

Project Name: Leaf Spots & Anthracnose Efficacy

New	Ongoing	Completed	X	Duration if ongoing or completed:	1982-1988, 2014-2019
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Project Description:

Leaf spots and anthracnose diseases have routinely surfaced in the biennial survey of grower needs. While numerous classes and subclasses for fungal mode of action are currently available, growers continue to have difficulty managing these diseases.

Research Project Abstract (if available):

Abstract from 2016 Leaf Spots & Anthracnose Efficacy

At the IR-4 Ornamental Horticulture Program Workshop in 2013, leaf spots and anthracnose efficacy was selected as a high priority project to expand the knowledge and list of fungicides available to growers for these diseases. In addition to research collected through the IR-4 program, this summary includes a review of experiments conducted from 1987 to 2019 on environmental horticulture crops. Species tested included: *Alternaria alternata*, *Apiognomonia quercina*, *Cephaleuros virescens*, *Cercospora cornicola*, *Cercospora lythracearum*, *Colletotrichum navitas*, *Colletotrichum sp.*, *Corynespora cassiicola*, *Diplocarpon rosae*, *Discula destructiva*, *Drechslera setariae*, *Elsinoe corni*, *Entomosporium mespilii*, *Marssonina populi*, *Myrothecium roridum*, *Phaeocryptopus gaeumannii* and *Septoria sp.* During this time period, numerous products representing 45 active ingredients were tested as foliar applications against these species causing various leaf spots and anthracnose. Most products are registered and commercially used. Although there were insufficient data for definitive conclusions, three new products that were included, Kleengrow, Orchestra, and Mural, looked promising. Compass, Pageant and Palladium provided variable efficacy depending on species. F9110, Proud 3, MBI-110, Milsana, Disarm, SP2770, SP2773 and ZeroTol were generally ineffective. Limited data on other relatively new products (NUP 09092, S2200, Tourney and Trinity) were inconclusive. The established standards Daconil and Eagle generally provided excellent efficacy; Chipco 26019 provided good efficacy, and Medallion provided variable efficacy depending on species. The data from these trials suggest that the effectiveness of some fungicides in controlling leaf spots and anthracnose is variable, depending on the pathogen species.

Target Species (Phytotoxicity, or common and Latin name of arthropod, pathogen, weed):

Algal Leaf Spot (<i>Cephaleuros virescens</i>)	Helminthosporium sp. (<i>Helminthosporium sp.</i>)
<i>Alternaria alternata</i> (<i>Alternaria alternata</i>)	Iris Leaf Spot (<i>Didymellina macrospora</i>)
<i>Alternaria sp.</i> (<i>Alternaria sp.</i>)	Leaf Spot, Entomosporium (<i>Diplocarpon maculatum</i>)
<i>Alternaria zinniae</i> (<i>Alternaria zinniae</i>)	Liatris Leaf Spot (<i>Septoria liatridis</i>)
Apple Scab (<i>Venturia inaequalis</i>)	Marssonina Leaf Spot (<i>Marssonina sp.</i>)
<i>Cercospora delphinii</i> (<i>Cercospora delphinii</i>)	Oak Anthracnose (<i>Apiognomonia quercina</i>)
<i>Cercospora rudbeckiae</i> (<i>Cercospora rudbeckiae</i>)	Ramularia viburni (<i>Ramularia viburni</i>)
<i>Cladosporium sp.</i> (<i>Cladosporium sp.</i>)	Rose Blackspot (<i>Diplocarpon rosae</i>)
<i>Colletotrichum acutatum</i> (<i>Colletotrichum acutatum</i>)	Swiss Needle Cast (<i>Phaeocryptopus gaeumannii</i>)
<i>Colletotrichum sp.</i> (<i>Colletotrichum sp.</i>)	
Flower Blight, Ovulinia (<i>Ovulinia azaleae</i>)	

Target Crops (list tested crops if ongoing or completed project)

Apple (<i>Malus sp.</i>)	Cottonwood (<i>Populus nigra</i>)
Azalea & Rhododendron (<i>Rhododendron sp.</i>)	Cottonwood (<i>Populus temuloides</i>)
Calathea (<i>Calathea sp.</i>)	Cottonwood (<i>Populus tremuloides</i>)
Chokeberry (<i>Photinia sp.</i>)	Dense Blazing Star (<i>Liatris spicata</i>)
Chokeberry (<i>Photinia fraseri</i>)	Dogwood, Flowering (<i>Cornus florida</i>)
Coneflower, Orange (<i>Rudbeckia fulgida var. speciosa</i>)	Fir, Douglas (<i>Pseudotsuga menziesii</i>)

Cottonwood (<i>Populus</i> sp.)	Fir, Douglas (<i>Pseudotsuga menziesii</i>) p. <i>menziesii</i>
Target Crops (continued)	
Geranium (<i>Pelargonium</i> sp.) Impatiens, New Guinea (<i>Impatiens hawkeri</i>)	Purple Coneflower (<i>Echinacea</i> sp.) E. <i>purpurea</i> Rose (<i>Rosa</i> sp.)
Iris, German (<i>Iris germanica</i>)	Snake Plant; Good Luck Plant (<i>Sansevieria</i> sp.)
Larkspur (<i>Delphinium</i> sp.) D. <i>elatum</i>	Southern Arrowwood; Arrowwood <i>Viburnum</i>
Oak (<i>Quercus</i> sp.)	(<i>Viburnum dentatum</i>)
Oak, White (<i>Quercus alba</i>)	Southern Magnolia (<i>Magnolia grandiflora</i>)
Peony (<i>Paeonia</i> sp.)	Zinna, Elegant (<i>Zinnia elegans</i>)

Target Product(s) (list tested products or numbered compounds if ongoing or completed project)	
3336 WP 70% (Pennwalt) (Thiophanate-methyl)	Mural WDG (Azoxystrobin + benzovindiflupyr)
Affirm (Polyoxin D zinc salt)	Orkestra Intrinsic (Fluxapyroxad + pyraclostrobin)
Alibi Flora SC (Azoxystrobin + difenoconazole)	Pageant Intrinsic (Boscalid + pyraclostrobin)
Badge X2 (Copper Oxochloride + Copper Hydroxide)	Palladium (Cyprodinil + fludioxonil)
Banner Heritage MAXX (Propiconazole + azoxystrobin)	Prestop (<i>Gliocladium catenulatum</i> Strain J1446)
Baycor 25W (Bitertanol)	Proud 3 (Thyme oil 5.6%)
Bayleton 25WP (Triadimefon)	Regalia MAXX (Extract of <i>Reynoutria sachalinensis</i>)
Benlate 50WP (Benomyl)	Regalia O5 (Extract of <i>Reynoutria sachalinensis</i>)
CG100 (Caprylic acid)	Regime (Banda de <i>Lupinus albus doce</i> (BLAD))
Chipco 26019 N/G 50WP (Iprodione)	S2200 4SC (Mandestrobin)
Compass (Trifloxystrobin)	SP2770 10WP (SP2770)
Compass 0 50WDG (Trifloxystrobin)	SP2773 (SP2773)
Concert II (Propiconazole + chlorothalonil)	Spirato (Fludioxonil)
Daconil 54EC (Chlorothalonil)	Stargus (<i>Bacillus amyloliquefaciens</i> strain F727)
Daconil Weather Stik (Chlorothalonil)	Strike Plus 50WDG (Triadimefon + trifloxystrobin)
Disarm 480SC (Fluoxastrobin)	Terraguard 50W (Triflumizole)
Dithane 75DF Rainshield (Mancozeb)	Tilt 3.6E (Propiconazole)
Fore 80WP (Manganese + Zinc + Ethylene bis-dithiocarbamate Ion)	Torque 3.6SC (Tebuconazole)
Funginex (Triforine 18.2) (Triforine)	Tourney 50WDG (Metconazole)
Heritage (Azoxystrobin)	Trinity 2SC (Triticonazole)
Insignia 20WDG Intrinsic Brand Fungicide (Pyraclostrobin)	V-10135 (Fenpyrazamine)
KleenGrow (Didecyl dimethyl ammonium chloride)	Vanguard 75WG (Cyprodinil)
Kocide 2000 (Dupont) (Copper Hydroxide)	ZeroTol (Hydrogen dioxide)
Medallion (Fludioxonil)	Zyban 75WP (Mancozeb + thiophanate methyl)

Product Registration and Research Status			
	Fully Screened (also includes standards)	Partially Screened through IR-4 ¹	Need Data Across Species?
Labeled Generally & Commercialized	Chipco 26019 DisArm 480SC	Insignia * Orkestra * Stargus *	Trinity
Labeled Generally But NOT Commercialized		Picatina Flora *	
Labeled for Specific Diseases & Commercialized			



Environmental Horticulture Program Research Project Sheet

<https://www.ir4project.org/ehc/ehc-registration-support-research/env-hort-extension-resources/>

Labeled for Specific Diseases but NOT Commercialized			
Not yet registered or Labeled		Proud 3 S2200	
No longer available for development		SP2770 10WP * SP2773	
* IR-4 Data contributed to registration decision – either adding pest to label or not pursuing further research 1 At least one species screened fully			

Area	Characteristic	Pro	Con
Availability & effectiveness of alternative management tools	A couple of new active ingredients are available in current and new MOA classes.	x	
	A few good products, but growers need more	x	
	Many classes are currently available for growers		x
	Difficult pathogen		x
	Several different genera cause these diseases and performance may not be similar	x	x
Damage potential of target	Leaf spot and anthracnose diseases can cause significant economic damage	x	
Performance and crop safety of proposed products (from other systems)			
Compatibility with IPM, resistance management programs			
Economics			
Geographic distribution			
Manufacturer interest in labeling products			
Other	Lack of potential researchers for certain diseases		x

IR-4 Efficacy Trials to Date
<p>Average rating on a scale of 1 – 5 with 1 = 0 to about 50% efficacy (not effective) and 5 = 95 to 100 efficacy (very effective); minimum to maximum rating; number of trials (See table on next page). For product/insect combinations that are blank, IR-4 has not screened this combination.</p> <p>‘Labeled’ indicates that this disease species or genera is listed on the label. A rating of 2 or lower is considered unacceptable efficacy (<i>red text</i>). A rating of 3 or higher is considered commercially acceptable (black text). Non-labeled, completed product/disease combinations (3 or more trials) with an average rating of 3 or higher are highlighted with green text. For disease/product combinations that are blank, IR-4 has not screened this combination.</p>

MOA	Product (Active Ingredients)	<i>Alternaria alternata</i>	<i>Apiognomonia quercina</i>	<i>Colletotrichum acutatum</i>	<i>Colletotrichum sp.</i>	<i>Diplocarpon (Entomosporium) mespili</i>	<i>Diplocarpon rosae</i>	<i>Helminthosporium sp.</i>
FRAC 1	3336 WP 70% (Pennwalt) (Thiophanate-methyl)							
FRAC 1	Benlate 50WP (Benomyl)				3.0 (3 - 3) n2			
FRAC 11	Compass (Trifloxystrobin)				<i>2.0 (2 - 2) n1 Labeled</i>			
FRAC 11	Compass 0 50WDG (Trifloxystrobin)							
FRAC 11	Disarm 480SC (Fluoxastrobin)	5.0 (5 - 5) n1 Labeled			<i>2.0 (2 - 2) n1 Labeled</i>			
FRAC 11	Heritage (Azoxystrobin)							
FRAC 11	Insignia 20WDG Intrinsic Brand Fungicide (Pyraclostrobin)						5.0 (5 - 5) n1 Labeled	
FRAC 11	S2200 4SC (Mandestrobin)			5.0 (5 - 5) n1	<i>2.0 (2 - 2) n1</i>			<i>1.0 (1 - 1) n1</i>
FRAC 11 + FRAC 7	Mural WDG (Azoxystrobin + benzovindiflupyr)							3.0 (3 - 3) n1 Labeled
FRAC 12	Medallion (Fludioxonil)				<i>1.0 (1 - 1) n1</i>			
FRAC 12	Spirato (Fludioxonil)			5.0 (5 - 5) n1 Labeled				3.0 (3 - 3) n1 Labeled
FRAC 2	Chipco 26019 N/G 50WP (Iprodione)	5.0 (5 - 5) n1 Labeled			<i>2.0 (2 - 2) n1 Labeled</i>	<i>1.0 (1 - 1) n1 Labeled</i>		<i>1.0 (1 - 1) n1 Labeled</i>
FRAC 3	Baycor 25W (Bitertanol)							
FRAC 3	Bayleton 25WP (Triadimefon)				3.0 (3 - 3) n2 Labeled	4.5 (4 - 5) n2 Labeled		
FRAC 3	Funginex (Triforine 18.2) (Triforine)							
FRAC 3	Terraguard 50W (Triflumizole)							
FRAC 3	Tilt 3.6E (Propiconazole)				<i>2.0 (2 - 2) n1</i>	5.0 (5 - 5) n1		
FRAC 3	Torque 3.6SC (Tebuconazole)		5.0 (5 - 5) n1 Labeled					
FRAC 3	Tourney 50WDG (Metconazole)							
FRAC 3	Trinity 2SC (Triticonazole)	4.0 (4 - 4) n1 Labeled						
FRAC 3 + FRAC 11	Banner Heritage MAXX (Propiconazole + azoxystrobin)							

MOA	Product (Active Ingredients)	<i>Alternaria alternata</i>	<i>Apiognomonia quercina</i>	<i>Colletotrichum acutatum</i>	<i>Colletotrichum sp.</i>	<i>Diplocarpon (Entomosporium) mespili</i>	<i>Diplocarpon rosae</i>	<i>Helminthosporium sp.</i>
FRAC 3 + FRAC M5	Concert II (Propiconazole + chlorothalonil)							
FRAC 7 + FRAC 11	Orkestra Intrinsic (Fluxapyroxad + pyraclostrobin)	5.0 (5 - 5) n1 Labeled	4.0 (4 - 4) n1 Labeled	5.0 (5 - 5) n1 Labeled	5.0 (5 - 5) n1 Labeled			1.0 (1 - 1) n1 Labeled
FRAC 7 + FRAC 11	Pageant Intrinsic (Boscalid + pyraclostrobin)							
FRAC 9	Vanguard 75WG (Cyprodinil)							
FRAC 9 + FRAC 12	Palladium (Cyprodinil + fludioxanil)				1.0 (1 - 1) n1 Labeled			
FRAC BM01	Proud 3 (Thyme oil (5.6%))	1.0 (1 - 1) n1		1.0 (1 - 1) n1	2.0 (2 - 2) n1			1.0 (1 - 1) n1
FRAC BM01	Regime (Banda de Lupinus albus doce (BLAD))	1.0 (1 - 1) n1	4.0 (4 - 4) n1	5.0 (5 - 5) n1	2.0 (2 - 2) n1			1.0 (1 - 1) n1
FRAC M1	Kocide 2000 (Dupont) (Copper Hydroxide)							
FRAC M3	Dithane 75DF Rainshield (Mancozeb)							
FRAC M3	Fore 80WP (Manganese + Zinc + Ethylene bis-dithiocarbamate Ion)				2.5 (2 - 3) n2 Labeled			
FRAC M3+ FRAC 3	Zyban 75WP (Mancozeb + thiophanate methyl)				3.0 (3 - 3) n1			
FRAC M5	Daconil 54EC (Chlorothalonil)							
FRAC M5	Daconil Weather Stik (2787 Flowable Fungicide) (Chlorothalonil)					5.0 (5 - 5) n1 Labeled		
FRAC NC	CG100 (Caprylic acid)							
FRAC NC	ZeroTol (Hydrogen dioxide)				1.0 (1 - 1) n1 Labeled			
IRAC UNF & FRAC BM02	Stargus (Bacillus nakamurai strain F727)			5.0 (5 - 5) n1 Labeled	1.0 (1 - 1) n1 Labeled			1.0 (1 - 1) n1 Labeled
unknown	SP2770 10WP (SP2770)	1.0 (1 - 1) n1	1.0 (1 - 1) n1					

MOA	Product (Active Ingredients)	Marssonina sp.	Nothophaeo-cryptopus gaeumannii	Ovulinia azaleae	Ramularia viburni	Venturia inaequalis	Unknown Leaf Spot
FRAC 1	3336 WP 70% (Pennwalt) (Thiophanate-methyl)	2.4 (1 - 3) n5					
FRAC 1	Benlate 50WP (Benomyl)	4.0 (4 - 4) n4					
FRAC 11	Compass (Trifloxystrobin)						
FRAC 11	Compass 0 50WDG (Trifloxystrobin)		4.5 (4 - 5) n2				
FRAC 11	Disarm 480SC (Fluoxastrobin)						
FRAC 11	Heritage (Azoxystrobin)		1.0 (1 - 1) n2				
FRAC 11	Insignia 20WDG Intrinsic Brand Fungicide (Pyraclostrobin)				5.0 (5 - 5) n1 Labeled		
FRAC 11	S2200 4SC (Mandestrobin)						1.0 (1 - 1) n1
FRAC 11 + FRAC 7	Mural WDG (Azoxystrobin + benzovindiflupyr)						
FRAC 12	Medallion (Fludioxonil)						2.0 (2 - 2) n1
FRAC 12	Spirato (Fludioxonil)						1.0 (1 - 1) n1 Labeled
FRAC 2	Chipco 26019 N/G 50WP (Iprodione)						
FRAC 3	Baycor 25W (Bitertanol)	4.0 (4 - 4) n1					
FRAC 3	Bayleton 25WP (Triadimefon)	3.2 (1 - 4) n6 Labeled		3.0 (3 - 3) n1 Labeled		3.0 (3 - 3) n1 Labeled	
FRAC 3	Funginex (Triforine 18.2) (Triforine)	2.3 (1 - 3) n4					
FRAC 3	Terraguard 50W (Triflumizole)		1.0 (1 - 1) n1				
FRAC 3	Tilt 3.6E (Propiconazole)						
FRAC 3	Torque 3.6SC (Tebuconazole)						
FRAC 3	Tourney 50WDG (Metconazole)		1.0 (1 - 1) n2 Labeled				
FRAC 3	Trinity 2SC (Triticonazole)		1.0 (1 - 1) n2 Labeled				
FRAC 3 + FRAC 11	Banner Heritage MAXX (Propiconazole + azoxystrobin)		1.0 (1 - 1) n2				
FRAC 3 + FRAC M5	Concert II (Propiconazole + chlorothalonil)		5.0 (5 - 5) n2				

MOA	Product (Active Ingredients)	Marssonina sp.	Nothophaeo-cryptopus gaeumannii	Ovulinia azaleae	Ramularia viburni	Venturia inaequalis	Unknown Leaf Spot
FRAC 7 + FRAC 11	Orkestra Intrinsic (Fluxapyroxad + pyraclostrobin)						3.0 (3 - 3) n1 Labeled
FRAC 7 + FRAC 11	Pageant Intrinsic (Boscalid + pyraclostrobin)		1.0 (1 - 1) n2				3.0 (3 - 3) n1
FRAC 9	Vanguard 75WG (Cyprodinil)		1.0 (1 - 1) n1				
FRAC 9 + FRAC 12	Palladium (Cyprodinil + fludioxanil)		1.0 (1 - 1) n2 Labeled				
FRAC BM01	Proud 3 (Thyme oil (5.6%))						1.0 (1 - 1) n1
FRAC BM01	Regime (Banda de Lupinus albus doce (BLAD))						1.0 (1 - 1) n1
FRAC M1	Kocide 2000 (Dupont) (Copper Hydroxide)	1.5 (1 - 3) n4 Labeled					
FRAC M3	Dithane 75DF Rainshield (Mancozeb)	2.8 (2 - 3) n4					
FRAC M3	Fore 80WP (Manganese + Zinc + Ethylene bis-dithiocarbamate Ion)						
FRAC M3+ FRAC 3	Zyban 75WP (Mancozeb + thiophanate methyl)						
FRAC M5	Daconil 54EC (Chlorothalonil)	3.0 (1 - 4) n4 Labeled					
FRAC M5	Daconil Weather Stik (2787 Flowable Fungicide) (Chlorothalonil)		5.0 (5 - 5) n2 Labeled				
FRAC NC	CG100 (Caprylic acid)		2.5 (2 - 3) n2				
FRAC NC	ZeroTol (Hydrogen dioxide)						
IRAC UNF & FRAC BM02	Stargus (Bacillus nakamurai strain F727)						1.0 (1 - 1) n1 Labeled
unknown	SP2770 10WP (SP2770)						

** Disarm 480SC is now known as Fame SC

FRAC Class	Fungicides (active ingredients)	Registered Use Site(s)	REI	Efficacy on Leafspots and Anthracnose					
				<i>Alternaria alternata</i>	<i>Apiognomonia quercina</i>	<i>Phaeocryptopus umannii</i>	<i>Diplocarpon rosae</i>	Other Leafspots*	Anthracnose
Registered Products									
1	3336, OHP 6672, etc. (thiophanate methyl)	G, I, L, N, S	12 h	-	-	-	F	G	P-E
2	Chipco 26019, etc. (iprodione)	G, N	12 h	E	-	-	-	G-E	-
2 + 1	26/36 (iprodione + thiophanate methyl)	G, N	12 h	-	-	-	-	-	-
3	Astun (isofetamid)	G, N	12 h	-	-	-	-	G-E	-
	Avelyo, BAS 750 (mefentrifluconazole)	G, I, L, N, S	12 h	-	-	-	-	-	-
	Banner MAXX, ProPensity (propiconazole)	N	12 h	-	-	-	E	E	G-E
	Bayleton, Strike (triadimefon) ^a	G, N	12 h	-	-	-	-	P-G	-
	Eagle, etc. (myclobutanil)	G, N	24 h	-	-	-	G-E	P-E	E
	Terraguard (triflumizole)	G, I, N, S	12 h	-	P	P	F	G-E	P
	Torque, Tebuconazole SC T&O Fungicide (tebuconazole)	N	12 h	E	E	-	G	E	E
	Tourney (metconazole)	N	0 h	-	-	P	F	E	G-E
Trinity (triticonazole)	G, L, I, N, S	12 h	G	-	P	-	F-E	G	
7	Picatina, A19649B (pydiflumetofen)	TBD	-	-	-	-	-	F-G	G
7 + 11	Broadform (fluopyram + trifloxystrobin)	G, I, L, N, S	12 h	-	-	-	E	-	-
	Orkestra, BAS703 (fluxapyroxad + pyraclostrobin)	TBD	12 h	E	G	-	P-G	G-E	G
9 + 12	Palladium (cyprodinil+fludioxonil)	G, L, N, S	12 h	-	-	P	G	P-E	P-G
11	Compass O (trifloxystrobin) ^b	G, I, L, N, S	12 h	-	-	G-E	E	G	P
	Cygnus (kresoxym-methyl)	G, L, N, S	12 h	-	-	-	-	-	-
	Disarm (fluoxastrobin)	G, I, N, S	12 h	E	-	-	-	G-E	-
	Heritage (azoxystrobin)	G, N, S	4 h	-	-	P	F	E	G-E
	Insignia (pyraclostrobin) ^c	^c	12 h	-	-	-	G	P-E	F-G
11 + 3	Alibi Flora (azoxystrobin + difenoconazole)	G, L, N, S	12 h	-	-	-	-	-	-
	Strike Plus (trifloxystrobin + triadimefon)	G, N	12 h	-	-	-	-	F	-
11 + 7	Mural, A18126B (azoxystrobin + benzovindiflupyr)	G, L, N, S	-	-	-	-	F-G	P-E	E
	Pageant Intrinsic (pyraclostrobin + boscalid)	G, L, I, N, S	12 h	-	-	P	E	F-E	P-E
12	Medallion, Spirato (fludioxonil)	G, I, L, N, S	12 h	-	-	-	-	P-E	-
12 + 7	Picatina Flora (fludioxonil + pydiflumetofen)	TBD	-	-	-	-	-	-	G
14	Botran (dicloran)	G, N	12 h	-	-	-	-	-	-
17	Decree (fenhexamid)	G, N	12 h	-	-	-	-	-	-
18B	Triact, Trilogy, etc. (neem oil extract)	G, I, L, N, S	4 h	-	-	-	P-F	P	P
19	Affirm, Veranda (polyoxin D zinc salt)	G, L, N, S	1 h	-	-	-	-	P	-
BM 01	Regalia (extract of <i>Reynoutria sachalinensis</i>)	G, I, L, N, S	4 h	-	-	-	P	F-G	-
BM 02	Cease, Rhapsody, Serenade Optimum, etc. (<i>Bacillus subtilis</i>)	G, I, N, S	4 h	-	-	-	P	P	F
	Stargus, 110 (<i>Bacillus amyloliquifaciens</i> strain F727)	G, N, S	4 h	-	-	-	-	P-G	-
	Actinovate (<i>Streptomyces lydicus</i>)	G, I, L, N, S	1 h	-	-	-	-	G,F	E,G
	Botector (<i>Aureobasidium pullulans</i> strains DSM 14940 & 14941)	G, N	4 h	-	-	-	-	-	-

FRAC Class	Fungicides (active ingredients)	Registered Use Site(s)	REI	Efficacy on Leafspots and Anthracnose					
				<i>Alternaria alternata</i>	<i>Apiognomonia quercina</i>	<i>Phaeocryptopus umannii</i>	<i>Diplocarpon rosae</i>	Other Leafspots*	Anthracnose
BM 02	Mycostop (<i>Streptomyces griseoviridis</i>)	G, N	4 h	-	-	-	-	-	-
	Prestop (<i>Gliocladium catelunatum</i> strain J446)	G, I, N, S	0 h	-	-	-	-	-	-
M1	Badge (copper hydroxide+copper oxychloride)	G, N, S	48 h	-	-	-	-	-	-
	Basicop, Cuprofix (copper sulfate)	G, N, S	48 h	-	-	-	-	E	-
	Camelot, etc. (copper octanoate)	G, I, N, S	4 h	-	-	-	-	E	-
	Champ, Champion, Kentan, Kocide, etc. (copper hydroxide)	G, I, N, S	48 h	-	-	-	-	-	-
	Copper Count-N, etc. (copper ammonium complex)	G, I, N, S	12 h	-	-	-	-	E	-
	Nordox (cuprous oxide)	M1	24 h	-	-	-	-	-	-
	Phyton 27 (copper sulfate pentahydrate)	G, I, N	24 h	-	-	-	F	P-G	E
M1 + M3	Junction, (copper hydroxide+mancozeb)	G, N	24 h	-	-	-	-	G	-
M2	Microthiol Disperss etc. (sulfur)	G, N	24 h	-	-	-	F	P	-
M3	Dithane, Fore, etc. (mancozeb)	G, N	24 h	-	-	-	-	-	-
	Ziram (ziram)	G,N	48 h	-	-	-	-	-	-
M3 + 1	Zyban (mancozeb + thiophanate methyl)	G, N	24 h	-	-	-	-	G	-
M3 + 3	Clevis (mancozeb+myclobutanil)	G, N	24 h	-	-	-	-	-	-
M4	Captan (captan)	G	48 h	-	-	-	-	-	-
M5	Daconil, Concorde, etc. (chlorothalonil)	G, N	12 h	-	E	E	E	E	P-E
M5 + 1	Consyst, Spectro (chlorothalonil+thiophanate methyl)	G, I, N	12 h	-	-	-	-	G	-
M5 + 3	Concert II (propiconazole + chlorothalonil)	N	12 h	-	-	E	E	P-E	P-E
NC	Armcarb, Milstop, etc. (potassium bicarbonate)	G, I, L, N, S	4, 1 h	-	-	-	P	P	-
	JMS Stylet Oil, SuffOil-X, etc. (mineral oil)	G, N	4 h	-	-	-	P-G	F	P
	Kleengrow (Didecyl dimethyl ammonium chloride)	G	48 h	-	-	-	P	G	P
	Proud 3 (thyme oil)	TBD	0 h	P	-	-	-	P-G	P
	ZeroTol (hydrogen dioxide)	G, I, N	0 h	-	-	-	-	P	-
Experimental Products									
3 + 11	Headway (propiconazole + azoxystrobin)	TBD	12 h	-	-	P	-	-	-
7	Indemnify (Fluopyram 500 SC)	TBD	-	-	-	-	-	-	-
	Indiflin (inpyrfluxam)	TBD	-	-	-	-	-	-	-
7 + 3	Postiva (pydiflumetofen + difenoconazole)	TBD	-	-	-	-	G	G	-
11	S2200 (mandestrobin)	TBD	-	E	-	-	-	G-E	P
BM 01	Regime, F9110 (<i>Lupinus</i> extract)	TBD	-	P	G	-	-	P-G	G
-	A20259E	TBD	-	-	-	-	-	F-E	-
-	A20259G (adepydin)	TBD	-	-	-	-	-	F	-
-	A20808C	TBD	-	-	-	-	-	G	-
-	A21055A	TBD	-	-	-	-	-	E	-
-	BW159	TBD	-	-	-	-	-	-	-
-	CG100 (caprylic acid)	TBD	-	-	-	P	-	-	-
-	F6123-1 1.04 SC (F6123-1)	TBD	-	-	-	-	E	-	-

FRAC Class	Fungicides (active ingredients)	Registered Use Site(s)	REI	Efficacy on Leafspots and Anthracnose					
				<i>Alternaria alternata</i>	<i>Apiognomonia quercina</i>	<i>Phaeocryptopus umannii</i>	<i>Diplocarpon rosae</i>	Other Leafspots*	Anthracnose
-	SP2770 (SP2770)	TBD	-	P	-	-	-	P	P
-	SP2773 (SP2773)	TBD	-	-	-	-	-	-	-

Registered Use Sites: G = Greenhouse; L = Lath House; I = Indoors; N = Nursery; S = Shade House; TBD = To Be Determined

Application Method: D = Drench; S = Spray

Efficacy: E = clearly statistically equivalent or better than untreated non-inoculated and/or clearly statistically different than untreated inoculated; G = statistically different from untreated inoculated and untreated non-inoculated; F = statistically equivalent to both untreated inoculated and untreated non-inoculated; P = statistically equivalent to untreated inoculated. For trials without non-inoculated check, efficacy determined on author's conclusions, % control or comparisons to standard product(s).

Efficacy ratings taken from 2016 IR-4 Leafspot Anthracnose efficacy summary and 2 additional 2015 IR-4 efficacy and 15 2017-2020 PDMR reports.

* *Cercospora cornicola*, *Cercospora hydrangea*, *Cercospora lythracearum*, *Colletotrichum acutatum*, *Colletotrichum* sp., *Corynespora cassiicola*, *Entomosporium mespili*, *Myrothecium roridum*, *Septoria* sp., *Sphaceloma poinsettiae*

^a Will be replaced with Armada 50WDG/Strike Plus (triadimefon + trifloxystrobin). Anthracnose in nursery grown fruit and environmental horticulture varieties.

^b Bayer comments: Leafspot and blight disease in foliage, annual and perennial crops. Anthracnose in nursery grown fruit and environmental horticulture varieties.

^c Insignia is labeled for use in landscape and turf use only. Empress Intrinsic has replaced Insignia for use in production environmental horticulture applied as drench to control soil-borne diseases caused by *Fusarium*, *Phytophthora*, *Pythium* and *Rhizoctonia* spp.

^d Bayer supports testing.