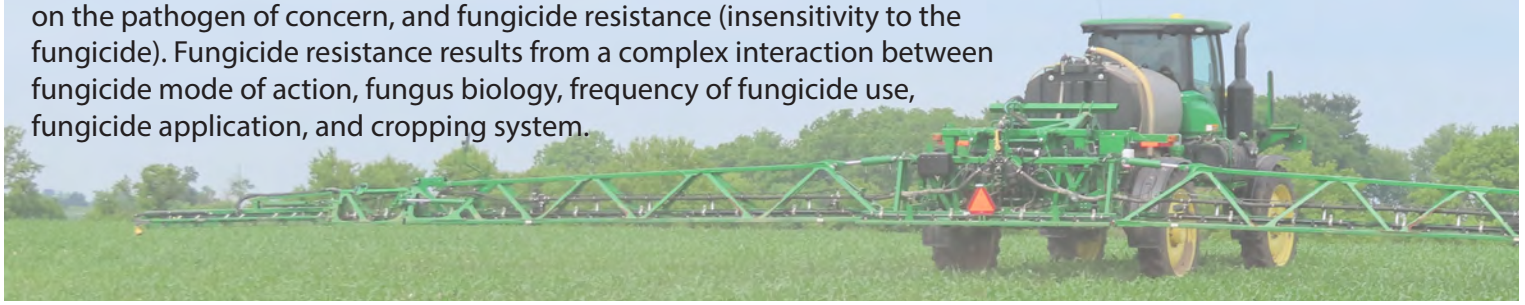
A3878

Fungicide resistance management in corn, soybean, and wheat in Wisconsin

Fungicides are important tools for managing plant diseases in corn, soybean, and wheat. Unlike insecticides and herbicides that are used to kill insects and weeds, fungicides act as a barrier to protect healthy plant tissues from infection by fungi. Due to the protective nature of fungicides, they should be applied in a spray volume that provides sufficient coverage of plant parts. Fungicides are often reapplied to plants because they can be degraded by time and weathering, and are needed to protect new plant growth. Poor disease control can result from weathering, insufficient fungicide coverage, low application rates, poor efficacy of the selected fungicide on the pathogen of concern, and fungicide resistance (insensitivity to the fungicide). Fungicide resistance results from a complex interaction between fungicide mode of action, fungus biology, frequency of fungicide use, fungicide application, and cropping system.



Fungicide mobility

Understanding fungicide mobility can provide valuable information about fungicide selection and help you decide whether or not to use a fungicide. Fungicides are classified into two basic groups: contacts and penetrants. Regardless of mobility, fungicide efficacy will be limited when applied after symptom development and pathogen reproduction (spore production). Fungicides will not cure existing disease symptoms. However, timely application can result in slowing or eliminating symptom development and stop pathogen reproduction. Applying fungicides before a pathogen is well-established results in the best control.

Contact fungicides remain on the plant surface. They do not move on or into plant tissues and can be readily washed from the plant surface. Contact fungicides must be reapplied to protect new plant growth. Because of the limited mobility of contact fungicides and their protectant-only nature, these products should be used prior to fungal infection.

Penetrant fungicides are absorbed into plants after being applied to the surface. Because of the movement of the fungicide into the plant, these fungicides are generally considered systemic fungicides. This can be misleading since the degree of systemicity can vary among fungicides. Local penetrant fungicides only move a short distance, such as into the waxy plant cuticle, and remain in that location. Translaminar penetrants can move through the cuticle between cells toward the opposite side of the leaf. Acropetal penetrants are xylem (water conducting elements of plants) mobile and move between cells along a water potential gradient. Acropetal penetrants only move upwards in plants. Systemic penetrants move through cells and follow sugar gradients in plants. Therefore, systemic penetrants can move upward and downward in plants. Very few fungicides are considered systemic penetrants. Regardless of the level of systemicity, penetrant fungicides have very limited curative ability. Penetrative fungicides will only stop or slow infections within the first 24–72 hours after infection. Therefore, best control of fungal infection with penetrant fungicides is achieved when these products are applied on a preventative schedule.

Fungicide resistance

Fungicide resistance is defined as a genetic adjustment of the fungus that leads to reduced sensitivity to a fungicide. Genetic mutations in fungi that result in fungicide resistance are thought to occur at low frequency and can be governed by a single gene or multiple genes. Mechanisms that lead to reduced sensitivity to a fungicide can vary, but include the alteration of the target site, reduced fungicide uptake, active export of the fungicide out of the fungal cell, and breakdown of the fungicide active ingredient. Fungicide resistance in fungi becomes a problem when the frequency of resistant strains in the population outnumbers the fungicide-sensitive individuals. This arises through repeated and exclusive use of at-risk fungicides.

Practices that result in fungicide resistance

Application of fungicide at the wrong time (e.g., after the fungus has begun reproduction) or with inadequate coverage can result in poor control of a pathogen and lead to reapplication; this results in many individuals

being exposed to the fungicide. Using inadequate rates can also lead to poor control and the need to apply fungicides frequently and exposing many individuals to the fungicide. Excessive application of fungicide where a need is not justified can also lead to higher risk of fungicide resistance. Other practices that result in unnecessarily high populations of fungal individuals being exposed to excessive fungicide application include using susceptible hybrids/varieties, inadequate or excessive fertilization, excessive and/or frequent irrigation, continuous cropping, and poor sanitation.

Text adapted from:

Damicone, John and Damon Smith. 2009. EPP-7663 *Fungicide Resistance Management*. Oklahoma State University Cooperative Extension Service Fact Sheet.

Mueller, Daren S. and Carl A. Bradley. 2008. *Field Crop Fungicides for the North Central United States*. Ames, IA and Urbana-Champaign, IL: Iowa State University and University of Illinois North Central Integrated Pest Management Center.

Dewerf, R, B. Jensen, P.J. Liesch, G. Nice, M. Renz, D. Smith, and R. Werle. 2019. A3646 *Pest Management in Wisconsin Field Crops - 2020*. University of Wisconsin – Madison, Division of Extension.

The Fungicide Resistance Action Committee provides a list of fungicides sorted by modes of action along with other resources for monitoring and mitigating fungicide resistance: https://www.frac.info

FRAC & the FRAC code

The Fungicide Resistance Action Committee (FRAC) is an organization made up of representatives of the agrochemical industry. Their mission …*is to provide fungicide resistance management guidelines to prolong the effectiveness of 'at risk' fungicides and to limit crop losses should resistance occur.* FRAC developed a code, known as the FRAC Code, which can be used to classify fungicides into groups based on their mode of action. Fungicides currently registered in Wisconsin for use on corn, soybean, and wheat fall into eight FRAC Codes: 1, 3, 7, 11, 29, P7, M, and U.

FRAC Code 1: The methyl benzimidazole carbamate (MBC) fungicide group contains the benzimidazole and thiophanate fungicide families. These fungicides are effective against a broad range of fungi that cause leaf spots, root and crown rots, stem rots, and powdery mildews, but not rusts. MBC fungicides inhibit tubulin production, interfering with normal cell division in sensitive fungi. These fungicides have preventative and early-infection activity. While they have penetrant properties, they cannot move down in the plant, making canopy penetration and complete plant coverage essential for control.

The MBC fungicide risk of resistance is HIGH. The modification of a single amino acid in a fungus can result in resistance. Resistance to these fungicides was first reported in 1970. Many important fungal plant pathogens have become resistant to these fungicides.

FRAC Code 3: The demethylation inhibitors (DMI) fungicide group contains the triazole fungicides. DMI fungicides are highly effective against powdery mildews, rusts, and many leaf spotting fungi. These fungicides work by inhibiting a specific enzyme that plays a role in sterol production in fungi. Sterols are necessary for the development of functional cell walls in fungi. Application of DMIs results in abnormal fungal growth and death. However, triazoles have no effect on spore germination because spores contain enough sterol for the formation of germ tubes. Thus, DMI fungicides must be applied preventively or at early infection to be effective. DMI fungicides are acropetal penetrant fungicides, meaning that they are taken up into the plant and can move short distances in the water-conducting elements (xylem) of plants. Generally, these fungicides have approximately 14 days of residual activity. DMI fungicides have a very specific site of action, so risk of resistance development is a concern. Resistance management practices include avoiding repeated applications of DMI fungicides in the same season, against high-risk pathogens such as powdery mildew.

FRAC Code 7: Succinate dehydrogenase inhibitors (SDHI) fungicides include several chemical groups such as the carboximides and benzamides. Some common active ingredients used in field crops are boscalid, carboxin, and flutolanil. Boscalid is primarily a foliar fungicide used against the Botrytis, Sclerotinia, and Alternaria pathogens. They work by inhibiting the respiration of target fungi, specifically complex II fungal respiration. SDHI fungicides are acropetal penetrant fungicides, meaning that they are taken up into the plant and can move short distances in the water-conducting elements (xylem) of plants. Resistance has been documented for these fungicides. The SDHI fungicide risk of resistance is MEDIUM to HIGH.

FRAC Code 11: The Quinone outside inhibitors (QoI) fungicide group contains several chemical groups including strobilurins, imidazoles, and oxazoles which are important in field and forage crops. QoI fungicides are very effective

against a broad spectrum of fungi. These fungicides work by inhibiting mitochondrial respiration, effectively stopping energy production of the fungus, and result in death. These fungicides are effective on spore germination and early growth. QoI fungicides vary in their mobility in plants. Some are local penetrants (moving from one side of the leaf to another), while others are acropetal penetrants (moving short distances in the xylem elements of plants). Regardless of mobility in the plant, QoI fungicides are not effective against fungi that are deeply established in plant tissue, so they must be applied preventively or at early infection to be effective. These fungicides have approximately 7–21 days of residual activity.

QoI fungicides have a very specific site of action, so the risk of resistance development is a HIGH. Currently there are more than 20 plant pathogens with some level of resistance to QoI fungicides.

FRAC Code 29: Oxidative Phosphorylation Uncoupler fungicides inhibit fungal respiration by disrupting the conversion of energy to a usable form. Fluazinam is an example of a common fungicide used to control white mold or Sclerotinia stem rot in crops such as soybean. Fluazinam does inhibit the development of fungal infection structures and spore germination. Fluazinam is a contact fungicide and has little mobility within the plant. The Oxidative Phosphorylation Uncoupler risk of fungicide resistance is LOW.

FRAC Code P7: Fungicide active ingredients classified as salts of phosphorus acid in the group phosphonates have an unknown mode of action on fungi. Some studies suggest that the phosphite ion acts as an energy production inhibitor in fungi and oomycetes. The phosphite ion might also be responsible for triggering defense mechanisms in the plant. Recently fungicides containing potassium phosphite have been labeled for corn, soybeans, and small grains in Wisconsin. Potassium phosphite is considered a truly systemic fungicide, meaning it is translocated in the plant via the phloem and xylem (moving upward and downward in the plant. The phosphonates risk of fungicide resistance is LOW.

FRAC Code M: Multi-site activity fungicides include inorganic compounds (M1), dithiocarbamates (M3), and chloronitriles (M5). Multi-site activity fungicides have a broad spectrum of disease control activity. They are contact fungicides and should be used preventatively since they are applied to the leaf and stem surfaces prior to pathogen appearance. They do not affect fungi once they have infected the plant. Multi-site activity fungicides affect multiple biochemical sites in fungi, killing fungi by overwhelming them with toxins. These fungicides are sensitive to rainfall and sunlight since they are not absorbed into the plant and generally remain active for 7–14 days.

Multi-site activity fungicides have a LOW risk of resistance development. Because of this, multi-site activity fungicides are an important part of fungicide resistance management. When multi-site fungicides are combined with either a FRAC code 3 or 11 fungicide (if allowed by the fungicide label), they may extend the number of years those higher risk fungicides can be used by reducing the number of applications of those high-risk fungicides.

FRAC Code U: While this FRAC code appears infrequently in this publication, the mode of action of some fungicides is unknown. In this case, a **U** is indicated to note that the mode of action is unknown.

Guidelines for fungicide resistance management

- Plant disease-resistant hybrids/varieties whenever possible.
- Maintain proper soil fertility.
- Choose hybrids/varieties adapted for your region; resist the temptation to "push" relative maturity or maturity group for your region.
- Scout fields on a regular basis, noting incidence and severity of diseases. Use this information to develop a field history for future disease management decisions.
- Avoid sites with a history of high disease pressure.
- Utilize a crop rotation that fits your area and field history.
- Tank mix high-risk fungicides with fungicides that have different modes of action, are active against the targeted disease(s), and have similar lengths of residual activity.
- Do not use reduced rates of fungicides.
- Alternate or tank mix fungicides with different modes of action when multiple applications are required.
- Monitor weather conditions in-season; warm dry weather does not promote disease development. You might be able to avoid having to make a fungicide application altogether in some years.
- Apply fungicides preventively or early in the disease cycle and when a disease threat is warranted.
- Avoid curative fungicide applications, especially with high-risk fungicides.

Always read and follow the pesticide label:

- For max. number of sprays per season.
- For recommended application rates.
- For application timing for both target disease and plant growth stage.

Table 1. Individual fungicides listed by FRAC code

FRAC CODE	GROUP NAME	CHEMICAL FAMILY	ACTIVE INGREDIENT	MANUFACTURER	PRODUCT EXAMPLE	REGISTERED CROP*
1	MBCs	thiophanates	thiophanate-methyl	United Phosphorus	Topsin® M 4.5FL	Soybean, Wheat
					Topsin ® M WSB	Soybean, Wheat
				ADAMA	Incognito 4.5F	Soybean, Wheat
				Nufarm Americas	Nufarm T-Methyl 70 WSB	Soybean, Wheat
				Helena Agri-Enterprises	Omni Brand T-Methyl 4.5 F	Soybean, Wheat
				FMC	Cercobin	Soybean, Wheat
				Sipcam Agro USA	Miramar	Soybean, Wheat
				Helena Agri-Enterprises	Omni Brand T-Methyl 70 WP	Soybean, Wheat
3	DMIs	triazole	cyproconazole	Syngenta	Alto 100SL	Soybean, Wheat
			flutriafol	FMC	Topguard	Corn, Soybean, Wheat
			metconazole	BASF	Caramba™	Wheat
			propiconazole	Syngenta	Tilt®	Corn, Soybean, Wheat
				Henena	Omni Brand Propiconazole	Corn, Soybean, Wheat
				Albaugh LLC	Propi-Star EC	Corn, Soybean, Wheat
				Corteva Agrisciences	PropiMax® EC	Corn, Soybean, Wheat
				ADAMA	Bumper 41.8 EC	Corn, Soybean, Wheat
				ADAMA	Bumper ES	Corn, Soybean, Wheat
				ADAMA	Bumper	Corn, Soybean, Wheat
				FarmHannong America	PropicZone	Corn, Soybean, Wheat
				Repar Corporation	Propiconazole 3.6 EC	Corn, Soybean, Wheat
				Sharda USA LLC	Shar-Shield PPZ	Corn, Soybean, Wheat
				Tide International USA	Tide Propiconazole 41.8% EC	Corn, Soybean, Wheat
				Willowood LLC	Willowood Propicon 3.6EC	Corn, Soybean, Wheat
				Innvictis Crop Care LLC	Vigil Broad Spectrum Fungicide	Corn, Soybean, Wheat
				Prime Source LLC	PPZ 41.8 Select	Corn, Soybean, Wheat
				AgBiome Innovations	Marazo	Corn, Soybean, Wheat
				Loveland Products	Fitness	Corn, Wheat
				Direct Ag Source	Propicure 3.6F	Corn, Soybean, Wheat
				Winfield Solutions	Topaz	Corn, Soybean, Wheat
				Tide	Tide Propiconazole	Corn, Soybean, Wheat
			prothioconazole	Bayer CropScience	Proline® 480SC	Corn, Soybean, Wheat
			tebuconozole	UPL NA	Tebuzol 3.6F	Corn, Soybean, Wheat
				Loveland Products	Monsoon	Corn, Soybean, Wheat
				SipCam Agro USA	Muscle	Soybean, Wheat
				Winfield Solutions	Onset	Corn, Soybean, Wheat
				Winfield Solutions	Topaz	Corn, Soybean, Wheat
				Albaugh LLC	TebuStar 3.6L	Corn, Soybean, Wheat
				ADAMA	Orius 3.6	Corn, Soybean, Wheat
				Repar Corporation	Tebucon 3.6F	Corn, Soybean, Wheat
				Sulphur Mills	Buzz Ultra DF	Corn, Soybean, Wheat

(continued on next page)

Table 1. Individual fungicides listed by FRAC code (continued from previous page)

FRAC CODE	GROUP NAME	CHEMICAL FAMILY	ACTIVE INGREDIENT	MANUFACTURER	PRODUCT EXAMPLE	REGISTERED CROP*
3	DMIs (cont'd)			Rotam North America	Tolido 3.6F	Corn, Soybean, Wheat
				Direct Ag Source	Tebucure Fungicide 3.6	Corn, Soybean, Wheat
				Sharda USA LLC	Tebu - Crop 3.6F	Corn, Soybean, Wheat
				Tide International USA	Tide USA Tebu 3.6F	Corn, Soybean, Wheat
				Henena	Omni Brand Tebuconazole 3.6	Corn, Soybean, Wheat
				Willowood LLC	Willowood Teb 3.6SC	Corn, Soybean, Wheat
				Innvictis Crop Care LLC	Vibe	Corn, Soybean, Wheat
				Altitude Crop Innovations	Quarry	Corn, Soybean, Wheat
				Prime Source LLC	Tebuconazole 3.6 Select	Corn, Soybean, Wheat
			tetraconazole	Gowan & Isagro USA	Domark® 230 ME	Corn, Soybean
				SipCam Agro USA	Andiamo 230 Fungicide	Corn, Soybean
7	SDHI	pyridine-carboximide		SipCam Agro USA	Andiamo 230 Fungicide	Corn, Soybean
		pyrazole-carboximide	penthiopyrad	DuPont	Vertisan	Corn, Soybean, Wheat
		pyridinyl-ethyl-benzamides	fluopyram	Bayer CropScience	Luna Privilege	Corn, Wheat
11	QoIs	methoxycarbamate	pyraclostrobin	BASF	Headline®	Corn, Soybean, Wheat
		methoxyacrylate	azoxystrobin	Syngenta	Quadris®	Corn, Soybean, Wheat
				Syngenta	Aframe	Corn, Soybean, Wheat
				Winfield Solutions	Tetraban	Corn, Soybean, Wheat
				Albaugh LLC	AzoxyStar	Corn, Soybean
				SipCam Agro USA	Arius 250	Corn, Soybean
				FarmHannong America	Azoxyzone	Corn, Soybean, Wheat
				Sharda USA LLC	A-Zox 25SC	Corn, Soybean, Wheat
				Vive Crop Protection	AZteroid FC 3.3	Corn, Soybean, Wheat
				Vive Crop Protection	AZteroid FC	Corn, Soybean, Wheat
				innvictis Crop Care LLC	Trevo	Corn, Soybean, Wheat
				Tigris LLC	Tigris Azoxy 2 SC	Corn, Soybean, Wheat
				AgBiome Innovations	Mazolin	Corn, Soybean, Wheat
			picoxystrobin	DuPont	Aproach	Corn, Soybean, Wheat
		dihydro-dioxazine	fluoxastrobin	Arysta LifeSciences	Evito 480 SC	Corn, Soybean, Wheat
				Arysta LifeSciences	Tepera Fungicide	Corn, Soybean, Wheat
		fluoxastrobin		Loveland Products	Aftershock	Corn, Soybean, Wheat
29		2,6-dinitro-anilines	fluazinam	Syngenta	Omega 500F Fungicide	Soybean
				Atticus LLC	Orbus 4F	Soybean
				AgBiome Innovations	Lektivar 40SC Fungicide	Soybean
M	M1	inorganic	copper hydroxide	Certis USA LLC	Kocide® 3000	Corn, Soybean, Wheat
					Kocide ® 2000	Corn, Soybean, Wheat
					Kocide HCu	Corn, Soybean, Wheat
				Albaugh Inc./Agri Star	Nu-Cop 3 L	Corn, Soybean, Wheat
					Nu-Cop 50 WP	Wheat
					NuCop XLR	Wheat

(continued on next page)

Table 1. Individual fungicides listed by FRAC code (continued from previous page)

FRAC CODE	GROUP NAME	CHEMICAL FAMILY	ACTIVE INGREDIENT	MANUFACTURER	PRODUCT EXAMPLE	REGISTERED CROP*
M	M1 (cont'd)			Isagro	Badge X2	Corn, Soybean
					Kentan DF Fungicide	Wheat
				Gowan LLC	Previsto	Soybean, Wheat
					Badge SC Fungicide	Corn, Soybean, Wheat
				Nufarm Americas	Champ Dry Prill	Wheat
					Champ Formula 2	Wheat
			copper octanoate	Certis	Cueva	Corn, Soybean, Wheat
			copper sulfate	United Phosphorus	Cuprofix® Ultra 40 Disperss	Soybean, Wheat
	M3	dithiocarbamate	mancozeb	Corteva Agriscience	Dithane® DF Rainshield™	Wheat
					Dithane® F-45 Rainshield™	Wheat
					Dithane® M45	Wheat
				FMC Corporation	Koverall	Wheat
				United Phosphorus	Manzate® ProStick™	Wheat
					Manzate Max	Wheat
					Penncozeb™ 75DF	Wheat
					Penncozeb™80WP	Wheat
	M5	chloronitriles	chlorothalonil	ADAMA	Bravo WeatherStik®	Corn, Soybean
					Bravo® Ultrex	Corn, Soybean
				Syngenta	Chloronil 720	Corn, Soybean
				Sipcam Agro USA	Echo® 720	Corn, Soybean
					Echo® 90DF	Corn, Soybean
					Echo® Zn	Corn, Soybean
				Prime Source	Chlorothalonil 720 Select	Soybean, Corn
				AMVAC Croporation	Equus 720 SST	Soybean, Corn
				Loveland Products	Initiate	Soybean, Corn
					Initiate ZN	Soybean, Corn

* May be registered on crops other than corn, soybean, or wheat. See label for information.

Table 2. Premix fungicides listed by FRAC code

FRAC CODE	GROUP NAME	CHEMICAL FAMILY	ACTIVE INGREDIENT	MANUFACTURER	PRODUCT EXAMPLE	REGISTERED CROP*
3	DMI	triazole	prothioconazole	Bayer	Prosaro™ 421 SC	Corn, Wheat
3	DMI	triazole	tebuconazole			
3	DMI		flutriafol	FMC	Topguard EQ	Corn, Soybean, Wheat
11	QoI		azoxystrobin			
3	DMI	triazole	propiconazole	Syngenta	Quilt®	Corn, Soybean, Wheat
11	QoI	methoxyacrylate	azoxystrobin			
3	DMI	triazole	cyproconazole	DuPont	Aproach Prima	Corn, soybean, wheat
11	QoI	methoxy-acrylates	picoxystrobin			
3	DMI		tebuconazole	ADAMA	Custodia	Corn, Soybean, Wheat
11	QoI		azoxystrobin			
3	DMI		flutriafol	FMC	Preemptor	Corn, Soybean, Wheat
11	QoI		fluoxastrobin			
3	DMI		flutriafol	FMC	Topguard EQ	Corn, Soybean, Wheat
11	QoI		azoxystrobin			
3	DMI		flutriafol	Arysta	Fortix	Corn, Soybean, Wheat
11	QoI		fluoxastrobin			
3	DMI	triazole	mefentrifluconazole	BASF	Veltyma	Corn, Soybean
11	QoI	QoI	pyraclostrobinstrobin			
3	DMI	triazole	propiconazole	Syngenta	Quilt® Xcel	Corn, Soybean, Wheat
11	QoI	methoxyacrylate	azoxystrobin			
3	DMI	triazole	propiconazole	Helena Chemical	Avaris™	Corn, Soybean, Wheat
11	QoI	methoxyacrylate	azoxystrobin			
3	DMI	triazole	propiconazole	Helena Chemical	HM-0812®	Corn, Soybean
11	QoI	methoxyacrylate	azoxystrobin			
3	DMI	triazole	cyproconazole	Syngenta	Quadris Xtra™	Soybean
11	QoI	methoxyacrylate	azoxystrobin			
3	DMI	triazole	difenoconazole	Syngenta	Quadris Top™	Soybean
11	QoI	methoxyacrylate	azoxystrobin			
3	DMI	triazole	metconazole	BASF	Headline AMP™	Corn
11	QoI	methoxycarbamate	pyraclostrobin			
3	DMI	triazole	metconazole	BASF	Twinline™	Wheat
11	QoI	methoxycarbamate	pyraclostrobin			
3	DMI	triazole	tebuconazole	Bayer CropScience	Absolute 500 SC	Wheat
11	QoI	oximinoacetate	trifloxystrobin			
3	DMI	triazole	prothioconazole	Bayer CropScience	Delaro 325 SC	Corn, Soybean, Wheat
11	QoI	oximinoacetate	trifloxystrobin			
3	DMI	triazole	prothioconazole	Bayer CropScience	Stratego® YLD	Corn, Soybean, Wheat
11	QoI	oximinoacetate	trifloxystrobin			
3	DMI	triazole	propiconazole	Bayer CropScience	Stratego®	Corn, Soybean, Wheat
11	QoI	oximinoacetate	trifloxystrobin			

(continued on next page)

Table 2. Premix fungicides listed by FRAC code (cont'd)

FRAC CODE	GROUP NAME	CHEMICAL FAMILY	ACTIVE INGREDIENT	MANUFACTURER	PRODUCT EXAMPLE	REGISTERED CROP*
7	SDHI	carboximide	flupyram	Bayer	Propulse	Corn, Soybean
3	DMI	triazole	prothioconazole			
7	SDHI	carboximide	pydiflumetofen	Syngenta	Miravis ACE	Wheat
3	DMI	triazole	propiconazole			
7	SDHI	carboximide	bixafen	FMC	Lucento	Corn, Soybean, Wheat
3	DMI	triazole	flutriafol			
7	SDHI	pyrazole-carboxamide	fluxapyroxad	BASF	Priaxor	Corn, Soybean, Wheat
11	QoI	methoxycarbamate	pyraclostrobin			
P7		phosphonate	potassium phosphite	Helena	Viathon	Corn, Soybean, Wheat
3	DMI	triazole	tebuconazole			
U			hydrogen dioxide	BioSafe Systems	OxiDate 2.0	Corn, Soybean, Wheat
U			peroxyacetic acid			
7	SDHI	carboximides	pydiflumetofen	Syngenta	Miravis Neo	Corn, Soybean
11	QoI	QoI	azoxystrobin			
3	DMI	triazole	propiconazole			
7	SDHI	pyrazole-carboxamide	fluxapyroxad	BASF	Priaxor D	Soybean
11	QoI	methoxycarbamate	pyraclostrobin			
3	DMI	Triazole	tetraconazole			
7	SDHI	pyrazole-carboxamide	fluxapyroxad	BASF	Revytek	Corn, Soybean
11	QoI	methoxycarbamate	pyraclostrobin			
3	DMI	triazole	mefentrifluconazole			
7	SDHI	carboximides	benzovindiflupyr	Syngenta	Trivapro	Corn, Soybean, Wheat
11	QoI	QoI	azoxystrobin			
3	DMI	triazole	propiconazole			

* May be registered on crops other than corn, soybean, or wheat. See label for information.

Extension
UNIVERSITY OF WISCONSIN–MADISON

Authors: Damon Smith, Associate Professor and Extension Field Crops Plant Pathologist, UW-Madison and UW-Extension and Richard Proost, Regional Agronomist, Nutrient and Pest Management Program, UW-Madison, UW-Madison. Division of Extension publications are subject to peer review.

University of Wisconsin–Madison Division of Extension, in cooperation with the U.S. Department of Agriculture and Wisconsin counties, publishes this information to further the purpose of the May 8 and June 30, 1914, Acts of Congress. An EEO/AA employer, the University of Wisconsin–Madison Division of Extension provides equal opportunities in employment and programming, including Title VI, Title IX, and ADA requirements. If you have a disability and require this information in an alternative format, or if you would like to submit a copyright request, contact Division of Extension Publishing at 702 Langdon St., L50 Pyle Center, Madison, WI 53706; pubs@extension.wisc.edu; or (608) 263-2770 (711 for Relay).

This publication is available from your Wisconsin county Extension office (counties.extension.wisc.edu) or from Division of Extension Publishing. To order, call toll-free 1-877-947-7827 or visit our website at learningstore.extension.wisc.edu.