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MONTANA STATE UNIVERSITY EXTENSION

MontGuide

Small Grain Seed Treatment Guide

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Lists methods for seed treatments to prevent various diseases and pest infestations.

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SEED TREATMENTS PROMOTE SEEDLING establishment and help reduce loss of yield and quality due to pathogens and insects. The ability of seed treatments to control fungal diseases has made them a success story of disease prevention. For instance, smuts and bunts historically caused yield and quality reductions in grain growing regions worldwide. The use of effective seed treatments has reduced the severity of smut and bunt damage to the point that their impacts are now minimal.

Fungicidal seed treatments control fungi residing on the seed surface or inside the seed and are also effective against pathogens that reside in the soil, causing seedling disease and root rot. Most seed treatments do not control bacterial pathogens and none control seed-borne viruses. Insecticidal seed treatments have been used for years to prevent seed and seedling damage caused by soil-inhabiting insects. Recently, the development of systemic insecticidal seed treatments with residual activity provides post-emergence protection against insects such as aphids. In addition to being one of the least expensive and safest methods of pest control, seed treatments are generally better targeted and more effective for a wider range of diseases and insect pests than in the past. This publication reports the effectiveness of available seed treatments on diseases and insects that commonly affect Montana's small grains.

Guidelines for choosing a seed treatment

While seed treatments often are a very important pest management tool, it is best to develop a long-term plan involving a spectrum of pest management practices. Seed treatments, resistant varieties, crop rotations, residue and volunteer management, adequate soil fertility (based on water availability), and application of other pesticides are just a few management variables that can influence disease/insect problems. Careful consideration of all management options available for recurring pest problems is important.

Before selecting a seed treatment product, producers should determine which diseases and/or insects recur in their location. County Extension agents or the Schutter Diagnostic Laboratory (119 Plant Bioscience Building MSU, Bozeman, MT 59717-3150 or http://diagnostics.montana.edu/) can aid in identifying pest problems and provide information for specific areas of the state. Producers can then choose a product based on comparisons of product activity against organisms of concern (see table, page 6).

It is always important to start with good quality seed. Examine seed lots carefully before purchase or when using stored seed. A seed laboratory can conduct standard seed quality tests at a low cost. Seed lots with low test weights, low germination rates, or discolored kernels often produce less vigorous plants, even when this seed is treated. Poor quality seed may be damaged further by seed treatments. Seed treatment dosage and environmental conditions affect the ability of seed treatments to control target diseases and insects. Using recommended application rates and minimizing environmental stresses through good management practices will maximize the benefits of any seed treatment. Because some seed treatments may become less effective over time, plant seed as soon as possible after it is treated.

Fungal Disease Control

Diseases controlled by seed treatments are categorized into three primary groups: the smuts and bunts, the seed and seedling diseases, and the root rots. In the case of smuts and bunts, seed treatments provide very effective control against a potentially devastating group of diseases. Although seed treatments have effectively controlled smuts for the last 40 years, these diseases are still present in Montana and growers should take this risk seriously. For seed and seedling diseases, seed treatments are an indispensable control tool whose effectiveness can be greatly enhanced through proper planting practices. Typically, a seed treatment will protect seedlings for two to three weeks. Historically, root rots have been less affected by seed treatments than other disease groups. However, some newer formulations are making significant strides in controlling root rot diseases. In some instances, these seed treatments may provide good root rot control by themselves, but one should not rely solely on them for disease management. Instead, seed treatments should be integrated with plant resistance and cultural practices to provide effective management of root rots.

Smuts and bunts

Common bunt of wheat Common bunt is caused by *Tilletia tritici* (formerly known as *T. caries*), and *T. laevis*, (formerly known as *T. foetida*). Common bunt is also known as stinking smut because its presence on the head causes a pronounced odor of dead fish. The disease may affect spring and winter wheats but is most common in late-planted winter wheat. Several seed treatments are highly effective against this disease and have made what was once a very common disease, relatively rare. Despite the disease's rarity, the fungus is present within the state and on occasion causes substantial losses in unprotected fields.

Dwarf bunt Dwarf bunt (*Tilletia controversa*, Kuhns), also referred to as TCK, only affects winter-sown cereals. Like common bunt, dwarf bunt reduces yield and grain quality through the production of an unpleasant odor and taste in infested grain. Dwarf bunt can only develop where snow exists for prolonged periods on unfrozen ground and occurs in scattered areas of western and central Montana. Depending upon temperature, the infection process requires anywhere from 35 to 105 days for completion. Dwarf bunt is a regulated pest species for many countries and is a phytosanitary issue for grain shipments outside the United States. Difenoconazole is the only effective seed treatment for this disease and as such, is highly recommended for anyone producing winter wheat in Montana. Difenoconazole provides nearly complete control of dwarf bunt when used at the highest recommended rate. While genetic resistance to this disease is available, many, if not most, varieties of winter wheat grown in Montana are not resistant.

Covered smut of barley Covered smut (*Ustilago hordei*) differs visibly from loose smut in that a mass of black spores develops within a semi persistent membrane in place of the kernels. Harvest of infected grain with healthy grain results both in yield and quality losses. Use of effective seed treatments can prevent yield losses due to covered smut. Covered smut can be soilborne, but is more commonly seedborne. The fungal spores reside directly on the seed surface or under the hull of the barley kernel. Most surface-acting seed treatments result in elimination of spores on the seed surface.

Loose smut of wheat and loose smut of barley Although loose smut of wheat (*Ustilago tritici*) and barley (*Ustilago nuda*) is caused by two different pathogens, these organisms act in a similar manner on both crops. Spikelets on infected plants normally become transformed into a dry mass of dark spores enclosed in a delicate membrane. This membrane ruptures easily and the spores blow away, leaving only a barren head stalk (naked rachis). The windblown spores enter the flowers of developing heads. Both pathogens then invade the seed germ or embryo, leaving one with infected seed. Because the fungus resides inside the infected seed, protective fungicides that only provide control on the surface of the plant are ineffective for control of loose smuts.

In contrast to loose smut of wheat, which is a fairly rare disease in Montana, loose smut of barley is fairly common. Therefore, treatment of barley seed with an effective systemic fungicide is recommended. It is important to note that Difenoconazole provides effective control for loose smut of wheat, but is ineffective for loose smut of barley. If grain is to be saved for seed from loose smut infested fields, that seed should be treated with an appropriate systemic fungicide to prevent losses in subsequent years.

Loose smut of oats Unlike most loose smuts (*Ustilago avenae*), loose smut of oats is not seed-infecting. Instead, the spores are carried on the surface of the seed like most covered smuts. For this reason, the fungus is exposed to surface treatments and may be controlled

by either a systemic or protective seed treatment. A few isolated oat fields experience loose smut each year in Montana. Seed treatment is recommended if seed from infested fields will be saved for future planting.

Seed and Seedling Diseases

Dry seed decay Dry seed decay caused by numerous *Penicillium* and *Aspergillus* species is typically a threat when winter wheat is seeded into dry soils that have insufficient moisture to stimulate immediate seed germination. Dry seed decay may occur anywhere these conditions exist as the pathogens are common to all areas of Montana. The disease is typified by the growth of a blue, green, or black mold on the seed. Often soil will cling to the affected seed due the fungal growth. Reduced germination and poor stands result. Unless prolonged dry soil conditions persist into the spring, dry seed decay will not be a problem on spring wheat. Effective seed treatments typically suppress this disease for 2 to 3 weeks. If adequate moisture occurs within that time frame, stand losses may be avoided.

Fusarium seedling blight Fusarium seedling blight is a widespread problem for Montana. It is caused by numerous *Fusarium* species, with the most common being *F. culmorum* and *F. pseudograminearum*. Generally, seed treatments effective against one species are effective against the others. *Fusarium* infections are not always lethal, but may lead to later disease development. Non-lethal fall infections of winter wheat may have a pronounced effect on winter survival even in years where snow cover is plentiful, and have been linked to serious crown rot the following summer. In the past few years, Fusarium head scab or head blight has affected seed lots in some parts of the United States. If seed infected with Fusarium head scab is planted, seedling decay may occur, resulting in a poor stand. If *Fusarium*-infested seed is suspected, it is important to clean seed prior to use and apply an effective fungicide. Difenconazole and tebuconazole have been shown to be effective in minimizing the impacts of infected seed on stand. Newer seed treatment products may be effective as well but have not yet been tested. Note that seed treatments, while controlling seedling rot from Fusarium-infested seed, do not provide control against Fusarium head blight.

Wet soil seedling rot Numerous species of *Pythium* can cause pre- or post-emergence death of wheat and barley seedlings. Symptoms include poor stands and/or patches of young plants that are pale green in color and stunted. Roots of young plants will have soft, wet, tan-brown areas at or near their tips. Older plants are minimally affected by *Pythium* disease. Wet soil seedling rot is favored by poorly draining soils, as well as by no-till and irrigated production. The disease is most commonly seen in winter and durum wheat. In problematic locations, systemic seed treatments that incorporate the active ingredients metalaxyl or mefanoxam protect against the seed and seedling stages of the disease. These compounds have been used for many years and in some fields may not be effective due to the selection of fungicide resistance in the pathogen. In those instances, newer fungicides such as Ethaboxam or Tolclofos-methyl should be considered. Since the activity of all three products is limited to Pythium and related fungi, they should always be used in combination with materials active against other pathogens.

Bare patch The pathogen *Rhizoctonia solani* and *R. oryzae* can cause seedling blight as well as root rot disease in small grains. Symptoms occur most prominently in the early season. Varying-sized patches of plants become stunted, and the seminal and crown roots of infected plants have distinct sunken, brown lesions and "spear-tipped" roots. Under warm and wet conditions, the fungus can move rapidly from seedling to seedling, producing bare patches in the field. While the disease is common, it can be particularly severe where large amounts of either volunteer wheat or cheatgrass were sprayed with glyphosate and subsequently seeded to small grains within one to seven days. In these situations, delaying planting for two weeks after spraying improves disease control and yield. The evaluation of systemic seed treatments suggests that they can suppress *Rhizoctonia* development. However, correct volunteer management and delayed seeding intervals remain important to the control of this disease.

Root rots

Common root rot A recent survey showed the fungus causing common root rot and its related seedling blight, *Cochliobolus sativus*, is the most widely distributed pathogen within Montana. The pathogen typically attacks subcrown internodes of plants grown under stress, especially moisture stress. This pathogen also causes the foliar disease **spot blotch** and is often seedborne. Evaluation of seed treatment trials indicate that some fungicides are effective in reducing seedling blight and common root rot severity, but corresponding yield increases do not always result. Conditions that favor common root rot also favor Fusarium crown rot. Planting depths in excess of 2.5 inches have been

associated with increased severity for both common root rot and Fusarium crown rot.

Fusarium crown rot Typically caused by *F. pseudograminearum* and *F. culmorum*, Fusarium crown rot attacks the crowns of plants grown under moisture stress similar to common root rot. The loss of crown roots and the associated crown tissue can result in yield losses up to 46 percent. Evaluations of seed treatment trials indicate that some fungicides are effective in reducing crown rot severity. Conditions which encourage abundant early season growth, such as high moisture or over-fertilization with nitrogen followed by a hot dry period, will deplete the available soil moisture and promote Fusarium crown rot development. This disease is commonly associated with common root rot. Excess planting depths should be avoided.

Barley stripe and net blotch of barley While most currently registered seed treatments provide some control for seedborne barley stripe and net blotch, none have been documented as providing acceptable levels of control for heavily-infested seeds.

Insect Control

Wireworms

These soil-inhabiting insects cause sporadic and sometimes severe stand reduction in wheat, barley and other crops, especially following seeding into sod or old pastures. Damage varies from feeding injury shortly after plant germination to stem boring shortly after plant emergence. Damaging wireworm populations are difficult to predict since, in Montana, there are several species with life cycles varying from one to seven years. However, the use of bait stations for monitoring wireworm populations has been somewhat effective for estimating field infestation levels. Wireworm activity typically begins with soil temperatures in the mid 50s, although dryland-infesting wireworms are thought to be active at lower temperatures. Damage is more severe when spring weather is cool and wet. Due to these factors, planting early in the spring often leads to increased damage from wireworms. Most producers may treat their seed with imidacloprid, thiamethoxam, or clothianidin to minimize potential stand loss, especially in locations with a previous history of wireworm feeding injury. In the past low rates (examples: Cruiser 5FS®: 0.19 - 0.50 oz/cwt; Gaucho 600®: 0.13-0.26 oz/cwt), have been thought to be effective, but new research suggests higher rates are needed for protection of crops from wireworm damage. Growers will need to use the higher rates of products containing imidacloprid, thiathemoxam, imidacloprid or clothianidin (examples: Cruiser 5FS®: 0.75-1.33 oz/cwt; Gaucho 600®: 1.2 – 2.4 oz/cwt; Nipsit™: 7.5 oz/cwt; NipsIt™Inside: 0.25 - 1.79 oz/cwt, respectively). These higher rates are often expressed as rates used for grasshopper or Hessian fly control for Cruiser 5FS®, Gaucho 600® and some generics. If planting winter wheat, growers should use the highest labeled use rate of the product selected, while also planting early in the fall to allow plant establishment.

Aphids

Russian wheat aphids (RWA) have caused significant crop losses Montana small grains. Other aphids, including the bird cherry oat aphid, English grain aphid and greenbug do occur in Montana and are common vectors of Barley yellow dwarf virus (BYDV). This viral disease has caused sporadic but serious losses in both winter and spring grains. Generally, BYDV is most serious in early-seeded winter wheat. Typically damaging populations of these aphids do not overwinter but migrate from southern states during the summer when weather patterns are favorable. Aphids may be identified using the MSU Extension MontGuide *Aphids of Economic Importance in Montana* by navigating to msuextension.org/publications/AgandNaturalResources/MT200503AG.pdf. Products containing imidacloprid (example: Treatments such as Gaucho®), thiathemoxam (example: Cruiser 5FS®) and clothianidin (example: NipsIt Inside®) have been registered for use against the above aphids and are most effective against early season infestations. They provide protection for several weeks. The higher registered rate can be used if extreme aphid pressure is expected early in the growing season. Because aphids migrate into Montana during the growing season, regular monitoring to detect their presence and estimate populations is recommended. When RWA populations reach or exceed the economic threshold, a foliar treatment may be applied (refer to *High Plains Integrated Pest Management Guide for Colorado, Western Nebraska, Montana and Wyoming* Bulletin 564A (http://www.highplainsipm.org/). Recently, the foliar treatment Lorsban® has been delisted by the EPA from barley. This has left many producers with no treatment options for RWA on barley. Recent studies by MSU suggest a foliar application of Warrior II1E with Zeon Technology® (active ingredient: lambda cyhalothrin) at the 1.92oz/acre rate to be highly effective against an early RWA infestation.

Cautions

Since some products are toxic and others are irritating to the skin and respiratory system, it is important to follow label directions when applying these chemicals and when handling treated seed. Regardless of the product, use of protective clothing, gloves, an approved chemical respirator and goggles are recommended; however, read the personal protective equipment (PPE) section on the pesticide product label to meet specific PPE legal requirements. Treated seed should never be used as food. In addition, equipment such as augers and trucks used to deliver grain to elevators should not be contaminated by treated grain.

It is always a good idea to have cleaning supplies, decontamination supplies (read and follow the label) in case of spill, and a pesticide spill plan readily available when mixing pesticides.

Most seed treatments are liquid concentrates or flowable formulations. Effective application requires uniform coverage of the seed at the correct rate for maximum pest control. To achieve this, application using recommended volumes is important. When correctly applied, seed should appear stained, not speckled. Color intensity is not a good tool for judging adequate application rates as dye levels may vary considerably among lots of seed treatment product. Combinations of some fungicidal and insecticidal seed treatments can be toxic to the seed. It is important to read the label carefully before mixing insecticides with fungicides.

Efficacy of Montana Registered Seed Treatments

PRODUCT INFORMATION			SEED AND SEEDLING BLIGHTS					ROOT ROTS		SMUTS AND BUNTS				INSECT PESTS			
BRAND NAME	CHEMICALS	COMPANY	Pythium	Rhizoctonia bare patch	Fusarium seedling blight	Common root rot & seedling blight	Dry seed decay	Fusarium root rot late season	Common root rot late season	Dwarf bunt of winter wheat	Common bunt of wheat	Covered smut of barley	Loose smut of barley	Aphid (various)	Hessian fly	Wire worm	White grub
Rancona Crest	ipconazole + metalaxyl + imidacloprid	Arysta	E	E	E	E	E	S	S		E	E	E	E	E	S	E
Rancona Summit	ipconazole + metalaxyl	Arysta	E	E	E	E	E	S	S		E	E	E				
Rancona V RTU	carboxin + metalaxyl + ipconazole	Arysta	E	E	E	E	E	S	S		E	E	E				
Acquire	metalaxyl	BASF	E														
Stamina	pyraclostrobin	BASF		E	S	S	E	S	S		S	S					
Stamina F3 Cereals	metalaxyl + pyraclostrobin + triticonazole	BASF	E	E	S	S	E					E	E				
Evergol Energy	metalaxyl + penflufen + prothioconazole	Bayer	E	E	E	E	E	S	S		E	E	E				
Raxil Pro MD	metalaxyl; prothioconazole; tebuconazole	Bayer	E	E	S	S	E				E	E	E				
Raxil Pro Shield*	imidacloprid+ metalaxyl+tebuconazole +prothioconazole	Bayer	E	E	E	S		S	S		E	E	E	S	S	S	
Salient 372 FS	difenoconazole	NuFarm	E	E	E	E	E	S	S	E	E	E	E				
Sativa 309 FS	tebuconazole	NuFarm		S	E	E					E	E	E				
Sativa M RTU	tebuconazole + metalaxyl	NuFarm	E	E	E	E						E	E				
Sebring 318 FS	metalaxyl	NuFarm	E														
Sebring 480 FS	metalaxyl	NuFarm	E														
Senator 600 FS*	imidacloprid	NuFarm												E	E	E	E
Spirato 480 FS*	fludioxonil	NuFarm					E										
ST-Methyl 540 FS	thiophanate - methyl	NuFarm		E	E	E	E										
Apron XL	mefenoxam	Syngenta	E														
CruiserMaxx Cereals*	difenoconazole; mefenoxam; thiamethoxam	Syngenta	E	E	E	E	E	S	S	E	E	E	E	E	E	E	
Cruiser Maxx Vibrance Cereals*	difenoconazole; defenoxam; sedaxane; thiamethoxam	Syngenta	E	E	E	E	E	S	S	E	E	E	E			E	
Dividend Extreme	difenoconazole; mefenoxam	Syngenta	E	S	S	S		S	S	E	E	E	E				
Dynasty*	azoxystrobin	Syngenta		E			E										
Maxim 4FS*	fludioxonil	Syngenta					E										
Mertect 340-F	mandipropamid	Syngenta			E						E						
Vibrance	sedaxane	Syngenta		E									E				

E: Effective; S: Suppressed; * not all pests on label are listed in this table.

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Efficacy of Montana Registered Seed Treatments, continued from page 6

Vibrance Extreme	difenoconazole; mefenoxam; sedaxane	Syngenta	E	E	E	S	E	S		E	E	E	E					
Intego Solo	ethaboxam	Valent	E															
NipsIt INSIDE*	clothianidin	Valent												E	E	E		
NipsIt Suite Cereals OF*	clothianidin; metalaxyl; metconazole	Valent	E	E	E	E	E				E	E	E					
Rizolex	tolclofos-methyl	Valent	E	S														

E: Effective; S: Suppressed; * not all pests on label are listed in this table.

Seed Treatment Product Information

EPA number	Brand name	Active Ingredients	Class	FRAC Group*	Company
400-574	Rancona Crest	ipconazole + metalaxyl + imidacloprid	Mixed Mode of Action	4A, 3, 4	Arysta
400-570	Rancona Summit	ipconazole + metalaxyl	Mixed Mode of Action	3, 4	Arysta
400-595	Rancona V RTU	carboxin + metalaxyl + ipconazole	Mixed Mode of Action	7, 3, 4	Arysta
71532-22-7969	Acquire	metalaxyl	Acylalanines	4	BASF
7969-266	Stamina	pyraclostrobin	Methoxy-carbamates	11	BASF
7969-322	Stamina F3 Cereals	metalaxyl + pyraclostrobin + triticonazole	Mixed Mode of Action	4, 11, 3	BASF
264-1122	Evergol Energy	metalaxyl + penflufen + prothioconazole	Mixed Mode of Action	4, 7, 3	Bayer
264-1072	Raxil Pro MD	metalaxyl; prothioconazole; tebuconazole	Mixed Mode of Action	4, 3, 3	Bayer
264-1186	Raxil Pro Shield	imidacloprid + metalaxyl + tebuconazole + prothioconazo	Mixed Mode of Action	4A, 3, 4	Bayer
55146-148	Salient 372 FS	difenoconazole	Triazoles	3	NuFarm
55146-101	Sativa 309 FS	tebuconazole	Triazoles	3	NuFarm
55146-112	Sativa M RTU	tebuconazole + metalaxyl	Mixed Mode of Action	4,3	NuFarm
55146-106	Sebring 318 FS	metalaxyl	Acylalanines	4	NuFarm
55146-107	Sebring 480 FS	metalaxyl	Acylalanines	4	NuFarm
228-522	Senator 600 FS	imidacloprid	Neonicotinoid	4A	NuFarm
55146-116	Spirato 480 FS	fludioxonil	Phenylpyrroles	12	NuFarm
55146-127	ST-Methyl 540 FS	thiophanate - methyl	Thiophanate	1	NuFarm
100-799	Apron XL	mefenoxam	Acylalanines	4	Syngenta
100-1305	CruiserMaxx Cereals	difenoconazole; mefenoxam; thiamethoxam	Mixed Mode of Action	4A, 3, 4	Syngenta
100-1383	Cruiser Maxx Vibrance Cereals	difenoconazole; mefenoxam; sedaxane; thiamethoxam	Mixed Mode of Action	4A, 3, 4, 7	Syngenta
100-1141	Dividend Extreme	difenoconazole; mefenoxam	Mixed Mode of action	3,4	Syngenta
100-1159	Dynasty	azoxystrobin	Methoxy-acrylates	11	Syngenta
100-758	Maxim 4FS	fludioxonil	Phenylpyrroles	12	Syngenta
100-1388	Mertect 340-F	mandipropamid	Methyl-benzimidazole carbamate	1	Syngenta
100-1374	Vibrance	sedaxane	Carboxamide	7	Syngenta
100-1382	Vibrance Extreme	difenoconazole; mefenoxam; sedaxane	Mixed Mode of action	3,4,7	Syngenta
59639-186	Intego Solo	ethaboxam	Ethylamino-thiazole-carboxamide	22	Valent
59639-151	NipsIt Inside	clothianidin	Neonicotinoid	4A	Valent
59639-183	NipsIt Suite Cereals OF	clothianidin; metalaxyl; metconazole	Mixed Mode of action	4A, 4, 3	Valent
59639-178	Rizolex	tolclofos-methyl	aromatic hydrocarbons	14	Valent

*FRAC is the Fungicide resistance action committee, which assigns the FRAC Group for active ingredients which demonstrate potential for cross resistance.

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