Fungicide Resistance Management Guidelines for Apple Scab and Powdery Mildew Control in the Mid-Atlantic United States

Alan R. Biggs, West Virginia University and Kari Peter, Penn State University

Fungicide	Active Ingredient(s)	FRAC Code[4]	Risk Rating[5]	Management Required[6]	Apple Scab[7]	Powdery Mildew[7]	General Fungicide Resistance Management Guidelines[8]
Kocide 3000 or similar	fixed copper(s)	M1	L	N	G	N	FRAC code M fungicides arelow risk, protectant fungicides. Use alone, or tank mix with high-risk fungicides to improve efficacy
Microthiol or similar	sulfur	M2	L	N	F	G	
Dithane, Ziram or similar	EBDC, ziram	M3	L	N	G	N	
Captan	captan	M4	L	N	G	N	
Dodine, Syllit	dodine	M7^{R+}	L-M	Y	E	N	
Topsin M, Cercobin	thiophanate methyl	1^{R+}	H	Y	N	G	Select fungicides with at least a "G" rating. Rotate among fungicides with different FRAC codes. Tank mix high risk fungicides with FRAC code M product if the product is not formulated with a FRAC code M fungicide. When resistance is qualitative (FRAC code 1 and 11 fungicides), resistant pathogen strains are completely insensitive and cannot be controlled with the fungicide. With quantitative resistance (FRAC Code 3 fungicides), pathogen strains exhibit a range in fungicide sensitivity and efficacy depends on level of insensitivity. Better control can be obtained with highest label rates and shortest spray intervals. Specific notes: Newer code 3 fungicides expected to be as effective as older ones when applied at same rate of active ingredient.
Rally	myclobutanil	3^{R+}	M	Y	E	E	
Procure, Trionic	triflumizole	3	M	Y	E	G	
Topguard, Rhyme	flutriafol	3	M	Y	G	E	
Tebuzol	tebuconazole	3	M	Y	E	E	
Indar	fenbuconazole	3	M	Y	E	G	
Inspire Super	difenconazole + cyprodinil	3 + 9	M	Y	E	G	
Aprovia	benxovindiflupyr	7	H	Y	E	F-G	
Fontelis	penthiopyrad	7	H	Y	E	F-G	
Luna Sensation	fluopyram + trifloxystrobin	7 + 11	H	Y	E	E	
Luna Tranquility	fluopyram + pyrimethanil	7 + 9	H	Y	E	E	
Merivon	fluxapyroxad + pyraclostrobin	7 + 11	H	Y	E	E	
Pristine	boscalid + pyraclostrobin	7 + 11	H	Y	G-E	G	
Sercadis	fluxapyroxad	7	H	Y	E	E	
Scala, Penbotec	pyrimethanil	9^{R}	H	Y	G	N	
Vangard	cyprodinil	9	H	Y	G	N	
Inspire Super	cyprodinil + difenconazole	9 + 3	H	Y	E	G	
Luna Tranquility	pyrimethanil + fluopyram	9 + 7	H	Y	E	E	
Flint	trifloxystrobin	11^{R+}	H	Y	E	G-E	
Luna Sensation	trifloxystrobin + fluopyram	11 + 7	H	Y	E	E	
Sovran	kresoxim-methyl	11^{R+}	H	Y	E	G-E	
Pristine	pyraclostrobin + boscalid	11 + 7	H	Y	G-E	G	
Merivon	pyraclostrobin + fluxapyroxad	11 + 7	H	Y	E	E	

Efficacy Ratings: N = poor or not recommended, S = slight, F = fair, G = good, E = excellent

[4] FRAC code: M= multi-site mode of action (MOA), numbered groups = fungicides with similar MOA.

[5] Risk Ratings: L = low risk, M = moderate risk or H = high risk for fungicide resistance to develop.

[6] Risk management required according to fungicide label; Y = yes, N = no.

[7] Refer to your grower's state guide for rates and recommendations. Efficacy in this chart pertains to at-risk materials mixed with FRAC code M fungicides.

[8] See fungicide label for specific crops, rates and instructions for correct use.

[R] = resistance known for scab and/or mildew for this class of fungicides.

(+) control failures detected for this class of fungicides in the mid-Atlantic and Northeast regions.

Fungicides with the same color belong to the same FRAC code.

 Table Updated 4/2017

Fungicide Resistance Management Guidelines for Brown Rot and Peach Scab Control in the Mid-Atlantic United States

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Fungicide	Active Ingredient(s)	FRAC Code[4]	Risk Rating[5]	Management Required[6]	Brown Rot[7]	Peach Scab[7]	General Fungicide Resistance Management Guidelines[8]
Kocide 3000 or similar	fixed copper(s)	M1	L	N	N	N	FRAC code M fungicides are low risk, protectant fungicides. Use alone, or tank mix with high-risk fungicides to improve efficacy.
Microthiol or similar	sulfur	M2	L	N	G	G	
Ziram	ziram	M3	L	N	N	G	
Captan	captan	M4	L	N	G	G	
Bravo or similar	chlorothalonil	M5	L	N	N	E	
Topsin M, Cercobin	thiophanate methyl	1	H	Y	E	G	Select fungicides with at least a "G" rating. Rotate among fungicides with different FRAC codes. Tank mix high risk fungicides with FRAC code M product if the product is not formulated with a FRAC code M fungicide. When resistance is qualitative (FRAC code 1 and 11 fungicides), resistant pathogen strains are completely insensitive and cannot be controlled with the fungicide. With quantitative resistance (FRAC Code 3 fungicides), pathogen strains exhibit a range in fungicide sensitivity and efficacy depends on level of insensitivity. Better control can be obtained with highest label rates and shortest spray intervals. Specific notes: Newer code 3 fungicides expected to be as effective as older ones when applied at same rate of active ingredient.
Rovral	iprodione	2	M-H	Y	N	N	
Topguard, Rhyme	flutriafol	3[R]	H	Y	G	N	
Elite, Tebuzol	tebuconazole	3	H	Y	E	N	
Indar	fenbuconazole	3	H	Y	E	G	
Quash	metconazole	3	H	Y	E	G	
Orbit, Tilt, Propimax	propiconazole	3	H	Y	E	N	
Luna Experience	tebuconazole + fluopyram	3 + 7	H	Y	E	E	
Inspire Super	difenconazole + cyprodinil	3 + 9	H	Y	E	F	
Fontelis	penthiopyrad	7	H	Y	G	F	
Luna Experience	fluopyram + tebuconazole	7+ 3	H	Y	E	E	
Luna Sensation	fluopyram + trifloxystrobin	7 + 11	H	Y	E	E	
Merivon	fluxapyroxad + pyraclostrobin	7 + 11	H	Y	E	G	
Pristine	boscalid + pyraclostrobin	7 + 11	H	Y	E	G	
Scala, Penbotec	pyrimethanil	9	H	Y	N	N	
Vangard	cyprodinil	9	H	Y	N	N	
Inspire Super	cyprodinil + difenconazole	9 + 3	H	Y	E	F	
Abound	azoxystrobin	11	H	Y	G	N	
Quadris Top	difenconazole + azoxystrobin	3 + 11	H	Y	G	G	
Gem	trifloxystrobin	11	H	Y	G	G	
Luna Sensation	trifloxystrobin + fluopyram	11 + 7	H	Y	E	G	
Merivon	pyraclostrobin + fluxapyroxad	11 + 7	H	Y	E	G	
Pristine	pyraclostrobin + boscalid	11 + 7	H	Y	E	G	

Efficacy Ratings: N = poor or not recommended, S = slight, F = fair, G = good, E = excellent

[4] FRAC code: M= multi-site mode of action (MOA), numbered groups = fungicides with similar MOA.

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[7] Refer to your grower's state guide for rates and recommendations. Efficacy in this chart pertains to at-risk materials mixed with FRAC code M fungicides.

Brown rot ratings are for the disease pre-harvest on fruit (not blossom blight or post-harvest rot).

[8] See fungicide label for specific crops, rates and instructions for correct use.

[R] = resistance known for brown rot and/or scab for this class of fungicides.

(+) control failures detected in the mid-Atlantic and Northeast regions.

Fungicides with the same color belong to the same FRAC code.

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