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Fruit and Nut Crops - Apple

Integrated Apple Disease Management

Many diseases commonly occur on apple, which can reduce flowering and the quality of the fruit in Louisiana. Disease management depends largely on the care and attention that trees are given throughout their lifetime. Achieving "store quality" apples in Louisiana is very difficult due to year-round hot and humid conditions, and they usually require an intensive fungicide and insecticide spray program. Planting resistant varieties is one of the best ways to reduce many of these disease problems. For many apple diseases, good sanitation practices are also essential for disease management.

***Plant resistant cultivars*:** Apple scab is the most widespread and destructive disease of apples in North America. Selecting cultivars that are resistant or tolerant to apple scab is recommended, especially in southern Louisiana where warm and humid conditions favor disease development. Fire blight is also a major apple disease, and thus planting varieties with resistance is strongly recommended.

Use good sanitation practices: Certain leaf diseases and fruit rots overwinter on leaves and fruit. Raking and burning leaves will help reduce the severity of apple scab the following year. Prune dead and broken limbs from trees infected with fire blight to prevent the spread of the bacterium in the early spring. Removing dead or rotting fruit from the trees and ground will slow bitter rot development the following season.

Ensure good spray coverage: Good spray coverage is essential for good disease control and, to a lesser extent, for insect control. A large air blast sprayer (speed sprayer) has proven very satisfactory for treating large acreages of apple trees.

Use registered chemicals: The potential for developing isolates of pathogens resistant to fungicides is high in apple production. To slow the development of resistant pathogen populations: 1) develop a spray program that uses fungicides with different modes of action; 2) avoid consecutive sprays with fungicides with the same or similar modes of action; and 3) only use the labeled rates of recommended fungicides. More information of fungicide-resistance management can be found in the front of this guide.

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Table 1. Symptoms, source of inoculum and management apples diseases.

Disease	
Apple scab (*Venturia inaequalis*)	**Symptoms:** Scab may occur on leaves, fruit, leaf and fruit stems and green twigs. Infections of the leaves and fruit are most common and obvious. Leaf spots are diffuse, brown-to-olive green in color and often have a velvety texture. Fruit lesions are dark brown and corky-like. **Source of Inoculum:** Infected leaves that have fallen to the ground. Spores are wind dispersed. **Management:** The use of resistant varieties is the most effective means for avoiding apple scab disease. Pruning to establish an open canopy will allow air to move through the tree and dry leaves quickly. Rake and burn fallen leaves. Perfect sanitation can control the disease. Follow the apple spray schedule.
Bitter rot (*Glomerella cingulata = Colletotrichum gloeosporioides*)	**Symptoms:** Although infection can occur at any stage of fruit development, most infection occurs after midseason as the fruit approaches maturity. The disease is characterized by sunken and (more or less) soft and watery, pinkish to brown rotten spots on the fruit. The rotten tissue has a bitter taste. **Source of Inoculum:** The fungus survives from season to season in mummified fruit and in dead wood and cankers. Fungal spores are dispersed primarily in splashing water, and disease develops best under warm, moist conditions. **Management:** Remove mummified fruit and dead wood. Follow the apple spray schedule; late cover sprays are important.
Cedar apple rust (*Gymnosporangium juniperi-virginianae*)	**Symptoms:** Galls or "cedar apples" are produced on eastern red cedar and yellow-orange spots are produced on the leaves and fruit of apples and crabapples. **Source of Inoculum:** The cedar apple rust fungus survives from season to season on the familiar "cedar apples" on eastern red cedar. Windborne spores are produced during periods of rain in the spring. **Management:** Rust can be avoided by eradicating cedar trees within two miles of apples. Follow the apple spray schedule.
Fire blight (*Erwinia amylovora*)	**Symptoms:** Affects blossoms, leaves, twigs and young fruit. Infected blossoms wilt suddenly and turn dark brown, followed by blighting of leaves and terminals. Infected twigs and leaves turn dark brown to black, and leaves cling to the stem, often remaining attached most of the season. **Source of Inoculum:** The bacteria overwinter at the base of blighted twigs or in cankers on larger limbs. Bacteria are spread by bees and splashing rains. **Management:** Spray during bloom with copper fungicides or streptomycin according to manufacturer's directions. Prune out and burn infected twigs. Cut 12-15 inches below affected tissue. Dip pruning tools in 10 percent chlorine bleach solution between cuts.
Powdery mildew (*Podosphaera leucotricha*)	**Symptoms:** Affects young green tissues and young blossoms. Yellowing of the upper side of young leaves. Infected leaves may crinkle, curl or roll upwards. Premature dropping of severely infected leaves. White fungal growth on leaves, petioles and shoots is a sign of the powdery mildew pathogen. **Source of Inoculum:** Developing buds become infected and overwinter as fungal strands. Disease is apparent on leaves and flower buds as they emerge in the spring. **Management:** The use of resistant varieties is the most effective means for avoiding powdery mildew disease. A strict fungicide spray program is required when susceptible varieties are planted.
Phytophthora crown, collar and root rot (*Phytophthora* spp.)	**Symptoms:** Foliar symptoms include thinning of the canopy, poor shoot growth and gradual decline. Removal of the outer bark reveals a reddish-brown to brown decay of the phloem and cambium with distinct margins between diseased and healthy tissue. **Source of Inoculum:** These pathogens are soil-borne organisms. **Management:** Use a combination of practices, including proper site selection, improving drainage and managing soil water, using resistant rootstocks and preventative applications of selected fungicides.

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Table 2. List of disease-resistant apple cultivars
Abbreviations for resistant categories: R = resistant; MR = moderately resistant; MS = moderately susceptible; S = susceptible.
Additional cultivars are listed at www.extension.purdue.edu/extmedia/BP/BP-132-W.pdf.

	Disease			
Cultivar	**Scab**	**Fire blight**	**Cedar apple rust**	**Powdery mildew**
Baldwin	S	S	R	S
Cortland	S	S	S	S
Liberty	R	R	R	R
Pixie Crunch	R	MS	S	-
Fuji	S	S	R	R
Gala	S	S	R	MS
Granny Smith	S	S	R	S
Honey Crisp	MR	R	S	S
Crimson Crisp	R	R	S	MR
Freedom	R	MR	R	R
Crimson Topaz	R	MR	-	MR
Florina	R	MR	S	MR
Enterprise	R	R	R	MR
Goldrush	R	MR	S	MR

Table 3. Seasonal fungicide spray schedule for apples

Developmental Stage	**Disease(s)**
Delayed dormant to ½-inch green tip	Scab
Green tip, white bud	Scab
Tight cluster, pre-pink	Scab
Pink bud	Scab, powdery mildew, fire blight and cedar apple rust
Bloom	Fire blight, scab, powdery mildew and cedar apple rust
Petal fall	Fire blight, scab, powdery mildew and cedar apple rust
First cover spray	Scab, powdery mildew, cedar apple rust and fruit rots
Second cover spray	Scab and fruit rots
Third through seventh cover sprays	Scab, fruit rots, sooty blotch and fly speck

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Table 4. Fungicide efficacy for apple scab and powdery mildew diseases
Symbols for fungicide efficacy categories: ++++ = Excellent and Consistent; +++ = Good and Reliable; ++ = Moderate and Variable; + = Limited and/or Erratic; +/- = Minimal and often ineffective - = Ineffective.
Table was reproduced from 2013 University of California Pest Management Guidelines (http://www.ipm.ucdavis.edu/PMG/r4902111.html).

Fungicide (Product mode of action)	Scab Protectant	Scab Eradicant	Powdery mildew
Inspire Super (3, 9)	++++	++++	++++
Flint (11)	++++	++++	++++
Fontelis (7)	++++	++	+++
Pristine (7, 11)	++++	-	+++
Procure (3)	++++	++++	++++
Scala (9)	+++	+++	+
Sovran (11)	+++	+++	+++
Syllit (M)	+++	+++	-
Tebuzol (3)	+++	+++	+++
Topsin M or T-methyl or Incognito (1)	+++	+++	+++
Vangard (9)	+++	+++	+++
PH-D (19)	+	+	+++
Captan (M)	+++	-	-
Dithane or Manzate or Penncozeb (M)	+++	-	-
Ziram (M)	++	-	-
Copper* (M)	++	-	-
Lime sulfur (M)	-	++++	+++
Sulfur* (M)	++	-	++++

*Copper and sulfur can cause fruit scarring.

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Table 5. Recommended pesticides, rates and pesticide use restrictions for apple
The symbol [OG] *indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.*

Disease (Pathogen)	Product Choices and Product Mode of Action Group		Rate	PHI	Maximum Use
Apple scab (*Venturia inaequalis*)	Copper hydroxide (various products)	M	See labels	1-2	See labels
	Copper sulfate				
	MasterCop[1]	M	See label	See label	See label
	Double Nickel 55[OG]		0.25-3 lb	0	
	Fontelis	29	16-20 fl oz	28	61 fl oz
	Indar2F	3	6-8 fl oz	14	32 fl oz
	Omega 500F	7	10-13.8 fl oz	28	8.625 pt
	PH-D (suppression only)	19	6.2 oz	0	6 app
	Pristine	7, 11	14.5-18.5 oz	0	74 oz
	Rally 40WSP	3	5-8 oz	14	5 lb
	Rally 40WSP (post-infection)	3	8 oz	14	5 lb
	Scala (applied alone)	9	7-10 fl oz	72	40 fl oz
	Scala (tank mixed)	9	5 fl oz	72	40 fl oz
	Sovran	11	3.2-6.4 oz	30	25.6 oz
	Serenade[OG]	44	2-6 qt	0	
	Serenade MAX[OG]	44	1-3 lb	0	
	Sulfur (various products)	M	See labels	1	See labels
	Thiophanate-methyl				
	85WDG	1	0.6-0.8 lb	3	3.3 lb
	Topsin 4.5FL	1	15-20 fl oz	1	80 fl oz
	Topsin M WSB	1	0.75-1 lb	1	4 lb
	T-Methyl 4.5F	1	15-20 oz	1	4 lb
	T-Methyl 70WSB	1	1 lb	1	4 lb
	Incognito 4.5F	1	15-20 fl oz	1	80 fl oz
	Cercobin	1	16-21.8 fl oz	1	87.2 fl oz
	Topguard Specialty Crops	3	13 fl oz	14	52 fl oz
	Vacciplant[3]		14 fl oz	See label	See label
	Vintage		6-12 fl oz	30	48 fl oz
	Ziram 76DF	M	6-8 lb	14	56 lb
Bitter rot (*Glomerella cingulata* = *Colletotrichum gloeosporioides*)	Adament 50WG	3, 11	4-6 oz	75	22 oz
	Captan (various products)	M	See labels	0	See labels
	Copper hydroxide (various products)	M	See labels	1-2	See labels
	Double Nickel 55[OG]		0.25-3 lb	0	
	Flint 50WP	11	2-2.5 oz	14	11 oz
	Merivon	7, 11	4-5.5 fl oz	0	22 fl oz
	Omega 500F	29	13.8 fl oz	28	8.625 pt
	Pristine	7, 11	14.5-18.5 oz	0	74 oz
	Scholar SC (post harvest drench)	12	10-16 fl oz/100 gal	0	1 app
	Serenade[OG]	44	2-6 qt	0	
	Serenade MAX[OG]	44	1-3 lb	0	
	Thiophanate-methyl 85WDG	1	0.6-0.8 lb	3	3.3 lb
	Ziram	M	6-8 lb	14	56 lb
Cedar apple rust (*Gymnosporangium juniperi-virginianae*)	Adament 50WG	3, 11	4-6 oz	75	22 oz
	Double Nickel 55[OG]		0.25-3 lb	0	
	Flint	11	2-2.5 oz	14	11 oz
	Fontelis	7	16-20 fl oz	28	61 fl oz
	Indar 2F	3	6-8 fl oz	14	32 fl oz
	Inspire Super	9, 3	8.5-12 fl oz	14	60 fl oz
	Mancozeb (various products)	M	See labels	See labels	See labels
	Merivon	7, 11	4-5.5 fl oz	0	22 fl oz
	Omega 500F	29	13.8 fl oz	28	8.625 pt
	Pristine	7, 11	14.5-18.5 oz	0	74 oz
	Procure 480SC	3	8-16 fl oz	14	64 fl oz
	Propiconazole				

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Disease (Pathogen)	Product Choices and Product Mode of Action Group		Rate	PHI	Maximum Use
	Inspire Super MP	3	4 fl oz	72	20 fl oz
	Propicon 3.6EC[2]	3	4 fl oz	See label	20 fl oz
	Topaz[2]	3	4 fl oz	See label	20 fl oz
	Rally 40WSP	3	5-8 oz	14	5 lb
	Serenade[OG]	44	2-6 qt	0	
	Serenade MAX[OG]	44	1-3 lb	0	
	Sovran	11	3.2-6.4 oz	30	25.6 oz
	Topguard Specialty Crops	3	8-12 fl oz	14	56 fl oz
	Vintage	3	9-12 fl oz	30	48 fl oz
	Ziram	M	6-8 lb	14	56 lb
Fire blight (*Erwinia amylovora*)	Agri-mycin 17	25	24-48 oz	50	See label
	Aliette WDG	33	2-5 lb	14	20 lb
	Copper hydroxide (various products)	M	See labels	1-2	See labels
	Copper sulfate				
	Copper sulfate crystals	M	5 lb	See label	See label
	Cuprofix Ultra 40	M	5-7.5 lb	See label	40 lb
	MasterCop[1]	M	See label	See label	See label
	Double Nickel 55[OG]		0.25-3 lb	0	
	Mancozeb (various products)	M	See labels	See labels	See labels
	Mankocide	M	8-16 lb	77	See label
	Nordox	M	1-16 lb	1	See label
	Phosphorous acid				
	Alude	33	1-2 qt	0	
	Confine Extra	33	1-3 qt/100 gal		
	K-Phite 7LP	33	2-8 qt/20 gal		
	Phostrol	33	2.5-5 pt		
	Potassium phosphite				
	Fosphite	33	1-3 qt	0	
	Fungi-phite	33	2-4 pt	0	
	Rampart	33	1-3 qt/100 gal		
	Serenade[OG]	44	2-6 qt	0	
	Serenade MAX[OG]	44	2-3 lb	0	
	Vacciplant[3]		14 fl oz	See label	See label
Phytophthora crown, collar and root rot (*Phytophthora* spp.)	Aliette WDG (root dip)	33	3 lb/100 gal	0	1 app
	Aliette WDG (foliar)	33	2.5-5.0 lb	14	20 lb
	MasterCop[1]	M	1.5 pt	0	1 app
	Mefenoxam				
	Ridomil Gold	4	2 qt		2 app (fall &spring)
	Metalaxyl				
	Metastar 2E	4	2 gal		2 app (fall & spring)
	Metalaxyl 2E AG	4	2 gal		2 app (fall & spring)
	Ultra Flourish	4	8 pt	See label	1 app
	Phosphorous acid				
	Alude	33	0.67 fl oz/gal		
	Confine Extra (root dip)	33	0.67 fl oz/gal		
	K-Phite 7LP (root dip)	33	2.5-5 pt		1 app
	Phostrol				1 app
	Potassium phosphite	33	2 qt/100 gal		
	Rampart (root dip)	33	1-3 qt/100 gal		
	Rampart (foliar)	33			1 app

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Disease (Pathogen)	Product Choices and Product Mode of Action Group		Rate	PHI	Maximum Use
Powdery mildew (*Podosphaera leucotricha*)	Double Nickel 55[OG]		0.25-3 lb	0	
	Fontelis	7	16-20 fl oz	28	61 fl oz
	Indar 2F	3	6-8 fl oz	14	32 fl oz
	PH-D	19	6.2 oz	0	6 app
	Rally 40WSP	3	5-10 oz	14	5 lb
	Serenade[OG]	44	2-6 qt	0	
	Serenade MAX[OG]	44	1-3 lb	0	
	Sulfur (various products)	M	See labels	1	See labels
	Thiophanate-methyl				
	85WDG	1	0.6-0.8 lb	3	3.3 lb
	Topsin 4.5FL	1	15-20 fl oz	1	80 fl oz
	Topsin M WSB	1	0.75-1 lb	1	4 lb
	T-Methyl 4.5Ag	1	15-20 oz	1	4 lb
	T-Methyl 70WSB	1	1 lb	1	4 lb
	Incognito 4.5F	1	15-20 fl oz	1	80 fl oz
	Cercobin	1	16-21.8 fl oz	1	87.2 fl oz
	Topguard Specialty Crops	3	8-12 fl oz	14	56 fl oz
	Propiconazole				
	Inspire Super MP	3	4 fl oz	72	20 fl oz
	Propicon 3.6EC[2]	3	4 fl oz	See label	20 fl oz
	Topaz[2]	3	4 fl oz	See label	20 fl oz
	Vintage	3	6-9 fl oz	30	48 fl oz

[1]Rates vary depending on the time of application (i.e., fall, late dormant, growing season, etc.).
[2]Registered for nonbearing fruits and nuts only.
[3]Apply with another registered bactericide or fungicide.

Information in this section was last updated in December 2019 by Dr. R. Singh.