

Disease Prevention in the Home Garden

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STEPS TO A DISEASE-FREE GARDEN

1. Site Selection. Choose a well-drained area.
2. Soil preparation. Encourage maximum growth.
3. Variety selection. Plant disease-resistant varieties.
4. Disease-free transplants. Prevent spread of disease into garden.
5. Proper type and rate of fertilizer. Encourage maximum growth.
6. Plant when soil temperature is correct. Reduce losses to seedling disease.
7. Watering. Reduce foliage diseases.
8. Mulches. Prevent fruit rots and encourage maximum growth.
9. Weed control. Reduce alternate host for vegetable disease.
10. Row spacing. Improve air circulation and reduce foliage disease.
11. Alternate planting. Prevent buildup of disease.
12. Rotation. Avoid soil disease buildup.
13. Insect control. Prevent virus spread.
14. Proper harvesting. Avoid storage decay.
15. Sanitation. Prevent buildup of diseased plant tissue in garden.
16. Fungicide application. Control diseases should they become established.

Disease Prevention in the Home Garden

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Home gardens are constantly besieged by a variety of disease-causing organisms. Some of these inevitably arrive at the garden site through natural forces. Others are introduced on seed or transplants, or already are established in the garden soil. Many diseases caused by these organisms can be prevented by adequate planning and by following recommended control practices before and during the growing season. Neglect or failure to take simple precautionary measures can result in a waste of money and labor through disease losses.

Site Selection

When selecting a garden site, a well-drained area should be chosen to prevent damping off and other problems commonly associated with water-saturated soil. Surface water should be diverted from flowing across the garden because it can recontaminate areas previously treated with fungicides or nematicides. After rains, surface water should percolate into the soil or be removed by draining. Surface moisture around a plant will increase the possibility of foliar and stem diseases caused by high humidity. Plants should be planted on a raised bed (6 to 8 inches) to improve water movement out of the root zone.

Organic Matter

Organic matter can be composed of straw, leaves and crop residue. Well-decayed organic matter is essential in maintaining a highly productive soil, but serious problems can arise from the presence of large amounts of partially decayed material. Organic matter should be buried below the expected root zone of next year's crops in the fall to reduce the buildup of southern blight, a fungal disease which occurs on many plants. Southern blight can live on partially decayed organic matter and attack

susceptible plants grown in the type of soil.

Manures

Manures should not be used when Irish potatoes or sweet potatoes are to be grown. Manure makes soil more alkaline, thus increasing the possibility for diseases such as Irish potato scab and sweet potato scurf.

Fertilization

Commercial fertilizers should be used according to recommendations based on a soil test. Fertilizers do not prevent diseases, but a healthy, well-fertilized plant is less susceptible to disease than one growing in soil lacking required nutrients.

Watering

Plants should not experience excessive drying or saturation. Regular watering in which the soil is wet down to 6 inches is more efficient than frequent shallow watering. Plants watered in the morning dry quickly, resulting in fewer foliage disease problems. Use furrow watering whenever possible to prevent wetting the foliage.

Varieties

Only those varieties recommended for your particular area should be used. Varieties not recommended for the environmental conditions of your area may be more susceptible to disease problems. Disease-resistant varieties should be used. For example, nematode-resistant tomato varieties can be grown in soil infested with root knot nematodes and not be damaged, whereas a susceptible variety grown in the same soil would be killed or severely stunted. Homeowners should contact their county Extension agent for disease-resistant varieties that are recommended for their counties.

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Rotation

A particular vegetable should be grown in the same location only once every two to three years. Home gardeners with inadequate space for proper crop rotation may compensate in part by planned usage of space to avoid growing vegetables of the same family group in the same area season after season. Vegetables in the same family group have many common diseases. Homeowners should make and keep a plan of their garden so rotation can be planned. Refer to Table 1 for specific plant groupings.

Table 1. Crop grouping for rotation to control soil-borne disease

Group A	Group B
Cantaloupe	Brussels Sprouts
Cucumber	Cabbage
Honeydew melon	Cauliflower
Pumpkin	Collards
Squash	Lettuce
Watermelon	Mustard
	Radish
	Rutabaga
	Spinach
	Swiss Chard
	Turnip
Group C	Group D
Eggplant	Beets
Irish Potato	Carrots
Okra	Garlic
Pepper	Onions
Tomato	Shallots
	Sweet Potato
Group E	Group F
Sweet Corn	Beans
	Cowpeas
	Peas

Seed

Only seed which have been stored and maintained properly should be planted. Use of poor quality seed will result in poor stands and unhealthy seedlings. Homeowners should not store seed from season to season because some vegetable diseases can be carried over in or on the seed.

Seed Treatment

Fungicides should be used as seed protectants to reduce seedling disease on vegetables. Place seed to be treated in a sealed container with a small amount of fungicide. Shake the container vigorously to insure coverage of all seed with a thin film of the protectant. After handling treated seed, wash hands thoroughly to avoid possible health hazards. When not planted immediately, store treated seed in a safe place to prevent human or animal consumption. Contact local county Extension agents for seed treatment recommendations.

Irish Potato Seed Piece Treatment

Potato seed piece decay is caused by several fungi and bacteria. Seed decay results in poor stands and reduction in yields.

Control can best be accomplished by using a combination of practices. Suberization or cork promotion of seed pieces is especially important. To insure proper suberization, seed potatoes should be cut and placed in an area at 60°F. and relative humidity of 85 to 90 percent with good air circulation. Suberization should occur in three to five days.

After suberization, fungicides applied as dips will help prevent decay.

Captan 50% WP can be used at 1 to 2.5 ounces per 5 gallons of water. Dip the seed pieces in this mixture after corking has occurred.

Zinc ion-maneb complex can be used as a dip at the rate of 2 ounces per 5 gallons of water. Treat after suberization has occurred and within six hours of planting. Compounds containing zinc ion-maneb are Manzate 200® and Dithane M-45®.

Zineb as a dip has been used to control seed piece decay at the rate of 1 to 1.5 ounces per gallons of water. Plant immediately after treating.

Black leg

Black leg of potatoes is especially troublesome in the home garden. It can be controlled using a formalin dip. Use at the rate of 1 pint per 30 gallons of water or 2.5 fluid ounces per 5 gallons of water. Soak in formalin suspension for 30 to 90 minutes. Treated seed pieces should be sprinkled with water and kept covered with burlap for 24 to 48 hours if they are soaked less than 90 minutes. If they are soaked for 90 minutes, plant immediately.

Scab

Either the zinc ion-maneb complex or the formalin treatment will control scab on potatoes.

Damping Off

Damping off is the result of several soil-borne fungi which attack the young plant in the seedling stage. This problem can be reduced by:

1. Planting good quality treated seed
2. Planting on a raised bed
3. Making sure the garden is well-drained
4. Planting in warm soil (75-85°F.)
5. Using Captan incorporated into the upper 3-4 inches of soil

Transplants

Use disease-free transplants in the home garden. A grower should either raise his own plants in sterilized seed beds or buy from a reputable dealer. If transplants are bought, roots should be examined carefully for galls or swellings. Destroy plants with galls because they are probably infected with root knot nematodes. Select only transplants with healthy roots and stems. Never use transplants with brown, discolored areas near the crown because *this indicates they were grown where damping off may have been a problem.*

Foliage Fungicides

The homeowner often can prevent serious crop loss with one or two applications of an effective fungicide when the disease first appears. The keys to effective disease control with fungicides are:

1. Proper timing
2. Proper type
3. Proper application
4. Proper interval

Most fungicides applied to foliage act as protectants rather than eradicants. When properly applied, fungicides retard growth and reproduction of disease-causing organisms and provide a barrier to new infections. Early fungicide application reduces the damage caused by early season infection and prevents rapid spread of disease.

Certain diseases are controlled more efficiently by a specific fungicide than by others. However, no single fungicide is effective in controlling all diseases. Recognition of certain foliage diseases is important before control measures are attempted.

All foliage must be covered if the chemical protectant is to be effective. Apply spray materials in sufficient volume, with adequate pressure, to reach the inner-most parts of plants and wet all leaf surfaces to the point of runoff. *Chemical protectants are lost* more readily from foliage during rainy weather, the most favorable time for disease development. Under such conditions, repeat applications to maintain the desired film of protectant on plant surfaces.

Resistant varieties should be used whenever possible to reduce nematode damage. This is not always possible because nematode-resistant plants may not be available. When resistant varieties are not available, grow plants in Group E and plant susceptible plants on this land only once every two to three years. If the entire field or garden is infested with root knot nematodes, consider using a soil fumigant or nematicide. Nematicides are available in liquid form and can be applied in broadcast or as in-row treatment. Fumigants are sold as a liquid. Further information on the use of nematicide fumigants around the home is given in Extension publication, L-781, *Control of Plant Parasitic Nematodes Around the Home and Garden.*

Table 2. Fungicides* commonly used on home garden vegetables.

Material	Trade name	Rate tsp./gal.	Days interval between sprays
Fungal leaf spot			
Maneb	Dithane M-22® Manzate®	3	7
Zinc ion-maneb complex	Manzate 200® Dithane M-45®	3	7
Captan	Orthocide® Captan®	3	7
Folpet	Phaltan®	2½	7
Bacterial leaf spot			
Copper bordeaux		Refer to label	7-14
Powdery mildew			
Benomyl (vine crops)	Benlate®	1¼	14
Folpet	Phaltan®	3	7
Dinocap	Karathane®	¾	7
Rust			
Sulfur (beans and peas)		6¼	5-7

*Fungicides listed are those with broad clearances which cover most vegetables grown in the home garden. This list is not meant to be a complete list of all compounds or all trade names used on home gardens. Homeowners should refer to product labels for additional fungicides that can be used.

Table 3. Common diseases of home garden vegetables in Texas

CROP		ORGANISM		DISEASE DEVELOPMENT		CONTROL	
Disease	Causal organism	Source of organism	Conditions favoring development	Cultural practices for control	Chemicals for control	Resistant varieties	
BEANS							
1. Damping off	Fungus	Soil-borne	Wet, cool soils	Raised beds, warm soils, well-drained soil	Captan (incorporated into soil)	None	
2. Downy mildew, anthracnose	Fungus	Airborne spores, old crop residue	Rainy, foggy, cool weather		Maneb, copper bordeaux, captan	None	
3. Powdery mildew	Fungus	Airborne spores	Cool, wet weather		Sulfur, copper oleate	None	
4. Rust	Fungus	Airborne spores	Cool, wet weather		Sulfur, maneb (bush or pole), captan	None	
BROCCOLI, CABBAGE, CAULIFLOWER AND BRUSSELS SPOUTS							
1. Fusarium yellows	Fungus	Soil and diseased transplants	Temperatures of 80°-90°F.	Long rotations; resistant seed or seedlings from a reliable source	None	CABBAGE Market Prize, Gourmet, Rio Verde and others	
2. Black rot	Bacterium	Soil and seed	Rain or heavy dews; temperatures of 80°-86°F. are optimum	1-year rotation; use of hot water-treated seed; raised bed with mulch; avoid sprinkler irrigation	None	CABBAGE Gourmet, Rio Verde, Sanibel are somewhat resistant; no resistance in the other cole crops	
3. Downy mildew	Fungus	Soil and seed-borne	Night temperatures of 41°-61°F. with day temperatures not exceeding 75°F.	Eradicate cruciferous weeds; avoid wetting foliage	Maneb, zineb, copper bordeaux	CABBAGE Gourmet, Rio Verde, Sanibel are somewhat resistant; no resistance in the other cole crops	
4. Alternaria leaf spot	Fungus	Soil-borne plant residue	Temperatures of 50°-72°F.	Hot water seed treatment; deep burial of crop residue	Maneb	None	
CUCUMBER, CANTALOUPE, SQUASH AND WATERMELON							
1. Powdery mildew	Fungus	Soil, airborne spores	Cool, dry conditions; infection occurs when humidity is above 46%	Rotation with unrelated crops; deep burial of crop residue	Karathane®, folpet, benomyl	CANTALOUPE Perlita, TAM Uvalde, PMR-45, Gulfstream, Planters, Jumbo, Topmark CUCUMBER (slicer) Ashley, Burpless, Poinsett, Texas Long	

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Disease	Causal organism	Source of organism	Conditions favoring development	Cultural practices for control	Chemicals for control	Resistant varieties
2. Downy mildew	Fungus	Soil, airborne spores	Temperatures of 61°-72°F. with moisture film and high humidity	Rotation with unrelated crops; deep burial or organic matter	Maneb, captan, folpet, zinc ion-maneb complex	CANTALOUPE Perlita, TAM Uvalde, Gulfstream, Planters, Jumbo, Topmark CUCUMBER (slicer) Ashley, Burpless, Poinsett, Texas Long CUCUMBER (pickles) Chipper, Explorer, Pixie
3. Cucumber mosaic	Virus	Susceptible weed hosts	Conditions favorable for buildup of insects	Control weeds in fence rows; control aphids	None	CUCUMBER (slicer) Market-more CUCUMBER (pickles) Chipper, Explorer, Pixie
4. Squash mosaic	Virus	Susceptible weed hosts	Conditions favoring buildup of insects	Control of weeds in fence rows; control of cucumber beetles; remove infested plants immediately from garden	None	No resistant varieties available
EGGPLANT						
1. Fusarium wilt	Fungus	Soil	Root knot nematode injury or other root injury increases incidence of disease	Rotation for 3 years or more	None	Varieties may vary in tolerance
2. Fruit rot	Fungus	Soil	Insect injury predisposes fruit to infection	Prevention of foliage disease control insects	Maneb, copper bordeaux, captan	Florida market
MUSTARD, TURNIPS AND SPINACH						
1. White rust	Fungus	Soil-borne and airborne	Temperatures of 50°-56°F. and prolonged dews or fogs	Rotation; deep burial of crop residue; if plants become infected, remove diseased foliage and begin spraying; avoid wetting foliage during irrigation	Maneb (use only on spinach), zineb (use only on spinach)	SPINACH Hy 612, Hy 621 and Dixie Market varieties are somewhat resistant; no resistance in mustard or turnips
2. Downy mildew	Fungus	Airborne spores	High humidity and mild temperatures (50°-65°F.)	Improved air circulation; removal of diseased foliage	Maneb, (use only on mustard), zineb (use only on mustard)	SPINACH Hy 612, Hy 621 and Dixie Market varieties are resistant to most races of the fungus; Viroflay and Resistoflay are resistant to all known races; no resistance on mustard and turnip

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Disease	Causal Organism	Source of Organism	Conditions favoring Development	Cultural practices for control	Chemicals for Control	Resistant varieties
3. Alternaria	Fungus	Soil-borne transmitted on seed	Temperatures of 55° - 65°F. and humid weather	Long rotation with unrelated crops; control of curciferous weeds; deep burial of organic matter	Maneb	Crops vary in susceptibility
4. Turnip mosaic	Virus	Weeds and old crop residue	Conditions favoring insect buildup	Destruction of weeds and old plants	Insect control program	Burpee's Just Right F ₁ Hy and Tokyo Market will mature faster, thus reducing the time the plant is subject to disease; spinach is not susceptible to the disease
ONIONS						
1. Downy mildew	Fungus	Soil and infected transplants	Cool, humid conditions	Rotation with unrelated crops; deep burial of crop residue	Maneb, zineb, captan, folpet, zinc ion-maneb complex; wetting agent will improve control	None
2. Pink rot	Fungus	Soil and infected transplants	Fungus can infect at temperatures of 55° - 90°F.	Maintenance of optimum fertility and good cultural practices	None	Select varieties with PRR after their name: e.g., Granex yellow PRR
3. Purple blotch	Fungus	Airborne spores	Prolonged wet periods	Avoid stress conditions	Captan, maneb	
PEPPER						
1. Virus	Several different viruses affect pepper	Other living hosts	Insect-transmitted viruses are more serious when insect populations are high; avoid handling plants	Weed eradication; control aphids		Canape, Early Bountiful and Spring Set are moderately tolerant
2. Bacterial leaf spot	Bacterium	Soil and seed	Mild temperatures and high humidity	Keep foliage dry; water by sprinkler only in morning	Copper bordeaux	Canape, Early Bountiful and Spring Set are moderately tolerant
3. Cercospora	Fungus	Airborne spores	High humidity and mild temperatures		Copper bordeaux, captan	Canape, Early Bountiful, and Sure Set are moderately tolerant
POTATO						
1. Early blight	Fungus	Diseased plant residue in soil	Humid weather conditions; nutrient deficient plants; optimum temperatures for disease development are 75° - 85°F.	Long crop rotations; good weed control; improved air circulation by adequate spacing between rows	Maneb, copper bordeaux, captan, zinc ion-maneb complex	Some varieties are more tolerant than others

CROP	ORGANISM	DISEASE DEVELOPMENT			CONTROL	
Disease	Causal organism	Source of organism	Conditions favoring development	Cultural practices for control	Chemicals for control	Resistant varieties
2. Scab	Fungus	Soil and diseased tubers	Alkaline-producing soil amendments such as lime, wood ashes and manure increase disease occurrence	Long rotations with grass crops; eradication of pigweed; avoid use of manures on potatoes	High rates of commercial fertilizers discourage disease development; sulfur can be used to lower the soil pH to approximately 5.2; 10 lbs. of sulfur per 1000 sq. ft. drops the pH .5. Example: Original pH 7.5; desired pH 5.5; 40 lbs. of sulfur required to adjust pH	Russet-type potatoes are less susceptible than smooth skinned ones
3. Ring rot	Bacterium	Infected seed pieces	Introduction of organism into cut seed pieces	Rotation and sanitation	Equipment may be treated with 10% household bleach solution	Certified seed potatoes should be free of the organism
4. Root knot	Nematode	Soil or infested tubers	Warm temperatures favor more rapid development of the nematode	Rotation with less susceptible crops	Vapam®	None
SOUTHERN PEAS						
1. Downy mildew	Fungus	Old crop residue	Cool, humid weather	Improved air movement by row spacing	Maneb	None
2. Rust	Fungus	Airborne spores from neighboring gardens	Cool, humid weather	Improved air movement by row spacing	Sulfur	None
3. Root knot	Nematode	Soil	Rainy weather with mild temperatures	Rotation	Vapam®	Mississippi Silver
SWEET CORN						
1. Smut	Fungus	Infested seed and soil	Mild temperatures	Rotation	None	Captan, Calumet, Merit, Bonanza
2. Maize dwarf mosaic	Virus	Rhizomes of Johnsongrass	Climatic conditions favoring high insect populations	Eradication of Johnsongrass; good insect control program	None	Bonanza, Merit, Captan
3. Downy mildew	Fungus	Soil and airborne spores	Mild temperatures	Rotation	None	Bonanza, Merit, Captan
4. Stewart's wilt	Bacterium	Seed	Mild temperatures	Rotation	None	Captan, Merit, Bonanza
SWEET POTATO						
1. Scurf	Fungus	Soil and infected seed potatoes	Alkaline soils favor disease development; optimum temperature of 70°-80° F.	Long rotations, avoidance of manure fertilizers; selection of disease-free seed potatoes; low soil pH (5.6-5.8)	10 lbs. of sulfur per 1000 sq. ft. is required to drop the pH .5; Example: Original pH 8.0; desired pH 5.5; 45 lbs. of sulfur would be required; CAUTION: Large amounts of sulfur may release toxic levels of micronutrients	None

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Disease	Causal Organism	Source of organism	Conditions favoring development	Cultural practices for control	Chemicals for control	Resistant varieties
2. Root knot	Nematode	Soil and infected sweet potatoes	Normal growing season and presence of organism	Nematode-free seed potatoes	Vapam®	Centennial, Nema-gold, Jewel
3. Storage roots	Fungus	Soil on potatoes	Improper curing; high humidities in storage; injury to roots	Proper curing; avoid injury to roots	None	None
TOMATO						
1. Damping off	Fungus	Soil	Cool, damp periods	Relocation of plant bed in uncontaminated areas	Captan incorporated into top 3-4 inches of soil	None
2. Root knot	Nematode	Soil and transplants	Warm temperatures favor rapid development	Rotation with sweet corn, onions and garlic	Vapam®	Better Boy, Big Set, Terrific, Jack Pot, Bonus and Small Fry (cherry type)
3. Southern blight	Fungus	Soil	Warm temperatures	Planting dates; bed planting; deep burial of crop residue; removal of diseased foliage	No material effective	None
4. Fusarium wilt	Fungus	Soil and transplants	Soil temperatures between 77°-88° F.	Plant unsusceptible crops; avoid root injury or any practice causing stunting	No material effective	Homestead 24, Spring Giant, Homestead Elite, Walter, Terrific, Better Boy, Jack Pot, Small Fry, Big Set, Bonus
5. Leaf mold	Fungus	Infected crop residue	Relative humidity above 95%; and temperatures above 50° F.	Rotation with other crops; if the disease is light, remove diseased foliage when it appears	Maneb, zineb, copper bordeaux	Floradel, Supermarket, Terrific
6. Late blight	Fungus	Infected crop residue, soil and transplants	Cool nights and warm days; mist or fog	Rotation with unrelated crops; if the disease is light, remove diseased foliage when it appears	Maneb, copper bordeaux, captan	None
7. Early Blight	Fungus	Airborne spores	High humidity and air temperature of 75° F.; poor fertility and overcrowding	Improved air circulation; removal of diseased foliage	Copper bordeaux, captan	Florida MH-1, Supermarket
8. Fruit rots	Fungus	Soil and nearby infected plants	Persistent rainy periods	Removal of diseased fruit; mulching, caging	Maneb, zineb	None
9. Blossom end rot	None	Nonpathogenic (related to available calcium and moisture in soil)	Lack of available calcium in soil; very wet or very dry soils	Lime or gypsum before planting; calcium nitrate form of nitrogen; use of mulch to maintain uniform moisture supply	Calcium chloride 96% (2 oz. by wt. per 3 gal.)	None
10. Septoria	Fungus	Airborne	Prolonged periods of high humidity	Maintain adequate fertility level	Maneb + benomyl	None

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