HORTICULTURAL

MU Guide

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Disease Prevention in Home Vegetable Gardens

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Vegetable gardening is the number one hobby in the United States. Keeping a garden healthy and attractive requires attention not only to its size and location but also to the soil, water availability, sunlight and air circulation in the garden. These environmental conditions can determine susceptibility to plant diseases. Diseased plants are unsightly and also detract from the enjoyment and fruits of the hobby.

Diseases affect home garden vegetable plants every year. Plant pathogens become established when environmental conditions are favorable. Losses due to disease can be reduced through a combination of proven disease-prevention methods:

- Select adapted, disease-resistant varieties.
- Use transplants that are free from disease.
- Plant closely related vegetables in separate areas of the garden (see Table 1).
- Rotate garden areas to prevent planting closely related vegetables in the same area year after year.
- Control weeds that compete with vegetables or harbor plant pathogens.
- Control insects that may carry disease.
- Remove and destroy diseased plant material.
- Remove plant refuse soon after harvest.
- Disinfect garden tools and shears.
- Apply fungicides appropriately and in a timely manner when resistant varieties are not available.
- Maintain a balanced soil fertility program.

In addition to diseases caused by pathogens, many nonparasitic disorders cause serious problems in vegetable production. The following disorders may mimic symptoms caused by pathogens: extremes in temperature, extremes in moisture, extremes in one or more nutrients, and herbicide misapplication or carryover. These disorders will not respond to the use of chemicals aimed at plant pathogens and can make conditions more favorable for disease development.

Getting started

Sanitation

Many plant pathogens survive through the winter in old plants and plant debris remaining in the garden. Removal of the plant material will reduce the chance of certain diseases increasing over years. It also reduces the chance that healthy plants will become infested early in the season. Some plant diseases would naturally occur late in the season and not be a problem on older plants. These same diseases can be devastating on young plants if pathogens are present early in the season.

Debris from diseased plants should not be added to a compost pile, because the temperatures reached in the pile often are not sufficient to kill the pathogens. See MU publication G 6956, *Making and Using Compost*. Burying the plant debris outside the garden will reduce the chance of spreading a disease from debris to plants currently in the garden or to plants that will be in the garden the next year. Some pathogens such as the wilt fungi survive in the soil for many years, and prevention is the best way to manage these diseases.

In addition to removing plant material from the garden, it is important to remove, destroy or disinfest support structures such as wooden stakes and poles used in the garden.

Garden tools can be disinfested by washing them

Table 1. Vegetable families susceptible to similar diseases.

Cucumber	Cabbage	Tomato	Beet	Bean	Onion	Corn
Cucumber, Watermelon, Squash, Cantaloupe, Pumpkin, Gourds	Cabbage, Cauliflower, Brussels sprouts, Broccoli, Mustard, Turnips, Collards	Tomato, Potato, Pepper (all types), Eggplant	Beets, Spinach, Swiss chard	Beans, Snow peas, Southern peas, English peas	Onions, Shallots, Garlic, Leek	Sweet corn

with detergent. Washing will remove soil and adhering fungi or bacteria, and the detergent will remove some of the virus from the tools and inactivate any remaining virus.

Clean seeds and transplants help reduce the chance of introducing plant pathogens into the garden. Do not save seed if disease is present in the garden. Whether growing your own transplants or purchasing them, transplants should be carefully inspected for abnormal growth above and below ground. Reject multipaks of transplants if several cells do not have plants or contain dead plants. Inspect transplants for insect damage on the leaf surface or insects on the lower leaf surface. If growing your own transplants, purchase steam-sterilized growth medium. Disinfest flats with bleach or use new plastic containers.

Certain plant pathogens can grow on weeds and spread to garden plants. For example, aster yellows phytoplasma can be spread from dandilions to carrots by the aster leafhopper. Additionally, some weeds attract insects that transmit diseases. This is especially true of viral diseases.

Cultural practices

The garden site should be well drained. Waterlogged soil encourages development of root rotting fungi, whereas good drainage promotes good growth of plant roots and thus the entire plant. If soil drainage is marginal, building a raised bed may solve the drainage problems. See MU publication G6985, *Raised-Bed Gardening.*

Plants with the proper available nutrients can withstand environmental stresses and plant pathogen attacks better than plants growing in soil with low fertility or where there is a nutrient imbalance.

Plant-parasitic nematodes, especially root-knot, can be a problem in the garden. See MU publication G 6204, *Managing Nematodes in Gardens,* for symptoms and management of nematode damage.

Crop rotation is a good way to manage diseases that attack related plants such as tomatoes, potatoes and eggplants (see Table 1). Moving the location of the related plants within the garden from season to season lessens the chance that plant diseases will build up. This is especially true of pathogens which survive in the soil. A good rule of thumb is to avoid returning to the same area of the garden for at least three years. This will not prevent diseases with long-lived resting spores, such as Pythium, Fusarium and Rhizoctonia.

Plant at the recommended seeding rate to reduce competition between plants and promote good air circulation and sunlight penetration. Use viable seed with good germination potential. Use seed packaged for the current year. The seed packet should have a date on it.

Physical practices

Plastic sheeting and organic mulch provide a physical barrier between soil and plant surfaces and reduce the amount of disease inoculum splashed onto foliage, stems and fruits during rainy periods.

Staking and trellising

To reduce the incidence of fruit rot in the garden, keep the fruit as far away from the soil as possible. Staking or trellising are especially effective with tomatoes. Sunburn can also be avoided if plants are grown in such a way that the leaves shade the fruit.

Solarization

Soil solarization is a nonchemical way to rid the garden of soil-borne plant pathogens. Solarization uses energy from the sun to heat the soil causing physical, chemical and biological changes in the soil. The process is most effective in mid to late summer, when high air temperatures combine with high radiation from the sun. The elevated temperature and toxic products generated from solarization kill or suppress plant pathogens and weed seed. It is believed that beneficial organisms are harmed less by solarization than by fumigation. Solarization also stimulates release of nutrients from organic matter present in the soil.

The biggest disadvantage to this method is that the area treated must be out of production for most of the growing season. Soil to be solarized should be tilled so that the soil is as uniform as possible (free of clods and plant debris) to prevent pockets of untreated soil. Slight elevation of the treated area will minimize recontamination of treated soil. A raised center of the bed will facilitate rainfall shedding. Water sitting on the plastic reduces the effectiveness of the treatment.

Check soil fertility and, if necessary, add fertilizer before beginning solarization. Dry soil should be moistened to a level that is ideal for planting. Wet soil conducts heat better than dry soil and will allow the heat to move deeper in the soil to remove pathogens present in the root zone.

Use clear plastic (1 to 6 mils) to cover the soil. Thinner plastic allows better solarization. The plastic needs to be stretched tight over the soil surface and be in contact with the soil. It is important to bury the edges of the plastic to prevent easy removal of the plastic before the soil has been adequately treated. Soil temperatures need to be over 100 F for four to six weeks to reduce soil-borne pathogens.

Contaminated plants introduced into the treated soil will undo the effects of solarization. Also mixing of adjacent soil with the treated soil will dilute the benefits of solarization.

Biological practices

Resistant varieties provide one of the best ways to manage plant disease in the garden (see Table 2). Resistance to a disease means that the plant is less likely to show symptoms than susceptible varieties; it does not mean that the plant is immune to that disease. Resistance to one disease does not protect against other diseases. Use of resistant varieties if available is especially recommended when a disease is known to occur in your area. Seed packets and catalogs are good sources of information about disease-resistant varieties. Be sure to check that the variety with disease resistance is adapted to your area before ordering seed.

After planting: Sanitation

Make a practice of removing diseased plants or plant parts from the garden without delay. It is often more cost-effective to remove plants than to try to bring them back to health. Removal also helps reduce the chance that disease will spread. Look for leaf spots, wilts, stunting, fruit rots, malformed leaves, and cankers. Bury diseased plant material away from the garden; do not place it in a compost pile.

Many plant pathogens require moisture to survive and infect plants. Avoid working in the garden when foliage is wet, because this can spread plant pathogens.

During the growing season

Good cultural practices

The following practices will help maintain healthy plants during the growing season:

- Maintain adequate levels of plant nutrients without overfertilizing. Excess nitrogen application can promote some root-rotting fungi. Nutrient stress can make plants more susceptible to diseases and insect damage.
- Water when the plants are dry to avoid drought stress. Excess water can lead to plant death from lack of oxygen to the roots or because of pathogen attack.
- Maintain adequate mulch cover to conserve moisture and reduce weed growth. Certain nonparasitic diseases such as blossom end rot can occur when moisture levels to the roots are uneven.
- Harvest produce at peak maturity. Overripe vegetables will attract insects and other pests.
- Remove nonbearing and old plants immediately after harvest to prevent accumulation of plant debris in the garden area.

Chemical control

Sometimes resistant varieties are not available and disease occurs in the garden despite all the cultural practices used. Many leaf diseases can be managed by spraying or dusting plants with an effective fungicide. Most fungicides are protectants. They work on the plant surface and protect against infection. They do not eliminate established infections. If disease is not detected early, the plant may die and disease may spread despite fungicide treatment. Some fungicides are systemic and will move in the plant. Some of these have curative properties and will kill infections already established in the plant, but they will not remove the spots already present on the leaves.

Table 2. Vegetables with resistance or tolerance to important diseases and nematode pests.

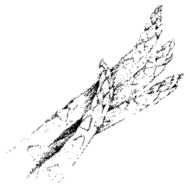
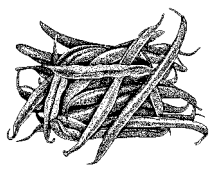
Vegetable	Cultivar	Disease resistance/tolerance
ASPARAGUS		
	Atlas Greenwich Jersey Knight Jersey Gem Jersey King Jersey Prince Mary Washington UC 157 F2	All cultivars possess rust resistance. All except Mary Washington possess Fusarium wilt resistance.
BEANS		
Bush, green 	Contender Derby Hialeah Matador Provider Tendercrop Topcrop	Common bean mosaic virus; Powdery mildew Common bean mosaic virus Common bean mosaic virus Common bean mosaic virus; Anthracnose Common bean mosaic virus; Powdery mildew Common bean mosaic virus; Powdery mildew Common bean mosaic virus

Table 2. Vegetables with resistance or tolerance to important diseases and nematode pests. (Continued)

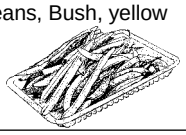
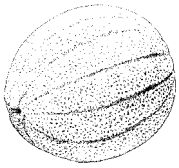
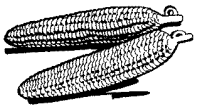
Vegetable	Cultivar	Disease resistance/tolerance
Beans, Bush, yellow 	Goldcrop	Common bean mosaic virus
	Goldkist	Rust
	Goldmine	Common bean mosaic virus; Halo blight
	Goldrush	Common bean mosaic virus
Beans, Pole	Kentucky Wonder	Rust
	Blue Lake	Common bean mosaic virus
BROCCOLI		
	Arcadia	Bacterial soft rot
BRUSSELS SPROUTS		
	Jade Cross Hybrid	Bottom/center rot
CABBAGE		
	Bravo	Black rot; Fusarium yellows
	Charmant	Fusarium yellows
	Golden Acre	Bacterial spot
	Market Prize	Black rot; Fusarium yellows
	Ruby Perfect	Fusarium yellows
	Savoy Ace	Fusarium yellows
	Stonehead	Black rot; Fusarium yellows
CANTALOUPE		
	Ambrosia	Downy mildew; Powdery mildew
	Athena	Fusarium wilt; Powdery mildew
	Eclipse	Fusarium wilt; Powdery mildew
	Saticoy	Fusarium wilt (race 2); Powdery mildew
	Supermarket	Fusarium wilt (race 2); Powdery mildew
	Superstar	Fusarium wilt (races 1,2)
CORN, SWEET		
Yellow, sugar-enhanced 	Incredible	Northern corn leaf blight; Southern corn leaf blight
	Legend	Stewart's wilt; Smut; Northern corn leaf blight; Southern corn leaf blight
	Sugar Ace	Stewart's wilt
	Tuxedo	Stewart's wilt
Bicolor, sugar enhanced	Delectable	Stewart's wilt
	Lancelot	Stewart's wilt; Northern corn leaf blight
	Seneca Arrowhead	Stewart's wilt
	Sweet Chorus	Stewart's wilt
	Sweet Symphony	Stewart's wilt; Smut
	Temptation	Stewart's wilt; Smut
White, sugar enhanced	Alpine	Stewart's wilt
	Seneca Sensation	Southern corn leaf blight
	Silver King	Stewart's wilt; Southern corn leaf blight
	Sweet Ice	Stewart's wilt; Southern corn leaf blight; Smut
Yellow, supersweet	Endeavor	Northern corn leaf blight; Southern corn leaf blight
	Flagship II	Stewart's wilt; Southern corn leaf blight
	Morning Star	Northern corn leaf blight; Southern corn leaf blight
	Saturn	Stewart's wilt
	Zenith	Stewart's wilt; Northern corn leaf blight; Southern corn leaf blight
Bicolor, supersweet	Candy Store	Stewart's wilt; Smut
	Festival	Northern corn leaf blight
White, supersweet	Ice Queen	Stewart's wilt; Northern corn leaf blight; Smut
	Summer Sweet 781	Stewart's wilt; Northern corn leaf blight; Southern corn leaf blight
	Vail	Stewart's wilt; Northern corn leaf blight

Table 2. Vegetables with resistance or tolerance to important diseases and nematode pests. (Continued)

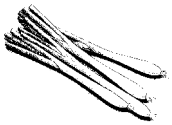
Vegetable	Cultivar	Disease resistance/tolerance
CUCUMBERS:		
Slicing 	County Fair	Bacterial wilt
	Dasher II	ALS; AN; CMV; Scab; DM; PM
	General Lee	CMV; Scab; DM; PM
	Lightning	CMV; Scab; PM
	Poinsett 76	ALS; AN; Scab; DM; PM
	Speedway	ALS; AN; CMV; Scab; DM; PM
	Thunder	CMV; Scab; PM; ZYM
Pickling	Calypso	ALS; AN; CMV; Scab; DM; PM
	Carolina	ALS; AN; CMV; Scab; DM; PM
	Francipak M	ALS; AN; CMV; Scab; DM; PM
	ALS = Alternaria leaf spot AN = Anthracnose CMV = Cucumber mosaic virus	DM = Downy mildew PM = Powdery mildew
EGGPLANT		
	Black Bell	Tobacco mosaic virus
	Dusky	Tobacco mosaic virus
	Epic	Tobacco mosaic virus
LETTUCE		
	Esmerelda	Tipburn
	Ithaca	Tipburn
	Sangria	Tipburn
	Sierra	Tipburn
	Summertime	Tipburn
ONION		
	Copra	Fusarium wilt
	Norstar	Botrytis; Mildew; Pinkroot; White mold
	Sweet Sandwich Hybrid	Pinkroot
	Yellow Sweet Spanish	Pinkroot
PEAS		
Shell peas 	Bolero	Bean yellow mosaic virus; Common wilt; Fusarium wilt; Powdery mildew
	Green Arrow	Fusarium wilt; Downy mildew
	Knight	Bean yellow mosaic virus; Common wilt; Fusarium wilt; Powdery mildew
	Lincoln	Common wilt
	Little Marvel	Fusarium wilt
	Spring	Fusarium wilt
Snap peas	Cascadia	Powdery mildew
	Oregon Giant	Powdery mildew; Common wilt
	Sugar Ann	Common wilt
	Sugar Bon	Powdery mildew
	Super Snappy	Powdery mildew
	Super Sugar Pod	Powdery mildew
Southern peas	Magnolia Mississippi Pinkeye Mississippi Purple Mississippi Silver Pinkeye Purple Hull BVR (different resistance)	Tolerance to blackeye cowpea mosaic virus and related viruses. Resistance to root-knot nematodes and Fusarium wilt

Table 2. Vegetables with resistance or tolerance to important diseases and nematode pests. (Continued)

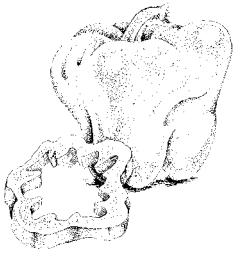
Vegetable	Cultivar	Disease resistance/tolerance
PEPPER		
Hot peppers 	Anaheim TMR 23	Pepper tobamovirus
	Caloro PS	Pepper tobamovirus
	Cherry Bomb	Pepper tobamovirus
	Delicias	Tomato etch virus; Potato virus Y; Pepper mottle virus
	Garden Salsa	Pepper tobamovirus
	Mesilla	Tomato etch virus; Potato virus Y; Tabomo
	Pasilla Bajio	Pepper tobamovirus
	Sante Fe Grande	Pepper tobamovirus
	Senorita	Tomato etch virus; Potato virus Y; Pepper mottle virus
	Serrano Chili	Tomato etch virus; Potato virus Y; Pepper mottle virus
	Super CayenneII	Tabomo; Bacterial spot (races 1,2,3)
	Tam Jalapeno #1	Potato virus Y
	Tam Vera Cruz	Tomato etch virus; Potato virus Y
Sweet peppers 	Bell Boy	Pepper tobamovirus
	Big Bertha PS	Pepper tobamovirus
	California Doner PS	Pepper tobamovirus
	California Wonder 300	Pepper tobamovirus
	Camelot	Bacterial spot (races 1,2,3)
	Chocolate Beauty	Pepper tobamovirus
	Emerald Giant	Pepper tobamovirus
	Enterprise	Bacterial leaf spot; Bacterial spot (races 1,2,3)
	Gator Belle	Pepper tobamovirus
	Golden Summer	Pepper tobamovirus
	Gypsy	Pepper tobamovirus
	Jingle Bells	Pepper tobamovirus
	Jupiter	Pepper tobamovirus; Tobacco mosaic virus
	Keystone Resistant Giant	Tobacco mosaic virus
	King Arthur	Tobamo; Potato virus Y
	Mayata F1RS	Pepper tobamovirus
	Merlin	Pepper tobamovirus
	North Star	Pepper tobamovirus
	Paladin	Tobacco mosaic virus; Phytophthora
	Peto Wonder	Pepper tobamovirus
	Pimento Elite	Pepper tobamovirus
	Rampage	Pepper tobamovirus
	Red Beauty	Pepper tobamovirus
	Sentinel	Bacterial spot (races 1,2); Potato virus Y
	Sunsation	Tobamo; Bacterial spot (races 1,2,3); Potato virus Y
	X3R Aladin	Bacterial spot (races 1,2,3); Tobacco mosaic virus
	X3R Camelot	Bacterial spot (races 1,2,3); Tobacco mosaic virus
	X3R Wizard	Pepper tobamovirus; Bacterial spot (races 1,2,3); Tobacco mosaic virus
POTATO		
Potato, red 	Chieftan	Potato virus A; Scab
	Dark Red Norland	Leaf roll; Potato virus Y; Potato virus A
	La Rouge	Scab
	Norland	Scab
	Sangre	Early blight
	Viking	Scab

Table 2. Vegetables with resistance or tolerance to important diseases and nematode pests. (Continued)

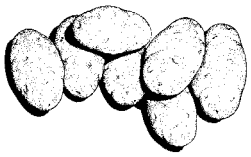
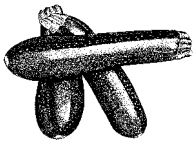
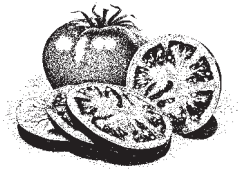
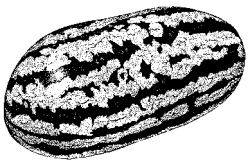
Vegetable	Cultivar	Disease resistance/tolerance
Potato, russet	Belrus	Potato virus A; Scab; Leaf roll; Northern root-knot nematode; Potato virus Y; Verticillium wilt
	Centennial	Early blight; Rhizoctonia; Verticillium wilt; Fusarium dry rot
	Frontier Russet	Fusarium dry rot
	HiLite Russet	Scab; Leaf roll; Potato virus X; Potato virus Y
	Krantz	Scab; Late blight; Verticillium wilt
	Lemhi Russet	Scab
	Norgold Russet	Scab
	Norkin Russet	Scab; Verticillium wilt
	Russet Burbank	Scab; Blackleg; Leaf roll; Potato virus A
Potato, white 	Allegany	Early blight; Late blight; Verticilium wilt
	Atlantic	Scab; Potato virus X; Verticillium wilt; Pink eye
	Gemchip	Verticillium wilt
	Irish Cobble	Potato virus A; Wart
	Katahdin	Potato virus A; Southern bacterial wilt
	Kenebec	Black leg; Late blight; Potato virus A; Potato virus Y
	Monona	Potato virus A; Scab; Potato virus Y; Verticillium wilt
	Norchip	Scab
	Norwis	Leaf roll; Potato virus X; Potato virus Y
	Onaway	Potato virus A; Scab; Late blight
	Sebago	Potato virus A; Early blight; Potato virus X; Potato virus Y; Late blight; Wart; Southern bacterial wilt
	Superior	Scab
Potato, yellow	Yukon Gold	Potato virus A; Leaf roll
PUMPKIN		
	Howden	Black rot
	Jack O Lantern	Black rot
	Magic Lantern	Powdery mildew
	Merlin	Powdery mildew
SPINACH		
	Decatur	Downy mildew
	Melody	Downy mildew; Cucumber mosaic virus
	Polka	Downy mildew
	Tyee	Downy mildew; Cucumber mosaic virus;
	Unipak	Downy mildew
SQUASH		
Zucchini 	Dividend	Cucumber mosaic virus; Watermelon mosaic virus; Zucchini yellow mosaic virus;
	Independence II	Watermelon mosaic virus; Zucchini yellow mosaic virus
	Revenue	Cucumber mosaic virus; Watermelon mosaic virus; Zucchini yellow mosaic virus
	Spineless Beauty	Powdery mildew
Yellow straightneck	Gen. Patton	Powdery mildew
	Liberator III	Cucumber mosaic virus; Watermelon mosaic virus; Zucchini yellow mosaic virus
	Multipik	Cucumber mosaic virus; Watermelon mosaic virus
Yellow crookneck	Prelude II	Watermelon mosaic virus; Powdery mildew
Patty pan types	Sunburst	Cucumber mosaic virus; Watermelon mosaic virus
Winter acorn	Taybelle PM	Powdery mildew
SWEET POTATO		
	Beauregard	Soil rot; Internal cork
	Centennial	Root-knot; Internal cork
	Jewel	Root-knot; Fusarium; Internal cork

Table 2. Vegetables with resistance or tolerance to important diseases and nematode pests. (Continued)

Vegetable	Cultivar	Disease resistance/tolerance
TOMATO		
	Beef Master	VT; F1; N; AS; M
	Better Boy	VT; F1; N; AS
	Big Beef	F12; GL; N; TM; VT; AS; EB
	Carnival	F12; GL; N; TM; VT; AS
	Celebrity	F12; GL; N; TM; VT; AS;
	Floralina	F12; GL; VT
	Florida 47	F12; VT
	Jet Star	F1; VT
	Mt. Delight	F12; VT; BE
	Mt. Fresh	F12; VT; BE; EB
	Mt. Gold	F12; VT;
	Mt. Pride	F12; VT; AS;
	Mt. Spring	F12; VT; BE;
	Mt. Supreme	F12; VT; EB
	Pink Girl	F12; GL; VT; AS;
	Spitfire	F12; GL; VT; EB
	AS = Alternaria stem canker BE = Blossom end rot EB = Early blight F12 = Fusarium wilt races 1,2	GL = Gray leaf spot N = Root-knot nematode TM = Tobacco mosaic VT = Verticillium wilt
WATERMELON		
Seeded 	Carnival	Anthracnose; Fusarium wilt (race 1)
	Crimson Sweet	Anthracnose; Fusarium wilt (race 1)
	Fiesta	Anthracnose; Fusarium wilt (race 1)
	Mardi Gras	Anthracnose; Fusarium wilt (race 1)
	Regency	Fusarium wilt (race 1)
	Royal Sweet	Fusarium wilt (race 1)
	Sangria	Anthracnose; Fusarium wilt (race 1)
	Star Brite	Anthracnose; Fusarium wilt (race 1)
	Stars n' Stripes	Anthracnose; Fusarium wilt (race 1)
	Tiger Baby	Fusarium wilt (race 1)
	Verona	Anthracnose; Fusarium wilt (race 1)
Seedless	Constitution	Fusarium wilt (race 1)
	Freedom	Fusarium wilt (race 1)
	Revolution	Fusarium wilt (race 1)
	SummerSweet 5244	Anthracnose
	SummerSweet 5544	Fusarium wilt (race 1)
	Tri-X 313	Anthracnose; Fusarium wilt (race 1)

For further information

G 6201, *Vegetable Planting Calendar*
G 6220, *Organic Gardening Techniques*
G 6461, *Growing Home Garden Tomatoes*
G 6951, *Understanding and Using Garden and Home Grounds Herbicides*
G 6952, *Garden and Home Weed Control*

OUTREACH & EXTENSION
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