A close-up photograph of a tomato plant. The plant has green, serrated leaves and a single yellow flower with a green center. The background is a blurred blue sky.

Organic Pest and Disease Management Practices for Residential Vegetables (and a bit of fruits)

Wilson County Women in Agriculture 2024

Dr. Natalie Bumgarner- UT Extension

A close-up photograph of a cluster of small, round berries. The berries are in various stages of ripeness, showing colors from green to yellow to red. They are attached to a dark stem and surrounded by green leaves.



Our time today

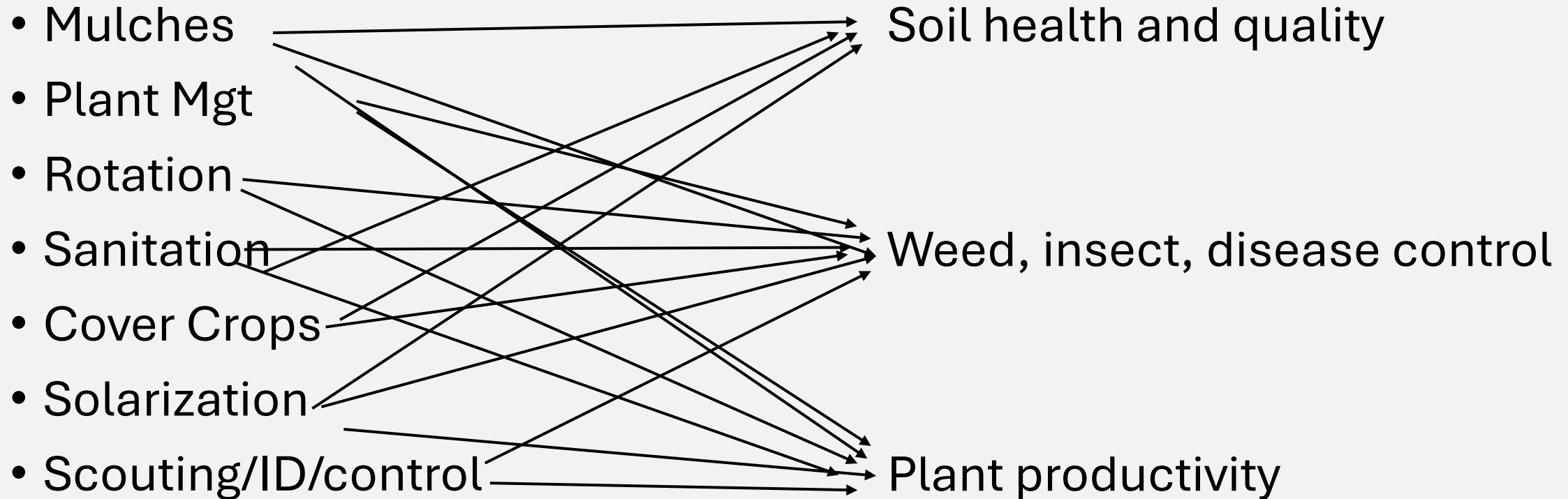
- A bit of intro to us and organic
- The tools in our toolbox
 - Soil stewardship
 - Diverse plantings
 - Cultivar selection**
 - Management/Sanitation**
 - Control steps- disease/pest**



Modern day organics in legal and practical terms

- "an ecological production management system that promotes and enhances biodiversity, biological cycles, and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain, or enhance ecological harmony. (NOSB, 1997)
- Use of non-synthetic materials
- Land health also extends to humans, water, and wildlife
- System-based

We want to support your success wherever in the system you are!



We need all the tools in the toolbox!



- Our climate is challenging
- We need to understand and use all our tools
- Soil stewardship
- Diverse plantings
- **Cultivar selection**
- **Cultural management**
- **Control materials**

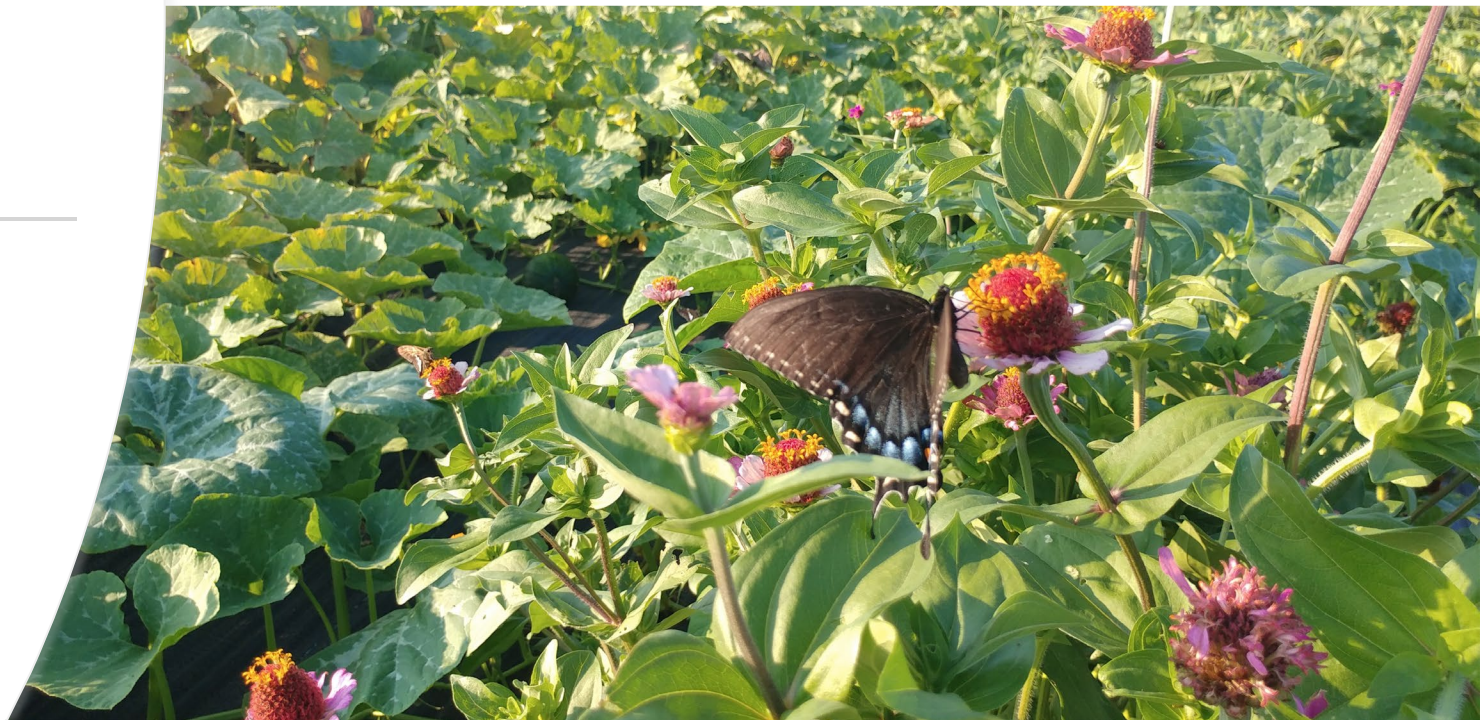
Soil Stewardship....A Long-term Relationship

- Focus on soil physical, biological, and chemical roles
- Cover crops/green manures
- Animal manures/compost
- Use of non-synthetic fertilizers
- (Moving toward) reduction of external inputs
- Tillage reduction practices





Biodiversity in our systems





Diverse plantings

- Odors- pull, push, confuse!
- Attracting predators or parasitoids
- Pollination support

Supporting Veggie Yields with Flowers

- Annuals- cosmos, basil, borage, Zinnia
- Perennial- Salvia
- Annuals interplanted, perennials in adjacent row
- Pepper yield ↑ in spring, fall
- Cucumber yield ↑ in fall



Montoya, Jr et al., 2020

Cultivar Selection- Resistance is Not Futile

- Tomato- Early and late blight
- Tomatoes, Vine crops- Fusarium, Verticillium
- Tomatoes- Root knot nematode
- Peppers, tomatoes, vine crops- Viruses
- Pepper- Bacterial leaf spot, Phytophthora
- Vine Crops- Powdery mildew, Downy Mildew



Resistance AND performance Trials in Knoxville





And across the whole state!

Tennessee

home garden

Variety Trials

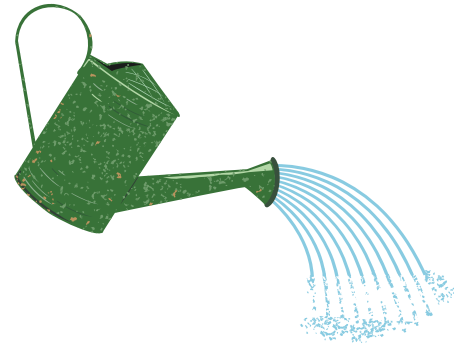


Image credits:
Mike Smith and
Stephanie
Powell



Cultural Management

- Crop rotation
- Seed sanitation
- Grafting
- Plant management
- In-season sanitation
- Soil solarization
- Natural enemy conservation





Crop Rotation

Cotton family (warm season)



Nightshade family (warm season)



Legume family (cool season)

Composite family (cool season)



Cucurbit family (warm season)



Seed Sanitation

- Bacterial spot- pepper
- Black rot-cruciferous

DISEASES AND PROBLEMS:

To prevent bacterial spot and phytophthora, drip irrigate only, plant only in well-drained soils, minimize soil compaction, follow a 4-year crop rotation. Sunscald is caused by an inadequate foliage canopy. Prevent blossom end rot with adequate soil calcium and regular moisture. Big bushy plants with few peppers can be caused by an excess of nitrogen, hot or cold temperature extremes during the flowering period, tarnished plant bug injury, and choice of late, poorly-adapted varieties.

BACTERIAL SPOT NOTICE:

Bacterial spot can be seed borne. All Johnny's pepper seed lots are tested for bacterial spot.

NOTE:

A disease-free test result does not guarantee a seed lot to be disease-free, only that in the sample tested, the pathogen targeted was not found.

Grafting

	Vert	Fus	Nem	TMV	Bact Wilt	Southern Blight
Beaufort	X	1,2	X	X		X
Big Power	X	1,2	X	X		X
Colossus	X	1,2,3	X	X		
Estamino	X	1,2,3	X	X		
Maxifort	X	1,2	X	X		X
RST-04-105-T	X	1,2	X	X	X	X

SP370-C Tomato Wilt Problems



Ken Chamberlain, OARDC



Spacing, Support, Mulch, Irrigation, Sanitation

Solarization

- Clear UV plastic (110-130F @ 2 in.)
- Smooth, moist soil
- Four to six weeks in summer
- Well secured, no punctures

Partial hit list

- Fusarium species
- Pythium species
- Southern blight
- Rhizoctonia



Solarizing planting beds in a garden.

Credit: Karey Windbiel-Rojas



Image credits: Dr. Bob Hayes

Exclusion





The toolbox- Microbial

- *Bacillus thuringiensis*- caterpillar pests- targets their digestive tracts
- Spinosad- from actinomycetes bacterium (several insect pests- mostly caterpillars)



Multiple modes of action- prevents infection/protection, growth promoting

- *Bacillus subtilis*- Cease, Serenade (several diseases)
- *Bacillus amyloliquefaciens*- Double Nickel (several diseases)



The toolbox- Elemental/Salts



Copper

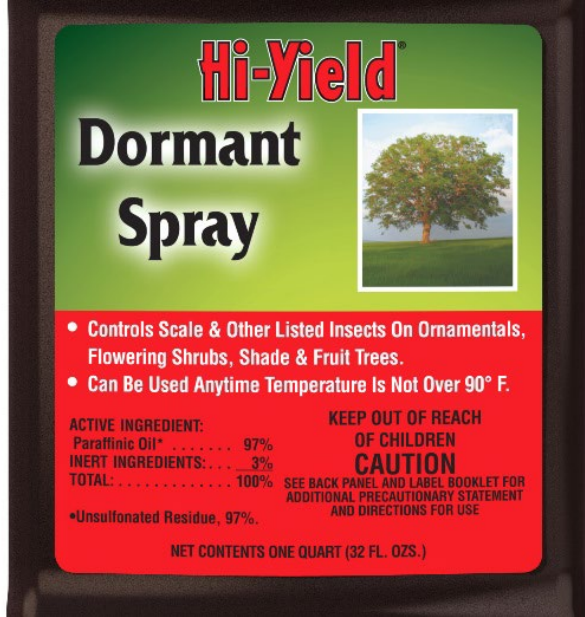
- Ions affect cell membranes- fungi, bacteria

Question- what is the best form of copper fungicide?

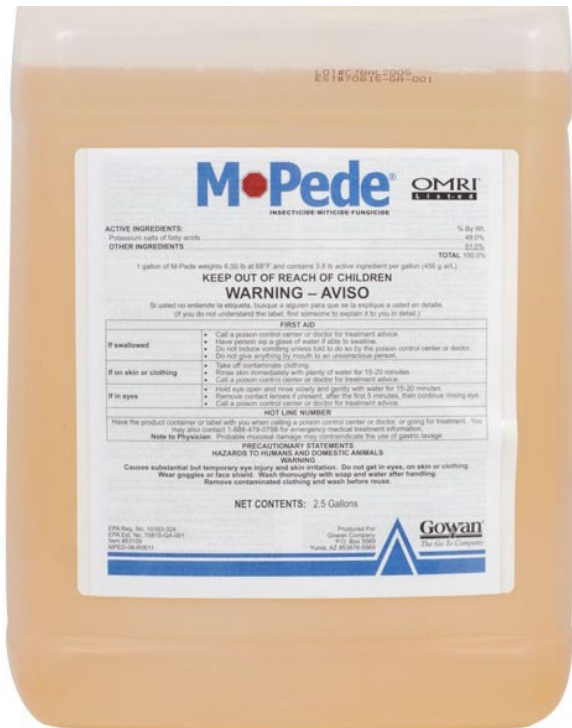
Answer- It depends... There have not been many comparative tests, but this publication from Cornell has great info on copper products, efficacy, formulations and more.

<https://bpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/1/7446/files/2020/08/Copper-Fungicides-McGrath-2020.pdf>

- Potassium bicarbonate- growth inhibition



The toolbox- Soaps and Oils



Suffocation and desiccation, cell membrane function

- Insecticidal soap- soft bodied insects
- Neem oil- insects and some diseases
- Mineral oil- some diseases and insects
- Cinnamon, rosemary, clove, thyme, peppermint, garlic oil- fungal and bacterial diseases



The toolbox- Botanicals

- Neem oil and Azadirachtin containing products- insect growth regulator, anti-feedant
- Pyrethrin containing products- insect nerve function



Question- What about adjuvants used with the sprays?

- With biological and low-impact sprays, there are few generalizations and not a lot of broad reference materials.
- Some benefits are increased coverage of leaf surface or contact with pests but care should be used to prevent plant damage or reduction in efficacy of the products.
- Each project label should be checked for compatibility.
- [Here is a useful \(and quite detailed\) article:](https://eorganic.org/node/34967)
<https://eorganic.org/node/34967>



Early blight





Early Blight

- Resistant cultivars
 - Defiant
 - Iron Lady
 - Stellar
 - Galahad
 - Plum Regal
- Early sanitation- Good
- Crop rotation- Fair
- Mulches- Fair
- Irrigation- Fair
- Foliar fungicides- Good

Most ratings from Southern Veg Crop Handbook

Fusarium wilt

- Resistant cultivars- Good
- Grafted rootstocks- Good
- Crop Rotation- Fair
- Field sanitation- Fair
- Biorational products- Poor







Southern blight

- Grafted rootstocks- Good
- Sanitation with crop residue- Fair
- Rotation- Fair
- Deep plow- Fair





Bacterial leaf spot

- Resistant cultivars- Good
- Disease-free seeds- Good
- Transplant handling and sanitation- Good
- Foliar fungicides (copper)-Fair





Cucurbit downy mildew



- Resistant cultivars- Fair
- Protective fungicides- Fair
- Crop timing- early season- Fair
- Multiple plantings- Fair

COMMON DISEASE PREVENTION AND CONTROL MATERIALS

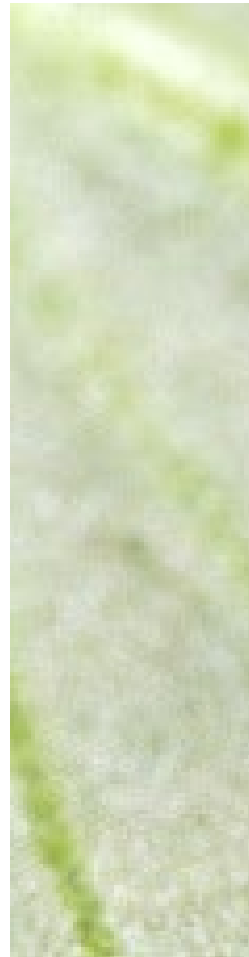
Material	Common Trade Names/Products	Diseases Addressed (Includes effectiveness rating scale: E, excellent; G, good; F, fair; P, poor; NC, no control; ND, no data. †)	Comments on Use
<i>Bacillus subtilis</i>	Serenade Garden Disease Control ^{OMRI} , Cease ^{OMRI}	Anthrachnose ^{NC} , bacterial leaf blight ^F , bacterial speck and spot ^F , rust ND , Botrytis ND , downy mildew ^{NC} , early blight ^P , late blight ND , powdery mildew ^F , scab ^F , target spot ND , others.	Organic*. These products contain live bacteria and should be stored at room temperature. Specific diseases controlled or suppressed are included on the label (including those on ornamentals and fruits). Can generally be used up to the day of harvest.
Chlorothalonil	Daconil, Bonide Fung-onil, Ortho Garden Disease Control	Rust ^P , Botrytis ^F , Alternaria leaf spot ^F , downy mildew ^F , Cercospora ^G , Anthracnose ^G , powdery mildew ^P , target spot ^F , early blight ^F , late blight ^G , Septoria ^F , others.	Best used as a protectant. Specific crops and listed diseases are included on the label (including ornamentals and fruits). Mixing rates, as well as pre-harvest intervals and maximum number of sprays per year are listed on the label for different crops.
Copper (Copper sulfate, fixed copper)	Bonide Liquid Copper Fungicide, Miracle Gro Nature's Care Garden Disease Control ^{OMRI} , Monterey Liquid Copper ^{OMRI} , Ortho Elementals Garden Disease Control ^{OMRI} , Camelot O ^{OMRI}	Anthrachnose ^P , Cercospora ^P , Alternaria ^P , bacterial leaf spot ^F , Septoria ^F , bacterial blights ^F , downy mildew ^P , powdery mildew ^P , white mold ND , rust ND , angular leaf spot ^F , gray mold ^{NC} , early blight ^F , late blight ^F , others.	Organic. Specific crops and listed diseases are included on the label (including ornamentals and fruits). Mixing rates, as well as pre-harvest intervals and maximum number of sprays per year are listed on the label for different crops.
Mancozeb	Dithane, Manzate, Bonide Mancozeb Flowable with Zinc	Rust ^G , corn leaf blight ND , Anthracnose ^G , Cercospora leaf spot ^G , downy mildew ^F , gummy stem blight ^F , scab ^F , Alternaria leaf spot ^F , Botrytis ^P , early blight ^F , late blight ^F , gray leaf spot ^P , Septoria ^F	Best used as a protectant. Specific crops and listed diseases are included on the label (including ornamentals and fruits). Mixing rates, as well as pre-harvest intervals and maximum number of sprays per year are listed on the label for different crops.
Myclobutanil	Spectracide Immunox, Monterey Fungi-Max	Powdery mildew ^F , rust ND	Some systemic (curative) activity but should primarily be used as a protectant. Specific crops and listed diseases are included on the label (including ornamentals and fruits). Mixing rates, as well as pre-harvest intervals and maximum number of sprays per year are listed on the label for different crops.
Neem oil	Garden Safe Fungicide 3 ^{OMRI} , Monterey Neem Oil ^{OMRI}	Powdery mildew ^F , downy mildew ^F , anthracnose ND , rust ^P , scab ^F , Botrytis ND , Alternaria ^F	Organic. These products are made from botanical extracts. They have insecticidal activity too, so sprays should always be made to avoid flying bees and other pollinators. Specific crops and controlled insects are listed on the label. Can generally be used up to the day of harvest. Often listed as not for indoor use.



Aphids

- Predators
- Parasitoids
- Soaps and Oils

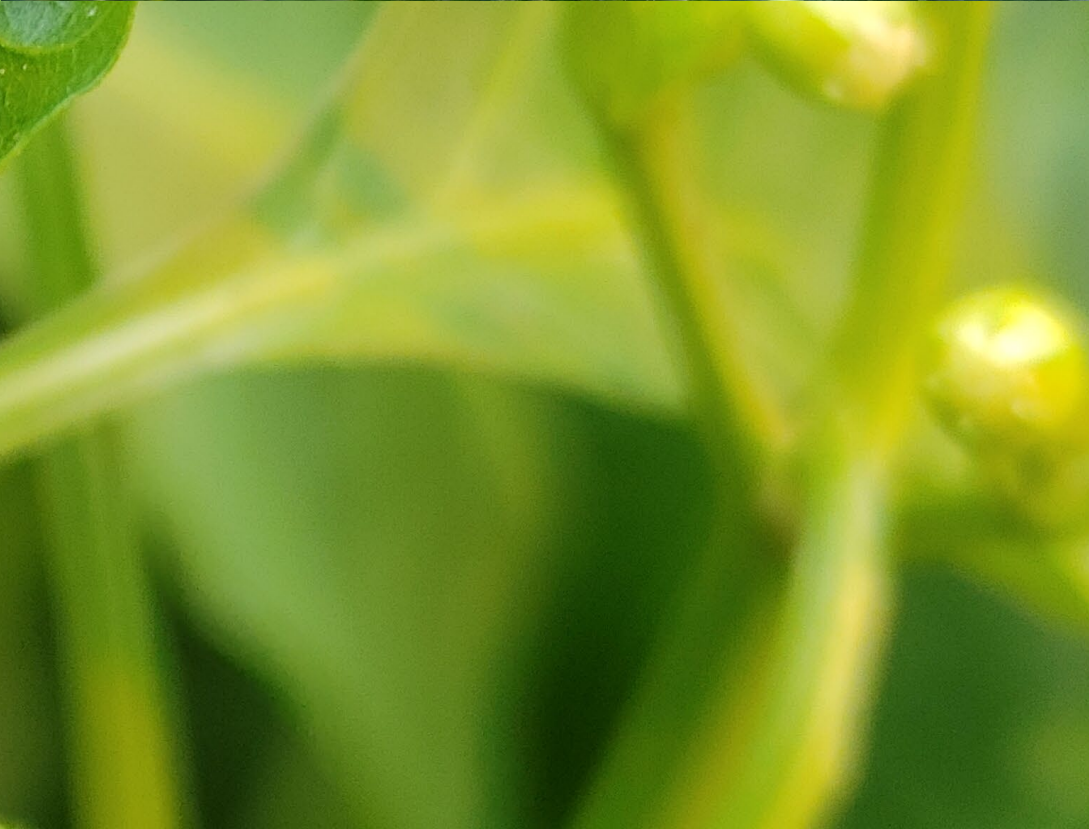
Select sprays with low/moderate impact on natural enemies – azadiractin, insecticidal soap



<http://extension.umn.edu/pestmanagement/ping.pdf>



[files/farmsca.org](http://files.farmsca.org)







Spider mites

- Irrigation – reduce stress
- Scout closely
- Insecticidal soaps
- Horticultural oils
- Neem/azadiractin products
- Protect natural enemies-
Azadirachtin





Howard F. Schwartz, Colorado State University, Bugwood.org; Gerald Holmes, Strawberry Center, Cal Poly San Luis Obispo, Bugwood.org



Cucumber Beetles and Bacterial Wilt



- Trap cropping- Hubbard (then spray)
- Row cover or exclusion early
- Scout and be vigilant
- Pyrethrins
- Neem oil



Tobacco hornworm

- Exclusion
- Scouting
- Mechanical control
- Pyrethrins
- Spinosad
- Bt- lowest impact on natural enemies





R.J. Reynolds Tobacco Company , R.J. Reynolds Tobacco
Company, Bugwood.org





A Few Notes on Fruit Crops

Blueberries

- Rabbiteye- less twig blight and fruit rot as well as environmental resilience
- Focus on soil pH, drainage and watering
- Biggest pest issue may be spotted wing drosophila- Spinosad, pyrethrins,
- Ground cover, good plant and harvest management



Blackberry

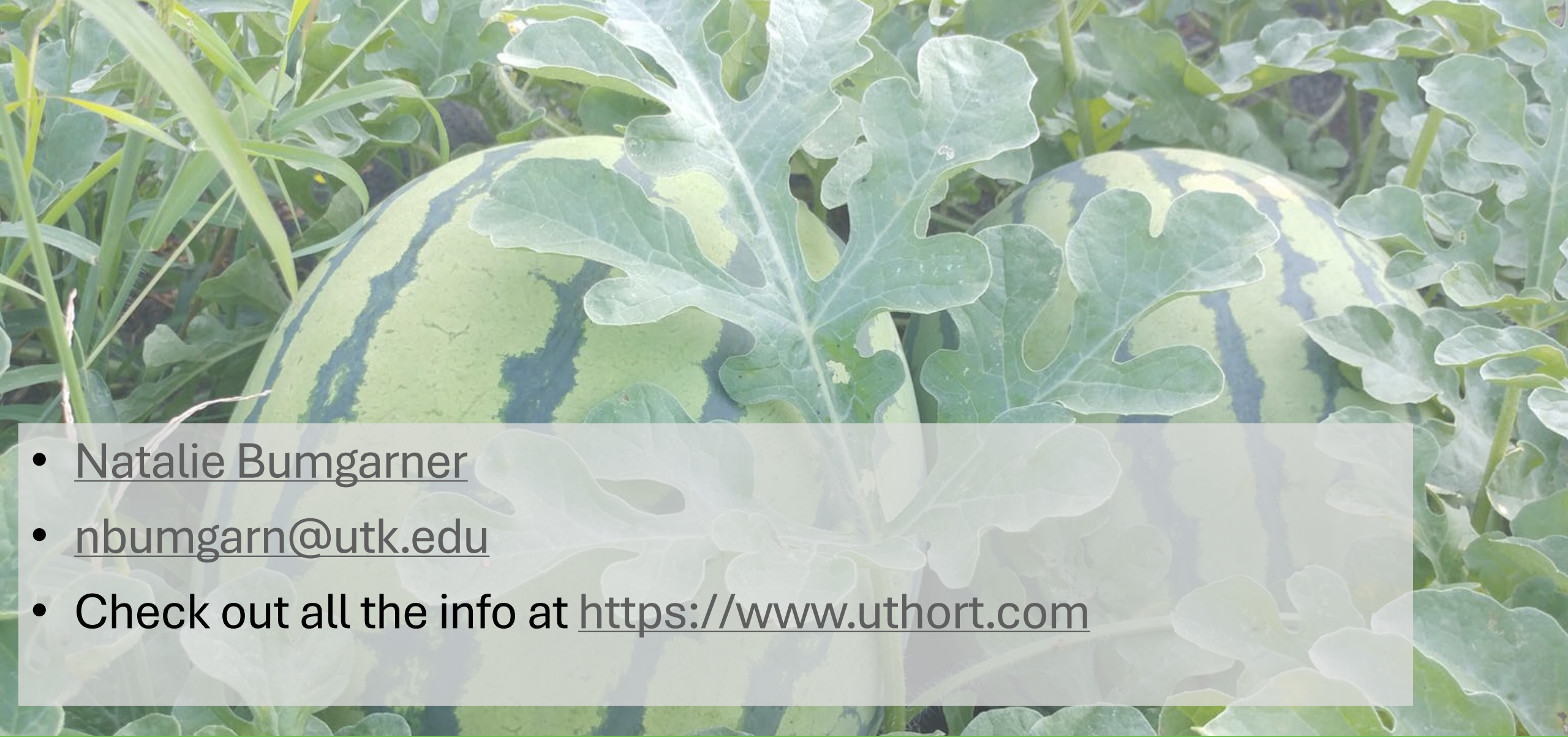
- Cropping in only a year or two
- May erect, thornless options
- Focus on cane health- cane blight a concern- care in pruning, protect canes
- Biggest pest issue likely to be spotted wing drosophila- Spinosad, pyrethrins



Strawberry

- Select for disease resistance- red stele, anthracnose, Verticillium
- Earliglow, Allstar, Cavendish, Flavorfest, Lateglow
- Albion (except for spider mites)
- Caution with Chandler (Anthracnose)
- Start healthy!
- Airflow, mulching
- Be prepared to replace more often



- 
- A photograph of two watermelons in a field, partially obscured by large, lobed green leaves. The watermelons have a characteristic green and dark green striped pattern. The background shows more green foliage and a clear sky.
- Natalie Bumgarner
 - nbumgarn@utk.edu
 - Check out all the info at <https://www.uthort.com>

Real. Life. Solutions.

Recent Vegetable Garden Cultivar Trial Overview

Natalie Bumgarner, Plant Sciences Department, University of Tennessee Institute of Agriculture (UTIA),
Knoxville, Tennessee

2024 Pepper Trials (yield in pounds per plant)

Cultivar (F1s are hybrids)	Disease resistances	Wt./plant (lb) ± SE	Fruit/plant	% cull	Comments
Alliance F1	BLS, PVY, PYMV, TMV, PMV, CMV	8.3 ± 3.7	26	17%	Thick wall green to red pepper
Autry F1	BLS, ToMV, TSWV	8.2 ± 1.6	31	11%	Medium sized green to red bell
Green Machine F1	BLS, ToMV, TSWV	7.8 ± 2.2	33	13%	Green to red large blocky bell pepper
Carmen F1		5.5 ± 1.7	45	20%	Green to red Italian roasting pepper
Red Knight F1	BLS, PVY	8.3 ± 2.4	36	11%	Green to red bell
Sailfish F1	BLS, Phy, ToMV	5.9 ± 0.3	35	8%	Green to red smaller better
Islander F1	TMV	5.4 ± 0.9	32	12%	Light to dark purple when unripe and then orange-red
SVBP8415 F1	BLS, ToMV	6.5 ± 2.6	25	22%	Green to yellow bell
Valahia F1	TSWV	4.2 ± 1.4	22	15%	Ivory bell
Dante F1	TMoV, BLS	9.1 ± 0.7	137	2%	Large fruit
Early Jalapeno		2.8 ± 0.6	78	4%	Small fruit, small plant
Everman F1	BLS	8.1 ± 0.3	108	1%	Large fruit
Jalafuego F1	BLS, PYV	8.4 ± 0.4	165	2%	Medium sized, tapered fruit
La Bomba II F1	BLS, TMV	5.3 ± 0.9	126	2%	Medium sized fruit
Pantera F1	BLS	11.0 ± 1.7	129	2%	Large fruit
Fooled You F1		7.7 ± 0.8	107	3%	Low heat, large fruit
Felicity F1		6.7 ± 0.6	117	2%	Low heat, large fruit

BLS- Bacterial leaf spot, CMV- Cucumber Mosaic Virus, TSWV- Tomato spotted wilt virus, TMV- Tomato Mosaic virus, PVY- potato yellow virus, Phy- Phytophthora, TEV- Tobacco etch virus

2021 Tomato Trials (yield in pounds per plant)

Cultivar (F1s are hybrids)	Disease resistances	Wt./plant (lb)	Fruit wt. (oz.)	Comments
Damsel F1	LB, V, F, N	18.6 ± 0.1	7.5	Indeterminate, smooth smaller pink fruit
Chefs Choice Orange F1	An, TMV	18.2 ± 2.3	7.8	Indeterminate, smooth, round, deep orange, low cracking
Big Beef F1	V, F, N, TMV, GLS	18.2 ± 1.8	8.1	Indeterminate, large red fruit
Garden Treasure F1	F, Phy, GLS	20.5 ± 1.7	8.9	UF bred for taste, large round, un-ribbed slicer, indeterminate

Cherokee Purple		13.6 ± 0.8	8.5	Indeterminate, purple, some cracking
Carbon		14.4 ± 0.3	9.8	Indeterminate, purple, some cracking
Coure di bue		21.7 ± 0.7	9.0	Indeterminate, stuffing tomato
Amish Paste		12.1 ± 2.5	5.2	Indeterminate, soft fruit, plum type
Granadero		20.2 ± 3.0	3.1	Indeterminate, firmer fruit, plum type
Tiren	V, F, N, TSWV, TMV	24.2 ± 2.5	3.6	Indeterminate, firm, tapered fruit, plum type
BHN 1021	V, F, N	7.3 ± 1.3	7.0	Determinate, medium sized fruit
BHN 589	F, V, TMV	8.9 ± 0.2	7.4	Determinate, medium sized fruit
Galahad	F, V, N, GLS, TSWV, EB, LB	7.7 ± 0.7	7.7	Determinate, medium sized fruit
Plum Regal F1	V, F, LB, TSWV	8.2 ± 0.1	4.0	Determinate plum fruit, fairly firm
Defiant F1	LB, EB, F, V	11.2 ± 3.2	5.2	Determinate, medium sized fruit, did well in tasting
Grand Marshall	A, F, V, TYLCV, GLS	9.3 ± 1.5	8.6	Determinate, large, firm fruit
Tasti-Lee	F, V	8.3 ± 1.2	5.2	Determinate, high lycopene, bred for flavor
Skyway	F, V, TSWV, N, TYLCV	6.2 ± 1.5	9.4	Determinate, large, firm fruit
Celebrity F1 (AAS)	V, F, N, A, TMV	8.4 ± 0.9	7.0	Determinate, consistent performer, large red fruit

V- verticillium, F- Fusarium, N- nematode, GLS- gray leaf spot, An- Anthracnose, TSWV- Tomato spotted wilt virus, TMV- Tomato Mosaic virus, LB- late blight, EB- early blight, Sep- Septoria, Phy- Phytophthora, A- Alternaria stem canker

2022 Cucumber, muskmelon, and squash trials (yield in pounds presented by plot)

Crop	Cultivar	Disease resistances	Wt./plot (lb) avg	Fruit/pl ot avg	Fruit wt. ounce	Comments
Cucumber	Bristol F1	A, CMV, ALS, CMV, ZYMV, DM, PM, PRV	63.25 ± 4.0	96	10.9	Standard 8" slicer
Cucumber	DMR401 OP	DM	43.58 ± 7.5	63	11.1	Standard 8" slicer
Cucumber	Green Light F1		45.79 ± 5.2	88	8.4	Thin-skinned snacker
Cucumber	Lime Crisp F1		33.47 ± 9.2	53	10.0	Light green slicer
Cucumber	Marketmore 76 OP	S, CMV, PM	56.55 ± 16.8	82	11.1	Long, slender slicer
Cucumber	Shintokiwa OP	BW	51.00 ± 3.6	68	12.1	Dark green thin-skinned, low bitterness
Cucumber	Southern Delight F1		59.85 ± 12.9	82	11.7	Dark green thin-skinned, low bitterness, burpless
Cucumber	Tasty Green F1	PM, DM	71.87 ± 2.1	89	13.1	Medium green thin-skinned

Summer Squash	Bossa Nova F1	ZYV, WMV	19.64±17.0	12	24.1	Mottled light and dark green
Summer Squash	Chiffon F1		23.67±5.0	19	20.0	Light yellow zucchini
Summer Squash	Cocozelle OP		10.26±0.3	7	22.5	Striped light and dark green zucchini- Costata Romanesco
Summer Squash	Emerald Delight F1	ZYV, WMV, PM	15.01±3.4	12	21.1	Dark green zucchini
Summer Squash	Green Tiger F1	PM	18.71±8.7	13	24.9	Striped light and dark green zucchini
Summer Squash	Slik Pik F1		12.39±5.6	18	10.9	Yellow spineless fruit with long, straight neck squash
Summer Squash	Yellow Crookneck OP		16.89±5.1	24	11.0	Warty crookneck squash, open- pollinated
Muskmelon	Ambrosia F1		35.14±4.5	11	3.5	Traditional aromatic, rapidly ripening, soft flesh
Muskmelon	Aphrodite F1	PM, F	48.30±14.9	9	5.4	Large early fruits, medium firmness
Muskmelon	Athena F1	PM, F	43.74±19.3	9	4.7	Cross over shipper and garden type with medium firmness
Muskmelon	Halona F1	PM, F	59.77±3.0	17	3.7	
Muskmelon	Sugar Cube F1	PM, F, ZYV, WMV, PRV	36.21±10.5	19	2.0	
Muskmelon	Sugar Rush F1	PM, F	27.71±5.6	8	3.7	
Muskmelon	Tasty Bites	PM, F	19.49±7.6	7	2.7	
Muskmelon	Tirreno	PM, F	58.54±27.1	14	4.7	

A- Anthracnose, ALS- Angular leaf spot, F- Fusarium, CMV- Cucumber Mosaic Virus, DM- Downy mildew, PM- Powdery mildew, PRV- Papaya ringspot virus, S- Scab, ZYV- Zucchini yellows virus, WMV- Watermelon mosaic virus, BW-Bacterial wilt