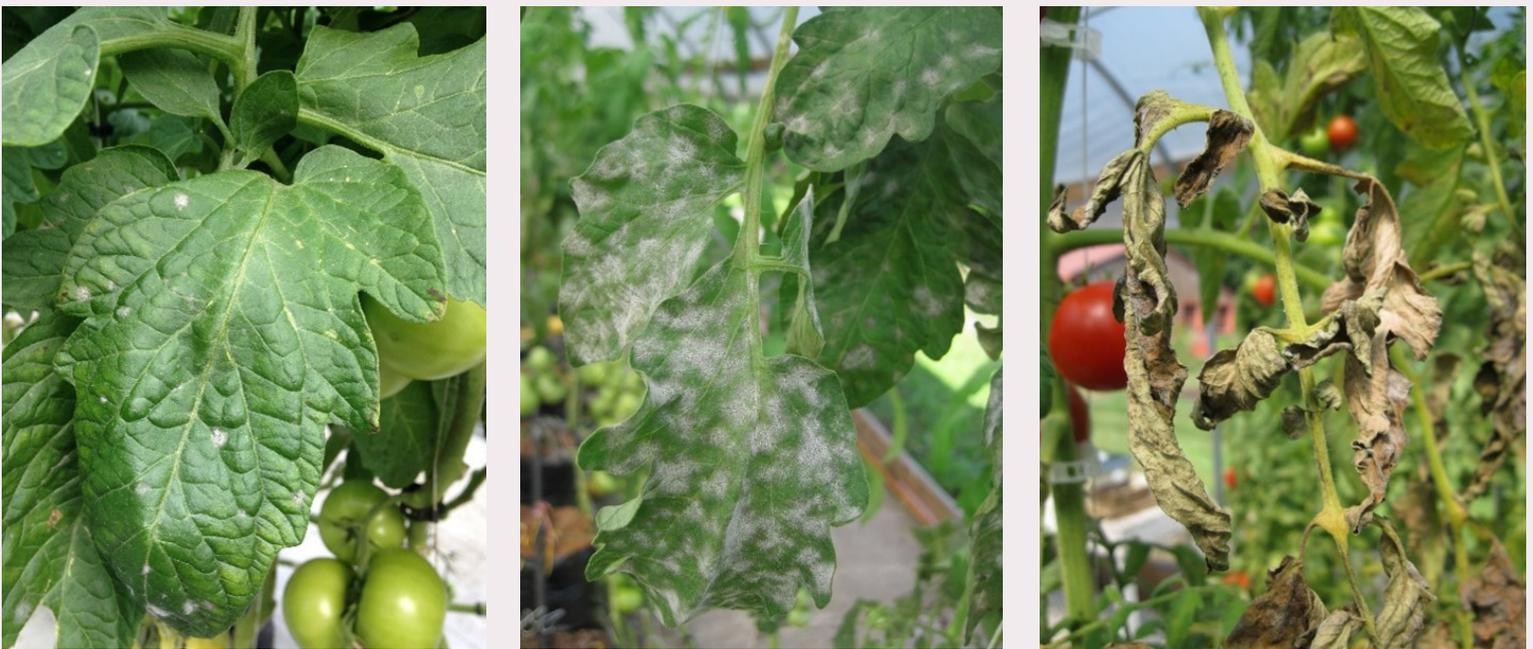


Figure 1: Progression of powdery mildew on greenhouse tomatoes (first two photos on the left by L. Pundt, UConn and photo on far right by R. Sideman, University of New Hampshire).

Causal Agent

Powdery mildews are obligate parasites, so they need living hosts. They cannot survive on dead and dying plant tissues common with *Botrytis* stem canker and blight on greenhouse tomatoes. The causal agent *Oidium neolycopersici* was first reported in CT in 1995. Its host range may include members of the solanaceous family including peppers, tobacco, eggplant, potato, and weeds in the nightshade family.

Favorable Conditions

Optimum conditions include low light intensity and temperatures between 68 and 80 °F with high relative humidity. However, infection can also occur at lower relative humidity levels of 50 %.

Dense plantings which increase humidity favor powdery mildew development. Unlike many foliar pathogens, powdery mildew does not need leaf wetness for its spores to germinate. Excess nitrogen fertilization can also favor powdery mildew.

Management

- Maintain proper plant spacing to reduce relative humidity levels within the plant canopy. (This will also help you gain better spray coverage). Remove lowermost leaves.
- Keep relative humidity levels below 90% in the greenhouse.
- Heat and ventilate in the late afternoon and early morning to reduce high relative humidity levels at night. See the factsheet, Reduce Greenhouse Humidity by John Bartok on the UConn IPM website <https://ipm.cahnr.uconn.edu/reduce-greenhouse-humidity/>
- Destroy all diseased plant debris at the end of the season and remove all nightshade weeds that could be alternative hosts.

Use registered fungicides preventively and/or at the first sign of disease. The [New England Vegetable Management Guide](#) lists both conventional and organic options for management. Repeated applications are often needed. To prevent the development of fungicide resistance, rotate among fungicides that have different modes of action or FRAC codes. <https://nevegetable.org/crops/disease-control-24>

Noticeable differences in susceptibility to powdery mildew caused by this fungus have been observed among other varieties., but varieties listed as tolerant may still succumb to this aggressive pathogen. Researchers are breeding resistance from wild tomato varieties into cultivated tomato varieties.

Consult and follow pesticide labels for registered uses.

Resources

Cornell Vegetable Program Work Team. Disease Resistant Vegetable Varieties. <https://www.vegetables.cornell.edu/pest-management/disease-factsheets/disease-resistant-vegetable-varieties/disease-resistant-tomato-varieties/>

LaMondia J. A., V. L. Smith, and S. M. Douglas. 1999. Host Range of *Oidium lycopersicum* on Selected Solanaceous species in Connecticut. *Plant Disease* 83:341-344

Li, Y. 2013. Powdery Mildew of Tomato. CAES Fact sheet. 2 pp. https://portal.ct.gov/-/media/CAES/DOCUMENTS/Publications/Fact_Sheets/Plant_Pathology_and_Ecology/PowderyMildewofTomato040113pdf.pdf?la=en

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Sideman, R., and C. Smith. 2018. Powdery Mildew of Greenhouse and High Tunnel Tomato. <https://extension.unh.edu/blog/2018/08/powdery-mildew-greenhouse-high-tunnel-tomato>

Mating Disruption

Mary Concklin, *Extension Educator Emeritus*
Fruit Production & IPM and IPM Program Coordinator

Integrated pest management (IPM) uses a range of tools to manage insect pests including cultural practices, biological control, host plant resistance, behavior modification, physical and mechanical methods, pesticides, and regulatory measures. Among those, biological management tools and behavior modification have seen increased use over the years for pest issues in fruit crops.

One behavior modification method is the use of mating disruption which targets specific insects and is a viable alternative to insecticides for some insect pests. Normally female insects emit a pheromone to attract males for mating. With mating disruption, the orchard is saturated with the female insect sex pheromone by hanging pheromone impregnated rubber ties, or puffers or misters. Male insects follow the scent but with so much of the scent everywhere, it causes confusion because they are unable to find her to mate with, creating a disruption in the life cycle. No mating equals no damage to fruit or to the trees.

This technique is used successfully with fruit Lepidopteran insects (moths): codling moth, *Cydia pomonella*, oriental fruit moth, *Grapholita molesta*, obliquebanded leafroller, *Choristoneura rosaceana*, peach tree borer, *Synanthedon exitiosa*, lesser peach tree borer, *Synanthedon pictipes*, and dogwood borer, *Synanthedon scitula*.

It is important to know, this management tool doesn't kill insects, and non-target pests are not impacted by mating disruption. It alters the behavior of the male insects through confusion.

Timing: Disrupters must be in the trees before the first flight to be successful. Codling moth and oriental fruit moth flight can be monitored at NEWA (<https://newa.cornell.edu>) and timing is usually pink to bloom. Dogwood borer mating disrupters should be placed in the orchard by Memorial Day, and peach tree and lesser peach tree borer mating disrupters should be out by shuck split. In addition, traps and lures for the insects are hung to monitor presence. The first year of use, a rescue insecticide application may be needed, but not always. Usually by the second year, none is needed.

Tools:

Dogwood Borer, *Synanthedon scitula*:

Disrupter: Isomate DWB (Pacific BioControl)

Organic: NOP Compliant

Codling Moth, *Cydia pomonella* and Oriental Fruit Moth, *Grapholita molesta*:

Disrupter: Isomate CM/OFM TT (Pacific BioControl)

Organic: Yes

Disrupter: Cidetrak CM-OFM Combo (Trece)

Organic: WA only

Codling Moth, *Cydia pomonella*

- Disrupter: Cidetrak DA MEC (Trece)
- Organic: Yes, WA state only
- Disrupter: Cidetrak CMDA COMBO MESO-A (Trece)
- Organic: WA only

Oriental fruit moth, *Grapholita molesta*

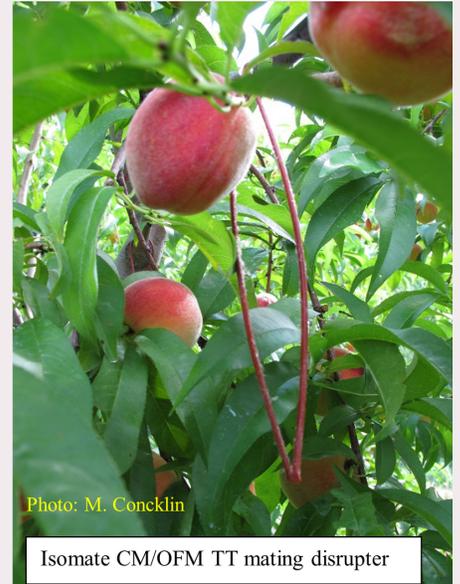
- Disrupter: Checkmate OFM Dispenser (Suterra)
- Organic: NOP Compliant
- Disrupter: Isomate OFM TT (Pacific BioControl)
- Organic: Yes
- Disrupter: Cidetrak OFM-L Meso (Trece)
- Organic: WA only

Codling Moth, *Cydia pomonella*, and Obiquebanded Leafroller, *Choristoneura rosaceana*

- Disrupter: Cidetrak CMDA+LR Dual MESO (Trece)
- Organic: WA only
- Timing: Prior to moth emergence

Peach Tree borer, *Synanthedon exitiosa* and Lesser Peach tree borer, *Synanthedon pictipes*:

- Disrupter: Isomate PTB Dual (Pacific BioControl)
- Organic: No





Tips & Tricks for Managing Insect Pests of Brassicas

Eggs

Cabbage maggot
Delia radicum (L.)

Cabbage Root Maggot

- Rotate locations of spring and fall brassica plantings within and between seasons.
- Predict CRM emergence using indicator plants (flowering yellow rocket), [NEWA model](#), or other monitoring tools.
- Check for signs of infestation: Look at the base of the plants for CRM eggs and check roots for damage.
- Control: Look for alternatives to chlorpyrifos. Verimarkis is a good choice, and other options are available including Entrust (OMRI-listed) for some crops (check labels, regional restrictions apply).
- Grow your own transplants and treat before setting out or during hardening off.
 - Exclusion netting can be used for small-scale or organic producers. It will protect from cabbage maggot and other insects—cabbage and other waxy crops can be grown on black plastic mulch for weed control under exclusion netting.
- Mature plants can withstand some level of root damage.

Photos: FaruqueZaman, Cornell

Caterpillars

- Identify the caterpillar species present to determine proper threshold level and inform choice of insecticide.
- Grow your own transplants to avoid introducing resistant diamondback moths.
- For small-scale production or hardening off transplants, exclusion netting works great to keep out caterpillars and other pests.
- Include an adjuvant (wetting agent or sticker) to keep spray materials on foliage.
- Do as much as possible to improve spray coverage, especially to get material under foliage and in center growth.
- Start with Bt materials – inexpensive and generally sufficiently effective – rotating to others as needed for larger loopers and other pests like FB.
- Rotate Bt subspecies used (Btkurstakior Btaizawai) for resistance management.
- Check pesticide side effects on beneficial insects like predators and parasitoids. Use selective pesticides.
- Scout weekly, if possible, to re-assess pest status and spray efficacy. Look for eggs (looper, ICW mainly) as well as larvae, to prevent feeding damage from large larvae.

Photos: Ana Legrand, UConn



Brassica Pest Collaborative

Flea Beetle



Flea beetles (top). Surround residue on kale (bottom).

- Rotate crop locations, moving spring crops away from fall crops in order to leave FB behind.
- Use row covers or insect netting in spring and/or for direct-seeded crops.
- Grow larger transplants, which can tolerate more damage.
- Use Surround to protect waxy seedlings during establishment. Mix well, include an adjuvant, and re-apply at least weekly and after rain.
- Conventional: many effective options including diamides (e.g. Exirel, Harvanta), neonicotinoids (e.g. Admire, Platinum, Venom), SevinXLR, Torac, and pyrethroids.
- Organic: spinosad (Entrust) is the most effective organic treatment. Pyganic is not effective alone.
- Improve spray coverage: Use an adjuvant (wetting agent or sticker), hollow cone nozzles, and enough spray volume to cover plants.
- **Re-apply insecticides** as long as FB are present during the susceptible period for that crop (first 2-4 weeks for transplanted waxy crops, or for the life of non-waxy crops).
- Till under residues quickly after harvest, and eradicate weed hosts.
- Use mustard trap crops (or use highly attractive cash crops e.g. bokchoy as traps) to reduce spraying. Keep the trap crop healthy and spray the trap crop regularly to be successful.

Cabbage Aphid

- Rotate crop locations, moving spring crops away from fall crops in order to leave CA behind.
 - Scout regularly for signs of the very first aphids, ESPECIALLY if there were high populations the previous year. Watch for patchy leaf yellowing! Rogue out any plants that are severely infested.
 - Take action when aphids are first observed: **treat with insecticides when 10% or more of the plants have at least one aphid.** For organic growers, options include azadirachtin, pyrethrum, and insecticidal soaps, alone or in tank-mixes or rotations. There are many effective conventional insecticide options: <https://nevegetable.org/crops/insect-control-3>
 - After treating, continue scouting on a weekly basis and treating whenever the threshold is exceeded.
- Do as much as possible to improve spray coverage, especially to get material under foliage and in center growth, and include an adjuvant (wetting agent or sticker).
- Incorporate crop residues thoroughly at the end of the season or in very early spring.



Leaf chlorosis caused by CA colony feeding on underside of leaf (top)—Photo: B. Sideman, UNH. CA on Brussels sprouts (bottom).





Brassica Pest Collaborative

Common Themes

- Rotate spring from fall plantings, and fall from spring plantings—leave your worries behind! (for CRM, FB, CA—not caterpillars)
- Scout early and often in order to catch problems early, get a proper ID, and keep up with continuous pests. (FB, caterpillars, CA)
- Improve spray coverage: Hollow cone nozzles are recommended for insecticide and fungicide applications. Consider adding drop nozzles for large crops like Brussels sprouts. Always use a spreader and/or sticker to keep spray materials on foliage. (FB, caterpillars, CA)
- Continue treating as long as thresholds are exceeded—one spray will not keep all the caterpillars, or aphids, or flea beetles away.
- Till under residues as soon as possible. Mow if you cannot till in order to start the breakdown process.



Brussels sprouts crop residue.



*Hollow cone nozzle.
Photo: TeeJet*

Alternatives & Frequent Questions



*Ammimajus insectary plantings in a brassica field.
Photo: Ana Legrand*

- Use insectary flowers to attract predators and parasitoids: alyssum, cilantro, dill, and *Ammimajus* attract both types of biocontrol organisms in New England.
- Mulches may interfere with insect host finding and deter activity and egg-laying of root maggots, flea beetles, and cabbage aphids.
- Beneficial nematodes may kill flea beetle larvae, but will not have a direct impact on damage, as adult beetles will move in from other fields.

Written April 2021

Photo credits: UMass Extension Vegetable Program, unless otherwise noted

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Written by Dan Gilrein - Cornell Cooperative Extension,
Ana Legrand - UConn Extension, Sue Scheufele - UMass Extension,
Becky Sideman - UNH Extension, and Faruque Zaman - Cornell Cooperative Extension

Solid Ground Updates

The Solid Ground program is taking a bit of a hiatus from our trainings for new and beginning farmers as the frenzy of summer months comes upon us, but we still have tools that we are providing for our farmers! Back again, for a second iteration, our FREE One-on-One Consultations with Ag professionals are available to new and beginning commercial farmers in the state right now!

These consultations are with professionals in the fields of vegetable production, hemp production, livestock production and management, soil health and land use, conservation practices, and urban agriculture. When requested, each professional schedules a time to visit your farm in person and look at the specific issues that you may be dealing with at the moment, giving you tailored advice and support for your farm operation. There is also the opportunity for follow up phone calls, email, and even video to make sure that you are supported fully in implementing any practices that may be new to you or to address follow up questions.



Farmers that utilized the consultants last year gained some good knowledge that helped with their operations. For instance,

“...The most valuable advice turned out to be about our grazing management, which was something we didn’t anticipate. I appreciated the flexibility of being able to walk our fields with Joe...We changed our grazing plan for the rest of the season and it will impact the way we will graze this upcoming season as well.”

“I like the one on one time that the farmer gets, especially for a newer farmer, who doesn’t have a mentor, having the time to pick someone’s brain was great.”

There are a limited number of these consults available so we encourage farmers to sign up for them ASAP and schedule them at whatever time feels most convenient for their farming operation during the summer months. Sign up now at <https://newfarms.uconn.edu/consultations/>

Making the Switch to Soil-Biodegradable Plastic Mulches (BDMs): Lessons Learned from Farmers

*Written by Lisa Wasko DeVetter and Brenda Madrid, Washington State University
Originally published in May 2022 issue of Sustainable Mulch Management newsletter, WSU*



Fig. 1. Soil-biodegradable mulch field trial conducted at Rebecca Bozarth's farm. Photo by Brenda Madrid.

Highlights

- Labor savings are a big benefit of BDM use
- Farmers also say BDMs simplify end-of-season field clean up and are safer than mulch removal equipment
- Long-time (20+ years) BDM users have not seen declines in soil health or plastic build-up in soils
- For first time users, the advice is to start small and don't apply BDM too tight!

Farmers are among the most knowledgeable people we get the opportunity to work with. When they take the time to share their wisdom and experiences, it is important to both listen and learn. This article highlights some of the information shared by four farmers that participated in a webinar on soil-biodegradable plastic mulch (BDM) held on March 1, 2022. These four growers differed in their years of experience working with BDMs, which provided a spectrum of knowledge that encompassed first- to long-time users of BDMs.

Representing the first-time user was Rebecca Bozarth. Bozarth is not new to agriculture, however, and has been growing strawberries commercially in California for 30 years. What led her to want to try BDMs was her concern with plastic residue left in fields after growing strawberry with conventional polyethylene (PE) mulch, which was costly to remove by hand and poses environmental and food safety concerns for rotational crops like lettuce. In lettuce systems there is the concern that fragments left in the field could be accidentally harvested and become a food contaminant. If BDMs don't break down fast enough there is similar concern about degrading fragments becoming contaminants.

Research is ongoing on Bozarth's farm to monitor BDM degradation and see if it can be accelerated through application of potentially degrading products. Specifically, she is evaluating whether Fluid Compost [Willbur-Ellis, Yakima, WA; contains compost extract, humic acid from leonardite, azomite, and kelp (*Ascophyllum nodosum*)] and Nutrio Unlock® (Willbur-Ellis, Yakima, WA; a biological catalyst containing multiple microorganism species), both combined with BenViero FolioSentials (Willbur-Ellis, Yakima, WA; a 3-0-3 liquid fertilizer derived from molasses, beet extract, and soy protein hydrolysate), increase degradation relative to an untreated control.

However, her experience to date has been that BDMs apply and perform in the field similarly to traditional PE films. In her system, she recommends discing and tilling the field thoroughly to incorporate BDMs well into the soil. Yet, an important question remains - how fast will BDMs degrade and will it be fast enough for the lettuce growers she rotates land with?

With just under a decade of experience was Bruce Gresczyk Jr. of Connecticut. Gresczyk uses BDMs for all of his mulched vegetables and strawberries. For Gresczyk, the labor and cost savings provided by BDMs during end-of-season cleanup has kept him a repeat user (BDMs just need to be tilled into the soil). Gresczyk recommends growers try BDMs on their own farms based on his positive experiences but cautions them about application. Application is different relative to PE and BDMs tighten after laying, so it's important not to initially apply too tightly or that will weaken the material.



Figure 2. Cole crops grown using soil- biodegradable mulches at Gresczyk Farms. Photo by Shuresh Ghimire.

Trevor Hardy represented a diversified fruit and vegetable grower in New Hampshire with 20 years of experience working with BDMs on his farm (except in the organic sections where commercially available BDMs don't meet organic requirements). Hardy also sells agricultural supplies in the northeast region, including BDMs. What attracted Hardy to BDMs and keeps him a long-time user is the labor savings during mulch removal and disposal. Field cleanup is also faster when using BDMs, allowing Hardy to establish a fall cover crop for improved soil health.

Hardy was full of wisdom on the use of BDMs. For first-time users, he recommends starting with a 0.6 mil film and testing it on a small portion of the farm before scaling up in future years. Mulch thickness can be adjusted in future years if the 0.6 mil is too thin or thick. Mulch laying will likely take longer than PE mulch, but application time should be comparable as the grower gets more familiar with the material. Additionally, apply when the weather is good and fields have been properly tilled (i.e., no big clods). Similar to Gresczyk, Hardy warns to avoid applying BDMs too tightly as this creates stress and can reduce its performance - it should be somewhat loose and will eventually shrink to form a good fit on raised beds. During tillage, Hardy advises tilling BDMs in the direction it was laid if using raised beds and then spreading cover crops perpendicular to rows to enhance degradation.

Last among the invited growers was Sandro Colombia of Italy. Colombia has 20-25 years of BDM experience. In the European Union, BDMs are allowed in organic/biological farming and this was one factor that influenced Colombia to try BDMs. In addition, some of the equipment used for PE mulch removal and disposal was considered to be hazardous by Colombia. BDMs avoid those risks by just needing to be tilled in. With such a long period of use, the audience was pleased to learn BDM fragments are not visible after the following season on Colombia's farm, indicating degradation was rapidly occurring. Additionally, Colombia has benefited economically by making the switch to BDMs - he saves on tractor fuel, labor, and associated costs that otherwise occur when removing non-degradable mulch at the end of the production cycle. He also feels his workers are safer because they spend less time operating mulch removal machinery that may not be safe. Columbia would recommend BDMs to growers but advises them to spend more time on site preparation before laying in order to ensure the integrity of the product once deployed in the field.

Soil-Biodegradable Plastic Mulch Webinar

Panelists

- Rebecca Bozarth – California, USA
- Trevor Hardy – New Hampshire, USA
- Bruce Gresczyk Jr. – Connecticut, USA
- Sandro Colombia, Italy

Logos at the bottom include: WESTERN SARE, USDA, NIFA, WSDA, UCONN, UC ANR, CAL POLY, WASHINGTON STATE UNIVERSITY, and the URL <https://smallfruits.wsu.edu>.

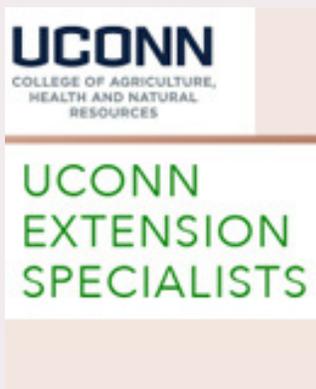
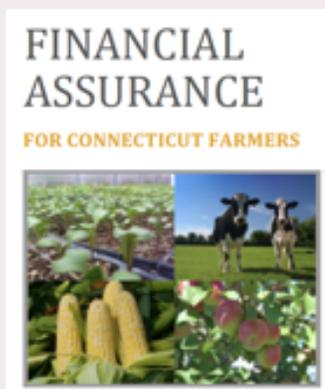
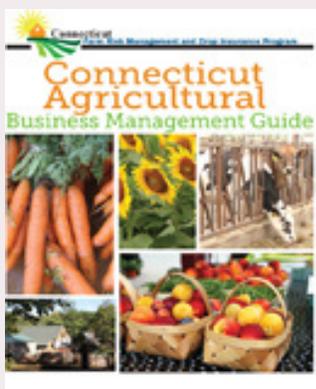
A recording of the panel is available on <https://www.youtube.com/watch?v=bOmFBZnI58E>

Connecticut Farm Risk Management Updates

UConn Extension offers a variety of informational webinars and pre-recorded videos regarding farm risk management, crop insurance, farm success, benchmarking, soil health, and soon to include financial webinar recordings with a Spanish translation option.

Publications are also available for download, including the Connecticut Agricultural Business Management Guide (updated May 2022), Financial Assurance for Connecticut Farmers, and a list of UConn Extension specialists.

Publications: Click an image to learn more!



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Visit <https://ctfarmrisk.extension.uconn.edu/>

FARM RISK MANAGEMENT VIDEO SERIES



Streamlined Stories of Farming Success

Farm success is dependent on many factors, including business plans. Our experts provide your agricultural operation with tools and resources to minimize risk, increase profitability, and define success in your terms.

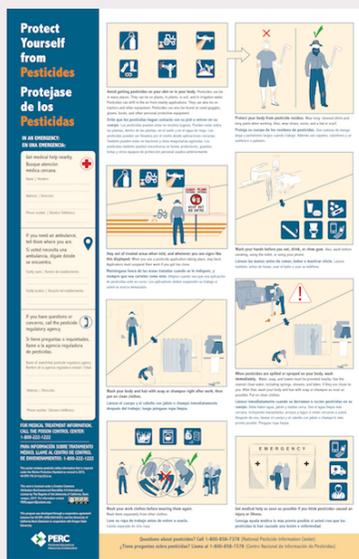
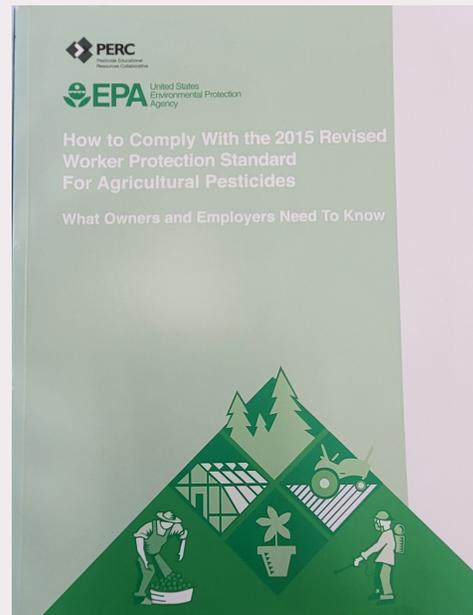
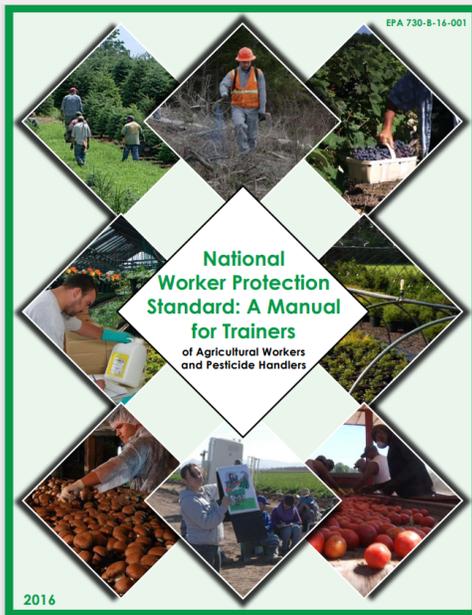
Visit s.uconn.edu/farms to view these short video clips!

This material is based upon work supported by USDA/NIFA under Award Number 2018-70027-28588

Free Pesticide Educational Resources Available

Items are available in English and Spanish and include:

- National Worker Protection Standard: A Manual for Trainers of Agricultural Workers and Pesticide Handlers
- EPA How to Comply With the 2015 Revised Worker Protection Standard For Agricultural Pesticides
- Workers Protection Standard Handbook for Agricultural Employers
- Pesticide protection laminated posters (small or large)



These free materials are available for pickup in the Extension Office at Tolland Agricultural Center or can be shipped at your own cost. If you are interested in having these items shipped, please reach out to Frances.Champagne@uconn.edu for an estimate of the shipping cost.

Crop Talk Editors/Contributors

Shuresh Ghimire, Commercial Vegetable Crops, UConn Extension, 860-875-3331, shuresh.ghimire@uconn.edu

Frances Champagne, newsletter compilation and layout, UConn Extension, frances.champagne@uconn.edu

Administrative Officers

Indrajeet Chaubey, Dean, College of Agriculture, Health, and Natural Resources

Michael P. O'Neill, Associate Dean and Associate Director, UConn Extension

Bonnie E. Burr, Assistant Director & Department Head, UConn Extension

Sydney Everhart, Department Head, Department of Plant Science and Landscape Architecture

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EXTENSION & PLANT SCIENCE
AND LANDSCAPE ARCHITECTURE

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