Use of Fungicides on Fruit Crops in Greenhouses and Tunnels

Annemiek Schilder

Most nurseries in Michigan produce fruit propagation material in greenhouses at some stage in the production cycle. Growers may also produce their own planting stock in a greenhouse or tunnel. In addition, the acreage of commercial fruit production under high tunnels is increasing. Tunnels allow extension of the growing season and production of high-quality fruit by protecting crops from rain.

Many diseases, particularly those that need rain or dew for infection, are absent or considerably reduced under covered production. However, powdery mildew may be favored by the higher temperatures and a lack of rain. Plants in propagation beds may suffer from soil-borne pathogens such as *Rhizoctonia, Cylindrocladium* and *Pythium*, which are favored by the continuous availability of moisture. Furthermore, the year-round presence of green leaf tissue in greenhouses may enhance survival and reproduction of rusts and other fungi.

Because of the risk of spreading diseases from nurseries to production fields, disease control is imperative to keep planting stock healthy. Disease control may also be needed to control diseases that are favored by the growing conditions in tunnels. The first step should be to use cultural methods and sanitation to reduce disease pressure. For example:

- Avoid overwatering and adjust watering schedules and misting regimes to allow the plants to dry out.
- Open vents to reduce relative humidity.
- Reduce plant density.
- Sanitize pots and benches to reduce carry-over of pathogen inoculum.
- Sterilize/pasteurize growth media.
- Have a plant-free period to break pathogen life cycles.

At times, fungicides will be needed, either on a preventive basis or for corrective action. It is important to obtain a correct disease diagnosis before applying fungicides and to verify that the fungicide in question is effective against the disease you are trying to control. As in field situations, it is important to alternate chemistries to reduce the risk of fungicide resistance buildup. This is especially important when numerous sprays are applied per year because of the extended growing season. Biological control agents may be good options as rotation partners and tend to work better under covered conditions than in the field. It is important to note that the Environmental Protection Agency has changed its approach to the use of pesticides in greenhouses. The current interpretation of the rules is that **the fungicide has to be labeled for the crop in question and should not be prohibited from use in the greenhouse**.

As an example, the fungicide Switch can be used on blueberry plants in the greenhouse because blueberries are on the label and there are no restrictions for greenhouse use. The fungicide Pristine, however, is prohibited from greenhouse use even though it is labeled for blueberries because the label says, "*Pristine is not for use in greenhouse or transplant production*." This last statement also applies to transplants grown outdoors. Some fungicides are prohibited from nursery use due to fungicide resistance concerns. Be sure to read the fungicide label before use because the label is the law.

Days Between Final Spray and Harvest

Listed below are some of the commonly used pesticides and the intervals from last application to harvest for each crop. See spray schedules for recommended materials. Consult product label. In some cases, the re-entry interval is longer than the pre-harvest interval. See later in this section or the label for re-entry intervals.

FUNGICIDES/BACTERICIDES

Chemical	Apples	Pears	Peaches	Plums & prunes	Cherries	Grapes	Straw-berries	Cane-berries	Blue-berries
Abound			0	0	0	14	0	0	0
Actinovate	0	0	0	0	0	0	0	0	0
Actigard							0		
Aftershock							2		
Agri-Fos	0	0	0	0	0	0	0	0	0
Agri-Mycin	50	30							
AgriStar Sonoma	14		1	1	1	14			
AgriStar TebuStar			0		0	14			
Aliette	14[n]	14[n]	365[m]	365[m]	365[m]	15	0	60	0
Armicarb	0	0	0	0	0	0	0	0	0
Azaka				0	0	14	0	0	0
Bayleton	45	45				14			
Biophos Pro	0	0	0	0	0	0	0		0
Bio-Tam	0	0	0	0	0	0	0	0	0
Blightban	0	0	0		0	0	0		0
Bloomtime Biological	[a]	[a]							
Blossom Protect	[a]	[a]							
Botector	0	0	0	0	0	0	0		
Bravo			[d]	[d]	[d]				42[f]
Bumper		0	0	0	0		0	30	30
Cabrio					0		0	0	
Cannonball									0
Captan	0[c]	[c]	0[c]	0	0[c]	0	0	3	0
CaptEvate					0		0	3	0
Cease							0		
Cevya	0	0	0	0	0				
Chloronil			[d]	[d]	[d]				42
Chlorothalonil			[d]	[d]	[d]				42
Confine Extra	0	0	0	0	0	0	0	0	0
Copper (copper-lime mixtures)	[b]	[b]	[b]	[b]	[b]	[b]	[b]	[b]	[b]
Double Nickel 55	0	0	0	0	0	0	0	0	0
EBDCs (mancozeb)	77	77				66			
Echo			[d]	[d]	[d]				42
Elevate		0	0	0	0	0	0	0	0
Endura						14			
Equus			0[d]	0[d]	0[d]				42
Evito							2		
Excalia	r								
Ferbam	7	7	21		0	7			
Fitness			0	0	0			30	30
Flint Extra	14	14	1	1	1				
Fontelis	28	28	0	0	0		0		

See **Legend** later in this section.

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Days Between Final Spray and Harvest (continued)

FUNGICIDES/BACTERICIDES

Chemical	Apples	Pears	Peaches	Plums & Prunes	Cherries	Grapes	Straw-berries	Cane-berries	Blue-berries
Forum						28			
Fosphite	0	0	0	0	0	0	0	0	0
Fracture						1	1		
FungaStop	0	0	0	0	0	0	0	0	0
Fungi-Phite	0	0	0	0	0	0	0	0	0
Gavel						66			
Gatten									
Gem			1	1	1				
Indar	14		0	0	0				30
Inspire Super	14	14	2	2	2 [q]	14	0		
Iprodione			[f]	[f]	[f]	7	[g]	0	0
JMS Stylet Oil	0	0	0	0	0	0 [j]	0	0	0
Kaligreen	1	1	1	1	1	1	1	1	1
Legion	14 [n]	14 [n]	365 [m]	365 [m]	365 [m]	15	0	60	0
Lifegard WG						0			
Lime Sulfur	[b]	[b]	[b]	[b]	[b]	[b]		[b]	[b]
Luna Experience						14 [s]			
Luna Sensation	14		1	1	1				
Luna Tranquility	72					7			
Merivon	0	0	0	0	0		0		
MetaStar	[n]	[m]	[n]	[n]	[n]		0 [e,k]	45	0 [k]
Meteor			[r]	[r]	[r]	7	[g]	0	
Mettle						14	0		
MilStop	0	0	0	0	0	0	0	0	0
Miravis	30	30	0	0	0				
Miravis Prime						14	14	14	14
Mycoshield		60	21						
Nutrol	0		0	0	0	0			
Omega									30
Oso	0	0	0	0	0				
Ph-D	0	0				0	0		
Phostrol	0	0	0	0	0	0	0	0	0
Presidio						21			
Prev-Am	0	0	0	0	0	0	0	0	0
Pristine	0	0	0	0	0	14	0	0	0
Procure	14	14			1	7	1		
Proline									7
Prophyt	0	0				0	0	0	0
PropiMax			0	0	21		30	30	30
Protocol			1	1	1		1		
Purespray Green	0	0	0	0	0	0	0	0	0
Quadris Top						14	0		
Quash			14	14	14				7
Quilt Xcel			0	0	0	30	0	30	30
Quintec					7	14	1		
Rally	14		1	1	1	14	1	1	

See **Legend** later in this section.

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Days Between Final Spray and Harvest (continued)

FUNGICIDES/BACTERICIDES

Chemical	Apples	Pears	Peaches	Plums & Prunes	Cherries	Grapes	Straw-berries	Cane-berries	Blue-berries
Rampart	0	0	0	0	0	0	0	0	0
Ranman						30			
Reason						30			
Regalia	0	0	0	0	0	0	0	0	0
Revus						14			
Revus Top						14			
Ridomil Gold MZ/Cu						66/42			
Ridomil Gold SL	n	m	n	n	n	60	0[e,k]	45	0[k]
Ridomil Gold GR	m	m	m	m	m			45	
Rovral			f	f	r	7	g	0	
Scala	72	72	2	2		7	2		
Serenade	0	0	0	0	0	0	0	0	0
Serifel Biofungicide									
Sil-Matrix	0	0	0	0	0	0	0	0	0
Sonata	0	0	0	0	0	0	0	0	0
Sovran	30	30				14			
Stargus						0	0	0	0
Sulforix	b	b	b	b	b	b		b	b
Sulfur	b	b	b	b	b	b	b	b	b
Switch						7	0	0	0
Syllit	t	7	r		7		14		
Tanos						30		0	
Tavano						0	0		
Tebuconazole			0	0	0	14			
Tenet	0	0	0	0	0	0	0	0	0
Thiophanate-methyl		1	1	1	1	14	1		
Thiram			7				3[a]		
Tilt			0	0	0		0	30	30
Topaz			0	0	0		0	30	30
Topguard	14		7	7	7				
Topsin M	1	1[o]	1	1	1	14	1		
Torino						3	0		
Trilogy	0	0	0	0	0	0	0	0	0
TriTek	0	0	0	0	0	0	0	0	0
Unicorn	75	75	0	0	0	14			
Vacciplant	0	0	0			0	0	0	0
Vangard	72	72	h	h	(tart)[hq]	7			
Viticure						7			
Vivando						14			
Zampro						28			
Ziram	14	14	14		14	21			30[p]

Legend:

[a] = No residue if used according to recommendations.
[b] = Sulfurs and copper plus lime mixtures are exempt if used as recommended, however, the REI is 12-24 hr for sulfur, 24 hr for copper, and 48 hr for lime sulfur.
[c] = May be used as postharvest treatment—See label.
[d] = Do not apply after shuck split and before harvest.
[e] = Foliar application allowed on strawberry.
[f] = Do not apply after full bloom.
[g] = Do not apply after first fruiting flower.
[h] = Do not apply past bloom.
[i] = Do not apply later than 3 weeks past full bloom.
[j] = Do not apply later than 14 days to harvest on table grapes.
[k] = REI is 48 hr.
[m] = Nonbearing only. Follow application instructions.
[n] = Bearing and nonbearing. Follow application instructions.
[o] = REI is 72 hr.
[p] = According to Special Local Need label.
[q] = Do not apply to sweet cherries.

Days Between Final Spray and Harvest (continued)

INSECTICIDES/MITICIDES

Chemical	Apples	Pears	Peaches	Plums & Prunes	Cherries	Grapes	Straw-berries	Cane-berries	Blue-berries
Acramite	7	7	3	3	3	14	1	1	
Actara	14[k]	14[k]	14	14	14	5	3	3	3
Admire Pro	7 (21[m])	7 (21[m])	0 (21[m])	0 (21[m])	7 (21[m])	0 (30[m])	7 (14[m])	3 (7[m])	3 (7[m])
Agri-Flex	35	35				28			
Agri-Mek	28	28	21	21	21	28	3		
Apollo	45		21	21	21				
Apta	14	14	14	14	14			1	3
Asana	21	28	14	14	14			7	14
Assail	7	7	7	7	7	7	1	1	1
Altacor eVo	14	14	10	10	10	14	1	3	1
Avaunt eVo	14	28	14	14	14	7			7
Aza-Direct	0	0	0	0	0	0	0	0	0
Banter	7	7	3	3	3	14	1	1	
Battalion	21	21							
Baythroid	7	7	7	7	7	3			
BeetleGONE	0	0	0	0	0	0	0	0	0
Belay	7	7	21			0 (30[m])			
Beleaf	21	21	14	14	14				
Besiege	21	21	14	14	14				
Bifenture		14				30	0	3	1
Biobit	0	0	0	0	0	0	0	0	0
BoteGHA	0	0	0	0	0	0	0	0	0
Brigade	14	14	14			30	0	3	1
Brigadier						30			
Capture		14				30		3	
Centaur	14	14	14	14	14				
Transform	7	7	7	7	7	7	1		
Confirm	14	14						14	14
Cormoran	14	12	8	8	8				8
Crymax	0	0	0	0	0	0	0	0	0
Cyd-X	4[h]	4[h]		4[h]					
Danitol	14	14	3	3	3	21	2	3	3
Delegate	7	7	7	7	7	7		1	1
Diazinon	21	21	21	21	21		5		7
Dimilin		14	[a]	[a]					
Dipel	0	0	0	0	0	0	0	0	0
Ecozin	0	0				0	0	0	0
Endigo	35	35	14	14	14				
Entrust	7	7	14	7	7	7	1	1	1
Envidor	7	7	7	7	7	14			
Esteem	45	45	14	14	14			7	7

Legend:

[a] = Do not apply after petal fall.
[b] = See label restrictions on use.
[c] = No residue if used according to recommendations.
[d] = 21 days if only 2 sprays are applied.
[e] = Lannate PHI is 1 day for fresh grapes.
[h] = 10-day PHI for processed strawberries.
[i] = Prebloom only.
[k] = 35-day PHI if use rates exceed 2.75 oz/A.
[L] = for rates below 1 1/3 lb/acre the PHI = 7d.
[m] = soil applied uses in ( ).

Days Between Final Spray and Harvest (continued)

INSECTICIDES/MITICIDES

Chemical	Apples	Pears	Peaches	Plums & Prunes	Cherries	Grapes	Straw-berries	Cane-berries	Blue-berries
Evergreen	12 hrs	12 hrs	12 hrs	12 hrs	12 hrs	12 hrs	12 hrs	12 hrs	12 hrs
Exirel	3	3	3	3	3				3
Gargoil	0	0	0	0	0	0	0	0	0
Gladiator	28	28				28			
Grandevo	0	0	0	0	0	0	0	0	0
Imidan	7[b]	7[b]	14[b]	7	7	14[L]			3
Intrepid	14	14	7	7	7	30			7
Intrepid Edge						30			
Hero						30		3	1
Javelin	0	0	0	0	0	0	0	0	0
Kanemite	14	14			7	7	1	1	1
Kelthane	7	7				7	2		
Lannate	14[b]		4				3h		3
Leverage 360	7	7	7	7	7	3			
Magister	7	7	3	3	3	7	1		7
Malathion	3	1	7	3	3	3	3	1	0 - 1[b]
Methoxychlor	7	7	21	7	7	14		3	14
Minecto Pro	28	28	21	21	21				
Mitac		7							
Movento 2SC	7	7	7	7	7	7			
Mustang Maxx	14	14	14	14	14	1		1	1
Nealta	7	7	7	7	7	14			
Neemix	0	0				0	0	0	0
Nexter	25	7	7	7	300	7			
Oberon							3		
Onegar	28	28	7	7	7	7	3	3	
Platinum						60	50		75
Portal	14	14	7	7	7	14	1	1	1
Pounce	[a]	[b]	14		3				
Proclaim	14	14			7				
PQZ	14	14	7	7	7	3			
Pyganic	12 hrs	12 hrs	12 hrs	12 hrs	12 hrs	12 hrs	12 hrs	12 hrs	12 hrs
Radiant							1		
Rimon	14	14	8	8	8		1		8
Scorpion			3			1 (28[m])			
Seduce	7	7	1	7	7	7	1	1	3
Senstar	45	45	14	14	14	21			7
Sevin	3	3	3	3	3	7	7	7	7
Shenzi	14	14	10	10	10	14	1	3	1
Sivanto HL	14 (30[m])	14 (30[m])	14 (30[m]) 1	4 (30[m])	14 (30[m])	0 (30[m])	0 (1[m])	0	3 (30[m])
Sivanto Prime	14	14				0			3
Sluggo	0	0	0	0	0	0	0	0	0
Spear T	0	0	0	0	0	0	0	0	0

Legend:

[a] = Do not apply after petal fall.
[b] = See label restrictions on use.
[c] = No residue if used according to recommendations.
[d] = 21 days if only 2 sprays are applied.
[e] = Lannate PHI is 1 day for fresh grapes.
[h] = 10-day PHI for processed strawberries.
[i] = Prebloom only.
[k] = 35-day PHI if use rates exceed 2.75 oz/A.
[L] = for rates below 1 1/3 lb/acre the PHI = 7d.
[m] = soil applied uses in ( ).

Days Between Final Spray and Harvest (continued)

INSECTICIDES/MITICIDES

Chemical	Apples	Pears	Peaches	Plums & Prunes	Cherries	Grapes	Straw-berries	Cane-berries	Blue-berries
Spear-Lep	0	0	0	0	0	0	0	0	0
Superior Oil	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
Surround	0	0			0	0			0
Sil-Matrix	0	0	0	0	0	0	0	0	0
Vendex	14[b]	14[b]	14	14	14	28	1		
Venerate	0	0	0	0	0	0	0	0	0
Venom			3			1 (28[m])			
Verdepryn	7	7	7	7	7	7	1	1	1
Sefina	7	7	7	7	7				
Virosoft	4[h]	4[h]		4[h]					
Voliam flexi	35	35	14	14	14	14			
Vydate L	14	14							
Warrior	21	21	14	14	14				
Zeal	14	14	7	7	7	14	1		

Legend:

[a] = Do not apply after petal fall.
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