

# Disease Management for Field Crops

Fungicides are an important component of the pesticide program for some Nebraska fields. While not all fields of corn, dry bean, sorghum, soybean, sugarbeet, sunflower, and wheat will require a fungicide application, it's critical that you know the correct product for the disease in your field when you do need it.

- **Identification.** The first step with any disease management program is to make sure you have correctly identified the problem. Identification is critical as there are many bacterial diseases with symptoms similar to fungal diseases and fungicides will have no activity on them.

For help identifying crop diseases, visit the Plant Disease section of UNL's CropWatch at <http://cropwatch.unl.edu/plantdisease>.

- **Timing.** The second step is to ensure accurate timing of the application. With some diseases it is critical to apply the fungicide before there is significant disease development.

Fungicides are plant protection compounds, but have some of the same restrictions as many other pesticides, such as preharvest intervals and post-application field reentry restrictions. Read and carefully follow all label directions.

## Resistance

The use of pesticides, including fungicides, has resulted in the development of organisms that are resistant to their effects. Currently, the only major field crop pathogen with known resistance is *Cercospora sojina* (Frogeye leaf spot of soybean) with resistance to the strobilurin (QoI) fungicide group. This has been identified in other parts of the U.S. and not in Nebraska as of 2014. Misuse of products may result in the development of other resistant populations and jeopardize the benefits that are provided by those products and other closely related fungicides.

Resistance can develop after the repeated use of products with the same modes of action, particularly with single-site modes of action. Also, organisms vary in their ability to become resistant and the

frequency that they develop resistant strains. The Fungicide Resistance Action Committee (FRAC) is responsible for ranking the risk for resistance development in fungal pathogen populations. FRAC assigns codes to each fungicide class based on its mode of action (MOA) and likelihood that its use could lead to the development of resistant strains. Rotating the use of products with different or mixed modes of action and avoiding repeated applications can help prevent the development of resistant populations. It's important to carefully read and follow the directions described in the most recent version of the product label in an attempt to avoid the development of resistant populations.

## Using this Resource

When crop diseases become a problem, use the following section to assist with the decision-making process for fungicide applications.

## Fungicide Mode of Action Table

FRAC Code	Code Number	Mode of Action	Site of Action	Common Name	Chemical Group
Group 1	B1	MBC (Methyl Benzimidazole Carbamates)	mitosis and cell division	thiabendazole	benzimidazoles
				thiophanate-methyl	thiophanates
Group 3	G1	DMI (DeMethylation Inhibitors)	sterol biosynthesis in membranes	cyproconazole	triazoles
				difenoconazole	
				flutriafol	
				ipconazole	
				metconazole	
				myclobutanil	
				propiconazole	
				tebuconazole	
				tetraconazole	
				triticonazole	
				imazalil	imidazoles
				prothioconazole	triazolinthione
Group 4	A1	PA (PhenylAmides)	nucleic acids synthesis	mefenoxam	acylalanines
				metalaxyl	
Group 7	C2	SDHI (Succinate Dehydrogenase Inhibitors)	respiration	carboxin	oxathiin-carboxamides
				fluopyram	pyridinyl-ethyl-benzamides pyrazole-carboxamides
				fluxapyroxad	
				penflufen	
				penthioopyrad	
				sedaxane	
				boscalid	pyridine-carboxamides
Group 11	C3	QoI (Quinone Outside Inhibitors)	respiration	azoxystrobin	methoxy-acrylates
				picoxystrobin	
				fluoxastrobin	dihydro-dioxazines
				pyraclostrobin	methoxy-carbamates
				trifloxystrobin	oximino-acetates

## Fungicide Mode of Action Table *(continued from page 231)*

FRAC Code	Code Number	Mode of Action	Site of Action	Common Name	Chemical Group
Group 12	E2	PP (PhenylPyrroles)	signal transduction	fludioxonil	phenylpyrroles
Group 14	F3	AH (Aromatic Hydrocarbons)	lipids and membrane synthesis	chloroneb PCNB	aromatic hydrocarbons
Group 22	B3	thiazole carboxamide	mitosis and cell division	ethaboxam	ethylamino-thiazole-carboxamide
Group M1	multi-site contact activity	inorganic	multi-site contact activity	copper	inorganic
Group M3	multi-site contact activity	dithiocarbamates and relatives	multi-site contact activity	mancozeb thiram	dithiocarbamates and relatives
Group M4	multi-site activity	phthalimides	multi-site activity	captan	phthalimides

\*Based on Fungicide Resistance Action Committee (FRAC) information on the Web at <http://www.frac.info/frac/index.htm>.

# Management of Corn Diseases

## Fungicide Efficacy for Control of Corn Diseases

The Corn Disease Working Group (CDWG) has developed the following information on fungicide efficacy for control of major corn diseases in the United States. Efficacy ratings for each fungicide listed in the table were determined by field testing the materials over multiple years and locations by the members of the committee. Efficacy ratings are based upon level of disease control achieved by product, and are not necessarily reflective of yield increases obtained from product application. Efficacy depends upon proper application timing, rate, and application method to achieve optimum effectiveness of the fungicide as determined by labeled instructions and overall level of disease in the field at the time of application. Differences in efficacy among fungicide products were determined by direct comparisons among products in field tests and are based on a single application of the labeled rate as listed in the table. Table includes systemic fungicides available that have been tested over multiple years and locations. The table is not intended to be a list of all labeled products<sup>1</sup>. Efficacy categories: NR=Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent; NL = Not Labeled for use against this disease; U = Unknown efficacy or insufficient data to rank product

Fungicide(s)			Rate/A	Anthraco-	Common		Gray	Northern	Southern	Harvest
Class	Active Ingredient (%)	Product/Trade Name	(fl oz)	se Leaf Blight	Rust	Eyespot	Leaf Spot	Leaf Blight	Rust	Restriction <sup>2</sup>
QoI Strobilurins Group 11	Azoxystrobin 22.9%	Quadris 2.08 SC Multiple Generics	6.0 - 15.5	VG	E	VG	E	G	G	7 days
	Pyraclostrobin 23.6%	Headline 2.09 EC/SC	6.0 - 12.0	VG	E	E	E	VG	E	7 days
	Picoxystrobin	Aproach 2.08 SC	3.0 - 12.0	VG	VG-E	VG	F-VG	VG	U	7 days
DMI Triazoles Group 3	Propiconazole 41.8%	Tilt 3.6 EC Multiple Generics	2.0 - 4.0	NL	VG	E	G	G	G	30 days
	Prothioconazole 41.0%	Proline 480 SC	5.7	U	VG	E	U	VG	G	14 days
	Tebuconazole 38.7%	Folicur 3.6 F Multiple Generics	4.0 - 6.0	NL	U	NL	U	VG	U	36 days
	Tetraconazole 20.5%	Domark 230 ME	4.0 - 6.0	U	U	U	E	U	G	R3 (milk)
Mixed Modes of Action	Azoxystrobin 13.5% Propiconazole 11.7%	Quilt Xcel 2.2 SE Aframe Plus 2.2 SE	10.5 - 14.0	VG	VG-E	VG-E	E	VG	VG	30 days
	Cyproconazole 7.17% Picoxystrobin 17.94%	Aproach Prima 2.34 SC	3.4 - 6.8	U	U	U	E	VG	VG	30 days
	Flutriafol 19.3% Fluoxastrobin 14.84%	Fortix 3.22 SC	4.0 - 6.0	U	U	U	E	VG	VG	R4 (dough)
	Pyraclostrobin 13.6% Metconazole 5.1%	Headline AMP 1.68 SC	10.0 - 14.4	U	E	E	E	VG	VG	20 days
	Pyraclostrobin 28.58% Fluxapyroxad 14.33%	Priaxor 4.17 SC	4.0 - 8.0	U	VG	U	VG	U	G	21 days
	Trifloxystrobin 32.3% Prothioconazole 10.8%	Stratego YLD 4.18 SC	4.0 - 5.0	VG	E	VG	E	VG	VG	14 days

<sup>1</sup>Additional fungicides are labeled for disease on corn, including contact fungicides such as chlorothalonil. Certain fungicides may be available for diseases not listed in the table, including Gibberella and Fusarium ear rot. Applications of Proline 480 SC for use on ear rots requires a FIFRA Section 2(ee) and is only approved for use in Illinois, Indiana, Iowa, Louisiana, Maryland, Michigan, Mississippi, North Dakota, Ohio, Pennsylvania, and Virginia.

<sup>2</sup>Harvest restrictions are listed for field corn harvested for grain. Restrictions may vary for other types of corn (sweet, seed or popcorn, etc.), and corn for other uses such as forage or fodder. Many products have specific use restrictions about the amount of active ingredient that can be applied within a period of time or the amount of sequential applications that can occur. Please read and follow all specific use restrictions prior to fungicide use. This information is provided only as a guide. It is the responsibility of the pesticide applicator by law to read and follow all current label directions. Reference to products in this publication is not intended to be an endorsement to the exclusion of others that may be similar. Persons using such products assume responsibility for their use in accordance with current directions of the manufacturer. Members or participants in the CDWG assume no liability resulting from the use of these products.

# Foliar Fungicides and Bactericides for Corn Grown for Grain

Class	Trade Name Active Ingredient (Conc.)	Rate (per acre)	Application			REI (hours)	PHI (days)
			Aerial	Chemigation	Ground		
QoI Strobilurins Group 11	Aftershock fluoxastrobin (40.3%)	2.0-5.7 oz	5 gpa minimum	Allowed	10 gpa minimum	12	30
	Aproach picoxystrobin (22.5%)	3.0-12.0 oz	Adequate for coverage and canopy penetration	Allowed	Adequate for coverage and canopy penetration	12	7
	Evito 480 SC fluoxastrobin (40.3%)	2.0-5.7 oz	2 gpa minimum	Allowed, < 0.4"	10 gpa minimum	12	30
	Headline pyraclostrobin (23.6%)	6.0-12.0 oz	2 gpa minimum	Allowed, < 0.5" application	Adequate for coverage and canopy penetration	12	7
	Quadris Flowable azoxystrobin (22.9%)	6.0-15.5 oz	Adequate for coverage and canopy penetration	Allowed, 0.1-0.25" application	Adequate for coverage and canopy penetration	4	7
	Satori azoxystrobin (22.9%)	6.0-15.5 oz	Adequate for coverage and canopy penetration	Allowed, 0.1-0.25" application	Adequate for coverage and canopy penetration	4	7
DMI Triazoles Group 3	Bumper 41.8 EC propiconazole (41.8%)	2.0-4.0 oz	2 gpa minimum	Allowed, 0.1-0.25" application	10 gpa minimum	12	30
	Bumper ES propiconazole (40.85%)	2.0-4.0 oz	2 gpa minimum	Allowed, 0.1-0.25" application	10 gpa minimum	12	30
	Domark 230 ME tetraconazole (20.5%)	4.0-6.0 oz	2 gpa minimum	Allowed	10 gpa minimum	12	Do not apply after R3 (milk)
	Fitness propiconazole (41.8%)	2.0-4.0 oz	2 gpa minimum	Allowed, 0.1-0.25" application	10 gpa minimum	12	30
	Monsoon tebuconazole (38.7%)	4.0-6.0 oz	5 gpa minimum	Not allowed	10 gpa minimum	12	36
	Orius 3.6F tebuconazole (38.7%)	4.0-6.0 oz	5 gpa minimum	Not allowed	10 gpa minimum	12	36
	Proline 480 SC prothioconazole (41.0%)	5.7 oz	2 gpa minimum	Allowed, 0.125- 0.5" application	10 gpa minimum	12	14
	PropiMax EC propiconazole (41.8%)	2.0-4.0 oz	2 gpa minimum	Allowed, 0.1-0.25" application	10 gpa minimum	12	30
	Prosaro prothioconazole (19.0%) + tebuconazole (19.0%)	6.5 oz	2 gpa minimum	Allowed	10 gpa minimum	12	36
	TebuStar 3.6L tebuconazole (38.7%)	4.0-6.0 oz	5 gpa minimum	Allowed	10 gpa minimum	12	36
	Tebuzol 3.6F tebuconazole (38.7%)	4.0-6.0 oz	5 gpa minimum	Allowed	10 gpa minimum	12	36
	Tilt propiconazole (41.8%)	2.0-4.0 oz	2 gpa minimum	Allowed, 0.1-0.25" application	10 gpa minimum	12	30
	Topguard flutriafol (11.8%)	7.0-14.0 oz	5 gpa minimum	Not allowed	10 gpa minimum	12	80
SDHI Carboxamides Group 7	Vertisan penthioopyrad (20.6%)	10.0-24.0 oz	2 gpa minimum	Allowed	15 gpa minimum	12	7

## Foliar Fungicides and Bactericides for Corn Grown for Grain *(continued)*

Class	Trade Name Active Ingredient (Conc.)	Rate (per acre)	Application			REI (hours)	PHI (days)
			Aerial	Chemigation	Ground		
Dithiocarbamates Group M3	Dithane F-45 Rainshield mancozeb (37.0%)	1.2 qt	2 gpa minimum	Allowed, <0.25" application	Adequate for coverage and canopy penetration	24	7
	Dithane M-45 mancozeb (80.0%)	1.5 lb	2 gpa minimum	Allowed, <0.25" application	Adequate for coverage and canopy penetration	24	40
	Penncozeb 75DF mancozeb (75.0%)	1.0-1.5 lb	2 gpa minimum	Allowed, 0.1-0.25" application	Adequate for coverage and canopy penetration	24	40
	Penncozeb 80WP mancozeb (80.0%)	1.0-1.5 lb	2 gpa minimum	Allowed, 0.1-0.25" application	Adequate for coverage and canopy penetration	24	40
Inorganics Group M1	Badge SC copper oxychloride (16.81%) + copper hydroxide (15.36%)	0.5-2.5 pt	3 gpa minimum	Allowed	10 gpa minimum	48	0
	Kocide 2000 copper hydroxide (53.8%)	1.0-3.0 lb	3 gpa minimum	Allowed	20 gpa minimum	48	0
	Kocide 3000 copper hydroxide (46.1%)	0.5-0.75 lb	3 gpa minimum	Allowed	20 gpa minimum	48	0
Mixed Modes of Action	Absolute Maxx tebuconazole (22.63%) + trifloxystrobin (22.63%)	5.0-6.0 oz	5 gpa minimum	Allowed	10 gpa minimum	12	36
	Affiance azoxystrobin (9.35%) + tetraconazole (7.48%)	10.0-17.0 oz	2 gpa	Allowed, 0.1-0.25" application	10 gpa minimum	12	7
	Approach Prima picoxystrobin (17.94%) + cyproconazole (7.17%)	3.4-6.8 oz	Adequate for coverage and canopy penetration	Allowed	Adequate for coverage and canopy penetration	12	30
	Evito T fluoxastrobin (18.0%) + tebuconazole (25.0%)	4.0-9.0 oz	3 gpa minimum	Allowed, <0.4" application	10 gpa minimum	12	36
	Fortix fluoxastrobin (14.84%) + flutriafol (19.30%)	4.0-6.0 oz	2 gpa minimum	Not allowed	10 gpa minimum	12	30
	Headline AMP pyraclostrobin (13.64%) + metconazole (5.14%)	10.0-14.4 oz	2 gpa minimum	Allowed, <0.5" application	10 gpa minimum	12	20
	Quilt azoxystrobin (7.0%) + propiconazole (11.7%)	7.0-14.0 oz	2 gpa minimum	Allowed, 0.1-0.25" application	10 gpa minimum	12	30
	Quilt Xcel azoxystrobin (13.5%) + propiconazole (11.7%)	10.5-14.0 oz	2 gpa minimum	Allowed, 0.125- 0.25" application	10 gpa minimum	12	30
	Priaxor fluxapyroxad (14.33%) + pyraclostrobin (28.58%)	4.0-8.0 oz	2 gpa minimum	Allowed, <0.5" application	Adequate for coverage and canopy penetration	12	21
	Stratego YLD prothioconazole (10.8%) + trifloxystrobin (32.3%)	2.0-5.0 oz	2 gpa minimum	Allowed, 0.125- 0.5" application	10 gpa minimum	12	14