High Tunnel Pest Management Practices

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Resources

SOUTHEASTERN VEGETABLE EXTENSION WORKERS







"Everything you need on the dashboard of your truck."



https://content.ces.ncsu.edu/southeas tern-us-vegetable-crop-handbook

Plant Health Clinic The Arkansas Plant Health Clinic What's wrong with my plant? Newsletters If you have questions about the damage to or symptoms of your plants, our plant health clinic can help. A - Z Search Submit plant samples online Plant Disease Images How to submit a plant sample for Learn how to submit a plant sample diagnosis You can also <u>submit a plant sample online</u> through our DDDi system Arkansas Plant Health Clinic, located in Fayetteville, Ark., is supported by the Cooperative Extension Service, (CES), as part of the Division of Agriculture. The clinic serves Arkansas growers, homeowners and nurserymen who have plant Contact disease problems or other plant health issues. Sherrie Smith Notice: We are back in the Cralley Warren building in our normal lab. The Plant Health Clinic is Plant Diagnostician still restricted for entry. We have a drop off tub at the clinic entrance and the main building Phone: 479-575-2727 entrance. We will go outside to talk to clients wearing masks and maintaining social distance. Email: ssmith@uaex.edu Keiddy Urrea Romero **Program Associate** SEARCH CLINIC ARCHIVES Phone: (479) 575-7257 Email: kurrea@uaex.edu How to help make an accurate diagnosis

https://www.uaex.uada.edu/yard-garden/plant-health-clinic/

Arkansas Nematode Diagnostic Laboratory

A / Extension Home / Farm & Ranch / Pest Management / Plant Disease Management / Nematodes

Plant Disease Management						
Field Crop Diseases						
Fruit & Nut Trees						
Nematodes						
Small Fruits & Berries						
Tomatoes						

Small Fruits & Berries

Staff Directory Plant Disease Publications

Plant Disease Presentations

Plant-parasitic nematodes are an economically important pest that affect many row crops, horticultural crops, golf courses, and trees and shrubs in Arkansas. Nematodes are host-specific organisms and the strategies for management of the species will vary by crop. Chemical control options for mematodes are limited so often rotation to a non-host crop is the best solution. The Arkansas Nematode Diagnostic Laboratory offers bioassay and quantification services for the following croos:

- Cotton, Soybean, Corn, and other Row Crops (Root-knot, Soybean cyst, Reniform, Lesion, etc)
- Rice (White tip nematode pest-free certification for export)
 Cedar and Pine (Pinewood nematode pest-free certification for export)
- Turf (Lawns and golf courses)
- Horticultural crops and shrubs (Commercial crops and home garden and landscape, pest-free certification for nursery stock)
- Forage crops
- Custom assays are available (Call for info 870-899-4199)
- Out-of-state samples are accepted per APHIS regulations. Permit must be printed and included with samples.
 <u>Click here to see our permit.</u>



https://www.uaex.uada.edu/farm-ranch/pest-management/plantdisease/nematodes.aspx

Pest Management in High Tunnels

- Why grow in high tunnels?
 - Protected environment
- Benefits
 - Intensive vegetable production in small areas
 - Season extension
 - Decreased impact from environment/climate
 - Decreased risk from some pests
- Considerations
 - New types of pests to deal with
 - Need to understand the environment within the high tunnel to shape control
 - Still need to practice sustainable IPM



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IPM Considerations within a High Tunnel

- Integrated Pest Management (IPM) Sustainable Pest Management
- IPM is an approach to pest management that combines several tactics to achieve long term solutions that are both economically and ecologically sustainable.
- Pest Prevention
- Biological Control
- Mechanical Control
- Chemical Control



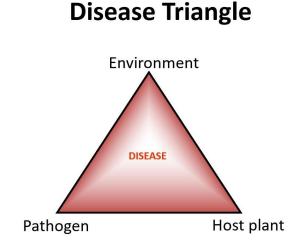
IPM within a High Tunnel

- Similar strategies are necessary in high tunnels and in the field
 - Crop rotation
 - Crop orientation
 - Optimum growing conditions
 - Using disease/insect resistant varieties
 - Sanitation
 - Scouting
 - Preventative fungicide applications
- These strategies will be modified based on the specific environment within your tunnel
 - Also based on the crops you hope to grow



Diseases in High Tunnel vs. Fields

• Need to understand the environmental differences to understand the difference in disease risk



Field Environment	High Tunnel Environment
Humidity based on weather - Worse in late summer	Excessive humidity - <u>Prolonged Leaf Wetness**</u>
Rainfall - Potential flooding - Can affect leaf wetness - Splashing	Protected from rainfall - Rare flooding - Minimal effect on leaf wetness - <u>Minimal splashing with drip irrigation**</u>
Temperature - Variable	- Can be excessive
Affected by wind	Affected by wind U of A System Division of Agriculture U of A System Division of Agriculture

Disease Management in High Tunnels

- Leaf wetness
 - Consistently high humidity is common in high tunnels
 - Increases risk of diseases that need prolonged leaf wetness to thrive
 - Diseases common in high tunnels due to prolonged leaf wetness
 - Leaf mold
 - Botrytis grey mold
 - Powdery mildew
- Rainfall/Splashing
 - Many diseases require movement through water droplets
 - Bacterial spot of tomato and pepper
 - Many Colleotrichum species (cause anthracnose)
- Wind
 - Spores of many diseases move with the wind
 - Wind/air movement is necessary in high tunnels to manage humidity







Disease Management Strategies in High Tunnels

- Cultural Control
 - Modify environment to make it less suitable for pathogens
- Orientation of tunnel
 - Maximize potential sunlight, avoid putting tunnel in shaded areas
 - Maximize airflow
 - Decreases humidity and leaf wetness
 - Single bay tunnels position perpendicular to prevailing winds
 - Multi-bay and roll-up sides parallel to prevailing winds
- Manage humidity, temperature, and moisture by rolling-up sides, etc.
- Other ways to maximize airflow
 - Weed management consider landscape fabric
 - Proper plant spacing
- Select disease-resistant varieties when possible
 - Fusarium resistance in tomatoes, TSWV resistance, etc.



Sanitation

- Avoid bringing in disease inoculum
 - Use high-quality disease-free seed and transplants
 - Consider fungicide seed treatments
- Remove as much disease inoculum between cropping cycles as possible
 - Remove entire plants and roots
 - Practice good weed control and remove weeds
 - Can compost, burn, or bury plants
 - Move as far from tunnel area as possible
- Deep till if there are known soilborne pathogen issues





Disease Management Strategies in High Tunnels

- Crop Rotation
 - Cornerstone of pest management in both field and protected structure environments
 - Mitigates issues due to residue and soilborne diseases
- Crop rotation is often hindered in high tunnels
 - Many growers get high tunnels to grow specific crops (tomatoes or lettuce)
 - Fallow? Hard to justify not growing
 - Less crop options
 - Increased farm season. Could limit cover crops, etc.
 - Many short rotations can lead to increase in residue borne diseases
 - Longer rotations can favor soilborne diseases



Examples of issues with limited crop rotation

- Timber rot (white mold) in tomatoes
- Southern blight in tomatoes
- Fungal leaf spot diseases
- Bottom rot in lettuce
- Nematodes
 - Large issue in a tunnel that is static
 - Many common vegetables are susceptible
 - Hard to get rid of once a problem emerges
 - Test often!





Managing Crop Rotation Issues in High Tunnels

- Rotate plant families
 - Many diseases and insect pests are specific within a plant family
 - Lettuce -> Kale = Is a true rotation (aster family to brassica family)
 - Peppers -> Tomatoes = Not a true rotation (Both in the Solanaceous plant family)
 - Similar considerations for cover crops between crops



Common Vegetable Plant Families



Plant Family	Common Crops
Composite family (Asteraceae)	Endive, Lettuce, Sunflower
Goosefoot family (Chenopodiaceae)	Beet, Spinach, Swiss Chard
Gourd Family (Cucurbitaceae)	Cantaloupe, Cucumber, Pumpkin, Squash, Watermelon
Grass family (Poaceae)	Ornamental corn, popcorn, sweetcorn
Lily Family (Alliaceae)	Chives, Garlic, Leek, Onion
Legume Family (Fabaceae)	Bush bean, Lima bean, Pea, Pole bean
Mallow Family (Mavaceae)	Okra
Mustard Family (Brassicaceae)	Broccoli, Brussels sprouts, Cabbage, Cauliflower, Collard, Kale, Mustard greens, Radish, Rutabaga, Turnip
Nightshade Family (Solanaceae)	Eggplant, Pepper, Potato, Tomato, Kale
Parsley Family (Apiaceae)	Carrot, Celery, Parsley, Parsnip

Managing Crop Rotation Issues in High Tunnels

- Rotate plant families
 - Many diseases are specific within a plant family
 - Lettuce -> Kale = Is a true rotation (Composite family to Nightshade Family)
 - Peppers -> Tomatoes = Not a true rotation (Both in the Solanaceous plant family)
 - Similar considerations for cover crops between crops

- Divide tunnel into distinct rotation areas
 - Plant specific plant families in different areas
 - Don't grow one plant family in a spot for more than a year
 - Rotate for 3 years if soilborne issues start
 - Use cover crops to fill void between production cycles





Cover crops in High Tunnels

- Benefits
 - Breakup disease cycles
 - Disrupt soilborne pests (nematodes)
 - Fix nitrogen
 - Shade out weeds
 - Some help with soil salinity
- Cover crop selection
 - Plant family
 - Seasonal window
 - Fall-Planted Winter-Kill, Fall-Planted Overwintered, Spring-planted, Summer-planted, Intercropping/living mulch
 - Heat tolerance
 - Non-host for nematodes (Get your soil tested frequently)
 - Residue considerations

Options for Including Cover Crops in High Tunnel Rotations in the Northern United States

eOrganic authors: Elizabeth Perkus, University of Minnesota

Anne Pfeiffer, University of Minnesota Charlotte Thurston, University of Minnesota Fucui Li, University of Minnesota Julie Grossman, University of Minnesota

https://eorganic.org/node/25214



Center for Crop Diversification System Profile CCD-SP-16

Covers Under Cover: Managing Cover Crops in High Tunnels

Tim Coolong¹, Julia Gaskin¹, Erin Haramoto², Krista Jacobsen², Jenny Moore³, Tim Phillips², Rachel Rudolph², and Annette Wszelaki³

https://www.uky.edu/ccd/sites/www.uky.edu .ccd/files/CoversUnderCover1.pdf



Disease Management in High Tunnels

- Fungicides
 - Restricted use of pesticides in high tunnel environments
 - Residues affected differently due to change in environment/sunlight penetration
 - Closed or open sides?
 - Closed sides = technically a greenhouse for pesticide rule purposes
 - Open sides = technically in the field for pesticide rule purposes

GREENHOUSE VEGETABLE CROP DISEASE CONTROL

Note: Follow manufacturer's directions on label in all cases. Caution: A the time this table was prepared, the entries were believed to be useful and accurate, however, labels change rapidly, and errors arepossible, so the user must follow all directions on the pasticide container. See product labels for application limits per cropiseason. Information in the following table must be used in the contact of a total disease control program. For example, many diseases are controlled by the use of resistant varieties, crop rotation, sentation, seed treatment, and cultural practices. Always use top-quality seed or plants obtained from reliable sources. Seeds are containity threated by the seed producer for the control of seed decay and damping-off. Mostfoliar diseases can be reduced or controlled by maintaining relative humidity below 90%, by keeping the air circulating in the house with a large overhead poly- tube, and by avoiding water on the leaves.

Caution: The risk of pesticide exposure in the greenhouse is high. Use protective clothing laundered daily or after each exposure. Ventilate during application and use appropriate personal protective equipment (PPE).

TABLE 3-46. GREENHOUSE DISEASE CONTROL FOR VARIOUS VEGETABLE CROPS

Commodity	Disease	Product 1	FRAC	Rate of Material	Minimum Days		
					Harv.	Reentry	Method, Schedule, and Remarks
Greenhouse	Sanitation	Solarization	NA	140°F, 4 to 8 hr for 7 days	-		Close greenhouse during hottest and sunniest part of summer for at least one week. Green- house must reach at least 140°F each day. Remove debris, heat sensitive materials, and keep greenhouse and contents moist. Will not control pests 0.5 inches or deeper in soil. Not effective against TMV.
		Added heat	NA	180°F for 30 min	-	-	Remove all debris and heat-sensitive materi- als. Keep house and contents warm.
Soil	Soilborne diseases and weeds		-	See soil fumigants table and check soil fumi- gant label if registered for greenhouse use.			Preplant soil treatment.
Basil	Anthracnose, Alternaria blight, bacterial blight, Botrytis, downy mildew, leaf spot, Rhizoctonia leaf blight	copper, fixed (various)	M01	See label	See label	See label	Some products are OMRI-listed. See prod- uct labels for complete application instruc- tions, specific crop and disease labels, and greenhouse usage. Check state registration status prior to use.





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Disease Control in High Tunnels

- Maximize cultural controls
 - Place tunnel in ideal locations
 - Start off with a rotation of plant families
 - Maximize airflow (plant spacing, weed control, etc.)
 - Integrate cover crops
 - Use resistant varieties where possible
 - Utilize clean seed and transplants
 - Understand which diseases could be a problem
- Sanitation
 - Remove residue between crops
 - Remove diseased plants (remove roots if it is a soilborne disease)
- Use preventative fungicides when possible
 - Determine if fungicides are legal for your operation





Insect pests in High Tunnels

- Most insect pests will not be excluded with high tunnels
- Very important to scout
- Increased pest issues
- Mites
 - Spider mites
 - Broad mites
 - Russet mite
- Aphids
 - Spread viruses
- Whiteflies, thrips, scale insects, hoppers, etc.

Weed Control is important

• Acts as reservoir for many tunnel pests





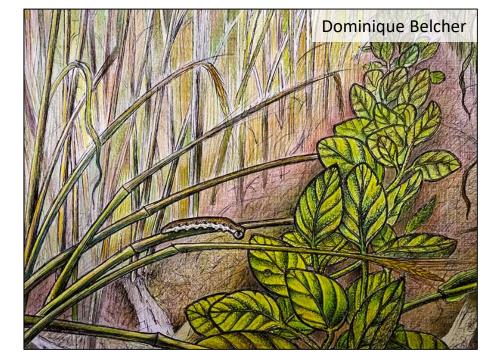




Management of Insects Pest in Tunnels

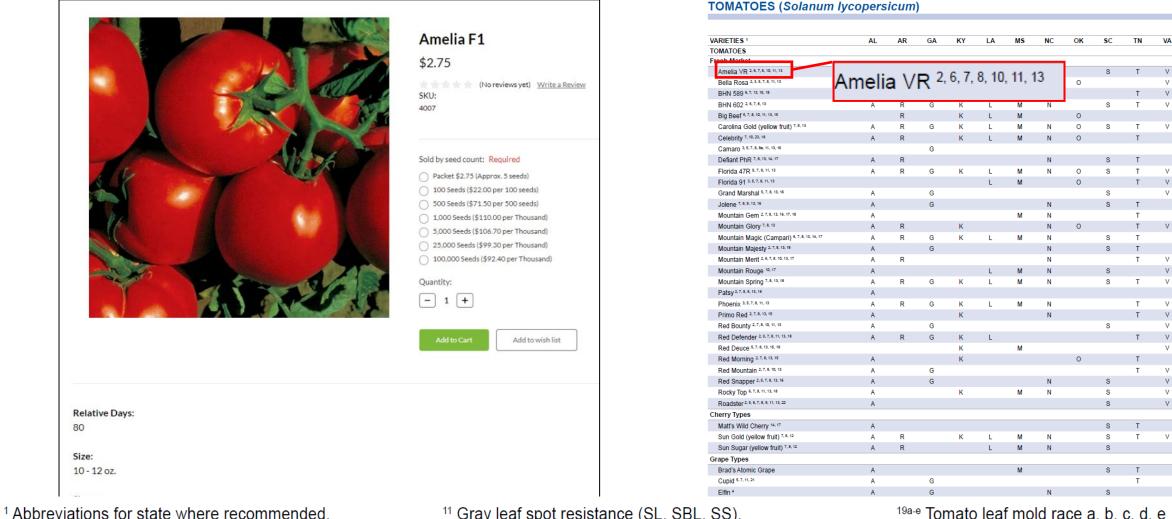
Combination of tactics necessary for successful control management in high tunnels

- **<u>Sanitation</u>**
 - Avoid the Green Bridge!
 - Remove residue and allow some time between crops
- Use virus resistant varieties when possible
 - Thrips, aphids, whiteflies, etc.









- ² Tomato spotted wilt virus resistance (TSWV).
- ³ Heat set (heat tolerance).
- ⁴ Determinant or short internode grape tomato.
- ⁵ Alternaria stem canker tolerance/resistance (ASC).
- ^{6, 7, 8, 8a} Fusarium Wilt race 0, 1, 2, 3 tolerance/resistance (F).
- ⁹ Fusarium Crown root rot tolerance/resistance (FCRR).
- ¹⁰ Nematode resistance (N).

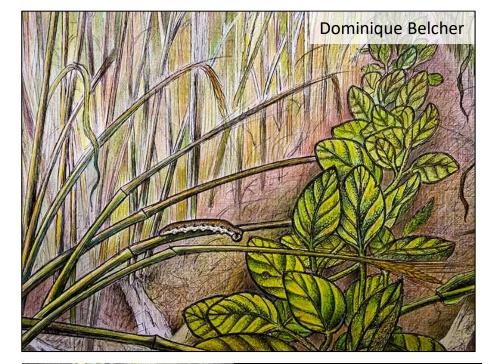
- ¹¹ Gray leaf spot resistance (SL, SBL, SS).
- ¹² Tobacco mosaic virus resistance (TMV).
- ¹³ Verticillium wilt resistance (V).
- ¹⁴ Early blight tolerance/resistance.
- ¹⁵ Tomato mosaic virus tolerance/resistance (ToMV).
- ¹⁶ Tomato yellow leaf curl virus tolerance/resistance (TYLCV).
- ¹⁷ Late blight tolerance/resistance.
- ¹⁸ Suitable for high tunnel production.

- ^{19a-e} Tomato leaf mold race a, b, c, d, e tolerance/resistance.
- ²⁰ Powdery mildew tolerance/resistance.
- ²¹ Bacterial speck tolerance/resistance (BSK-0).
- ²² Tomato brown rugose fruit virus (ToBRFV) tolerance/resistance.

Management of Insects Pest in Tunnels

Combination of tactics necessary for successful control management in high tunnels

- **<u>Sanitation</u>**
 - Avoid the Green Bridge!
 - Remove residue and allow some time between crops
- Avoid pools of standing water
 - Big issue with fungus gnats, shore flies, and potentially slugs
- Weed control
 - Reduces risk from mites and other pests
- Scout!
- React with appropriate insecticides or miticides quickly







Biological Control

- Reduce use of pyrethroids, organophosphates and carbamates
 - Bifenthrin, malathion, and carbaryl
 - Many insects pests are resistant but natural enemies are not!
 - Minute pirate bugs, black lady beetles, bigeyed bugs, etc.
 - Help manage mites, thrips, and all other small soft-bodied insects
- Pathogenic Fungus
 - Neozygites floridana
 - Naturally occurring fungus will help with spider mite suppression
 - One reason we see less mites in 'wet' environments
 - Likely affected by lack of rainfall in tunnels
 - Use of captan and group 11 fungicides can limit effectiveness
- Use of predatory mites
 - More cost effective in tunnels?
 - Example from Strawberry
 - When mite numbers are low (early season) 1.5 predatory mites per plant
 - When mite numbers are at threshold 5 predatory mites per plant
 - Err on the high infestation side for tunnels very susceptible
 - Cost? One source was \$85 per 10,000 mites
 - Consider knocking back mites with a short residual miticide prior to infesting
 - What species is right for your crop/pest combo?
 - Galendromus occidentalis, Neoseiulus californicus, **Phytoseiulus persimulus**, Amblyseius andersoni, and Amblyseius swirskii









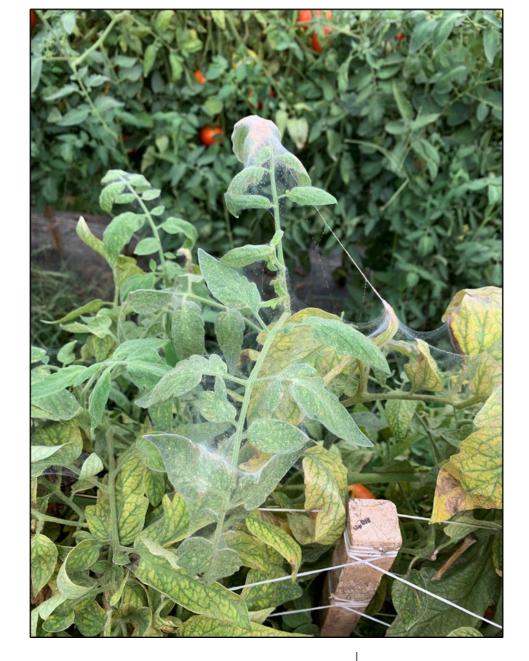
Insecticide options for Mites

Conventional Control

- Pyrethroids Likely to flare mites
- Abamectin (Agri-Mek)
- Acramite or Kanemite
- Zeal, Magister, Portal, Oberon
- Most of these will kill predatory mites.
 Establish predatory mites early then use miticides only if acceptable suppression fails

Organic control

- Maintain weeds
- Generally less insect pests when shooting for earlier market
- Insecticidal Soap, horticultural oil, neem oil, sulfur
 - All can harm plants in high temps





Insecticide Options for Aphids, Whiteflies, and other Small Soft-Bodied Insects

Conventional Control

- Pyrethroids
 - Resistance in many products/pests
- Neonicitinoids (potentially more residual)
 - Acetamiprid (Assail), Imidacloprid (Admire Pro), dinotefuron (Scorpion, Venom), Thiamethoxam (Actara), or Clothianidan (Belay)
 - Options for seed treatments and soil drench with good residual
- Transform, Sivanto often best products (expensive)
- Many IGR (growth regulator) options (Knack, PQZ, etc.)

Organic control

- Neem oil, insecticidal soap, pyrethrin
 - NOT DISH SOAP or homemade soap
- Save horticulture oils for mites and trees
- Kaolin Klay (Surround WP)







Cool Season Pests of High Tunnels

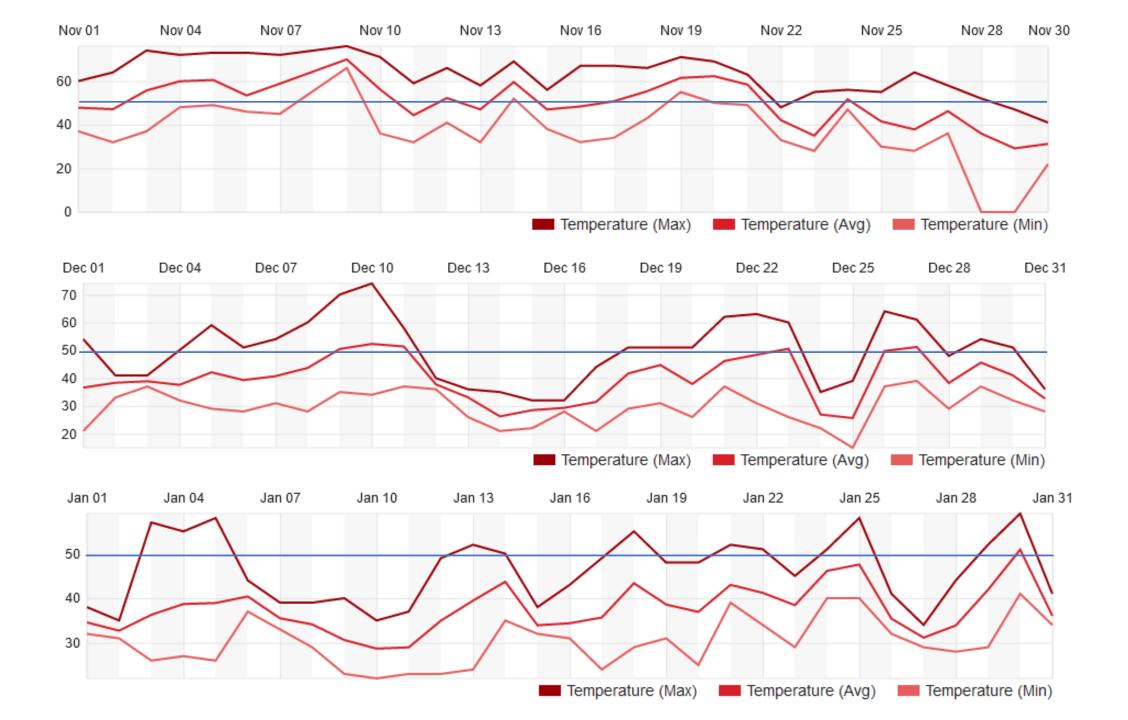
- Winter green production and other vegetables are still at a high risk from pests in the cooler months
- Pests multiply and damage crops on sunny and warm days during the winter





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Cool Season Pests of High Tunnels

- Winter green production and other vegetables are at a high risk from insect pests in the winter.
- These pests will multiply and damage crops on sunny and warm days during the winter.
- It's often difficult to control pests in the winter/cool season
 - Preventing pests before the cool season is paramount.
- Using sustainable IPM tactics is key to preventing losses



Specific Considerations for Winter Veggies

- Rotation/Sanitation
 - Make sure to go into these veggies clean. Remove all previous residue
 - Continue your rotation, try not to grow the exact same greens
 - Consider doing it in different locations within the tunnel each winter
- Varietal resistance
 - Look for varieties with resistance when possible
- Ventilation
 - Ventilate even on cold days
 - Maximize air movement within
- Manage row covers
 - Keeps crop healthier by reducing cold injury
 - Can increase humidity and disease risk
 - Remove when possible to let plants "air out"
- Pesticides
 - Do no apply when temperatures are below freezing





Questions?

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UAEX Fruit & Vegetable

www.youtube.com/@ARfruitveg

https://www.uaex.uada.edu/hort-ipm

Vegetable Insect Pest Monitoring in Arkansas

This interactive map of Arkansas shows locations of various insect trapping efforts by Extension Specialists and County Agents, When a location is clicked, the map will populate with insect trap data for that region to help indicate pest presence or absence. We are currently done monitoring for Squash Vine Borer (Melittia cucurbitae), Cabbage Looper (Trichoplusio ni), and Tomato Fruitworm Moth (Helicoverpa zea) for 2022. We will update the map at the start of the 2023 growing season



· Raspberry crown borer applications should have been applied to blackberries by now. More info in the MP 467

New monitoring for SWD Factsheet available below!

Insect and Irrigation Monitoring Resources

Videos:

- How-To Construct Watermark Sensors for Plasticulture Bedsg
- How-To Install Watermark Sensors for Plasticulture Bedsg
- How-To Build a Venturi Injectorget
- · How-to IPM: Using Pheromone Traps in Tomato and Squashg How-to IPM: Tomato Pestsr#

Factsheets:

Monitoring for Spotted-Wing Drosphila in Blackberries in Arkansas



Phone: A. Cano

Phone & Cam

https://www.uaex.uada.edu/hortblog



Arkansas Fruit, Vegetable, and Nut Update

Dr. Amanda McWhirt and Dr. Aaron Cato are Extension Horticulture specialists who post timely content for Arkansas producers. Find information on anything from pest management to best practices for growing seasonal crops in Arkansas.

Sign up to receive an email update when a new post is made to our blog!



Caller C. The Southern Fruitcast Covers the Latest Developments in Small Fruits FRUIT

By Aaron Cato, Amanda McWhirt - January 06, 2022

The purpose of this podcast is to be an easily accessible source of information about small fruits for growers and extension agents. Below we categorized each episode by the main topic and the small fruit crop they are most relevant to. This should allow you to find the episodes and information provided by this podcast that is most relevant for your operation and listen at your convenience while you work on the farm.

tags: Fruit, Pests, Planting, Harvest, Fertility



2021 County Agent Sweet Corn Demonstration Results By Aaron Cato, Amanda McWhirt, and Hank Chaney - November 05, 2021

A wrap-up of the 2021 Sweet Corn Demonstration carried out by Horticulture Specialists and County Agents. The Demonstration investigated Corn Earworm (CEW) Resistant Sweet Corn Cultivars across the state

tags: Vegetables, Pests

MP 29 Peach Rootstock Could Offer Protection from Peach Tree Short Life By Sarah Cato, Amanda McWhirt, Lizzy Herrera - September 09, 2021

If growers are not able to rotate away from old peach ground, rootstocks may offer limited resistance to some common peach diseases and pests and may help with some re-plant issues.

tags: Fruit, Planting

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