



Fusarium head blight on barley.
Photo by Janet Lewis/CIMMYT.

Control of Fusarium pathogens in cereals

Frankie Crutcher, Plant Pathologist, Eastern Agricultural Research Center

The genus *Fusarium* contains many plant pathogens which cause damping off, vascular wilts, root rots, blights, and/or storage rots. *Fusarium* are ubiquitous in the soil and cause disease in just about every crop. In cereals, *Fusarium* pathogens are responsible for both crown rot and Fusarium head blight (FHB). Both these diseases can have a drastic effect on yield and typically involve disease complexes (more than one pathogen causing disease in the same field or plant). Most importantly, crown rot and FHB can involve the same pathogens, so management of both diseases is essential to prevent future disease issues.

Fusarium disease complexes can cause crown rots in several crops, but in cereals crown rot is caused primarily by *F. culmorum*, *F. pseudograminearum*, and *F. graminearum*. The disease is often associated with very dry soils in areas of low rainfall. It is characterized by a reddish-brown to brown discoloration of the root and crown. Plants infected with crown rot cannot uptake

enough water for grain fill and will therefore appear stunted and prematurely ripen.

The best strategies to control crown rot include crop rotation with non-host broad leaf plants and the use of seed treatments that have suppressive activity against *Fusarium*. Also, spreading chaff and straw evenly across the field during harvest will minimize moisture and slow the growth of *Fusarium* on residue. Controlling grassy weeds and volunteer cereals that can act as hosts for the fungus can also contribute to maintaining low pathogen numbers in the soil. This disease can often be confused with common root rot – caused by *Bipolaris sorokiniana* – however, management for these two diseases is similar.

Fusarium head blight, also called Scab, is caused by several species of *Fusarium*, the most damaging of which is *F. graminearum*. The disease is economically important due to the production of mycotoxins, specifically deoxynivalenol (DON). DON, also called

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FIGURE 1. Fusarium head blight on wheat. Photo credit Mary Burrows, MSU.



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vomitoxin, can lead to problems with grain refusal in cattle, chicken, and hogs. Current standards require that DON concentrations in grain be less than 2 ppm, otherwise grain will be rejected. In malting barley, Fusarium metabolites produced in addition to DON cause problems in the malting process that lead to over-foaming (gushing) of beer.

The most noticeable symptoms of FHB are partial bleaching of the heads in wheat and brown, discolored kernels in barley. At the base of the florets, an orange mass of spores or black reproductive structures can sometimes be observed. In the floret, grain can be completely absent or contain infested seed – called tombstone kernels – which are small, shriveled, and covered in either white or pink fungal growth.

After harvest, Fusarium remaining on the wheat stubble will form reproductive structures that can survive harsh winters. Additionally, *F. graminearum* is the causal agent of stalk rots in corn and can overwinter and produce inoculum on the residue left in the field. If grain is planted into the stubble the following year, the stubble provides inoculum for crown rots, root rots, and FHB. Spores are dispersed

by wind (ascospores) or water splashing (conidia) and infect the head, primarily during flowering stage.

No single method of control is one hundred percent effective, therefore the best way to avoid high DON levels in grain is to prevent FHB through a combination of several management practices. Use of less susceptible varieties when available, crop rotation or tillage to avoid planting into grain and corn stubble, reduced irrigation during flowering, and fungicide applications should be used together to prevent the disease.

A fungicide application can control FHB and DON up to 50 percent if applied at the correct timing. Fusarium spores infect the head any time between flowering and soft dough, however, the most severe symptoms and highest DON concentrations occur when the fungus infects during flowering (when the head ejects the anthers in wheat and when the head leaves the boot in barley). Thus flowering is the optimal time to apply a foliar fungicide. Prothiconazole, tebuconazol, metconazol, and propiconazol have all shown good control of FHB. Strobilurin fungicides, however, have been

shown to increase DON concentrations when applied after flag leaf stage and therefore should be avoided.

Although DON is not always produced with FHB, if it is present, the highest concentration will be located within the tombstone kernels. Tombstone kernels are light weight and can be cleaned from the seed after harvest. Although you can turn up the fan speed on the combine during harvest to remove infested seed, this is not recommended because it can increase Fusarium levels in the field that can lead to root rots in grain and other crops, including pulses.

You can read more about Fusarium pathogens and cereal diseases in the following MontGuides:

- *Fusarium Head Blight of Wheat and Barley*
<http://msuextension.org/publications/AgandNaturalResources/MT200806AG.pdf>
- *Small Grain Root and Crown Diseases*
<http://msuextension.org/publications/AgandNaturalResources/MT201007AG.pdf>

Here it comes: Cheatgrass emergence season

Tim Seipel, Cropland Weed Extension specialist

Biology and impact of cheatgrass

Cheatgrass (*Bromus tectorum*), also commonly called downy brome, is a problematic weed in winter wheat and in rangeland throughout Montana. Cheatgrass is a winter annual, that means the species typically germinates in the autumn, overwinters, then grows, flowers, produces seed and senesces by mid-summer. Cheatgrass' life cycle is similar to winter wheat which makes it such a problematic weed in winter wheat fields; however cheatgrass can also emerge in spring if fall moisture is limiting, but this is generally less common. Cheatgrass is an abundant seed producer, but seed is only viable for one to two years in the seedbank.

Cheatgrass is a strong competitor with winter wheat seedlings, as they too emerge during the autumn, and can cause appreciable yield loss. In addition to being a good competitor, cheatgrass also serves as a 'green bridge' for diseases that need green living plant material as a bridge to the next growing season. Wheat streak mosaic virus is one of these diseases that has periodic outbreaks in Montana. Breaking the green bridge between harvest and planting is important for limiting the vector (wheat curl mite) and the viral disease. In general, there should be no living grassy weeds or volunteer wheat (i.e. no green, living plant material) for two weeks prior to the emergence of next season's crop.

So, why review cheatgrass biology now? Because this is the time of year when we should think about managing cheatgrass in crop fields, fallow fields, and in rangeland. Cheatgrass begins to emerge in the early autumn when pulses of moisture (precipitation) allow seeds to germinate and establish. Cheatgrass and winter wheat often germinate and emerge at similar times. Managing cheatgrass plants when they are small but actively growing results in better control and can help keep cheatgrass density low heading into winter and spring.

Integrated management of cheatgrass

No 'silver bullet' for managing cheatgrass exists, and in each situation one should

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evaluate what is the best course of action. Below are guidelines to help develop an integrated weed management plan. These can include targeted grazing, reduction in nitrogen availability, chemical or biological control, and some combinations thereof.

- **Develop a monitoring strategy.** Scout fields to determine when cheatgrass is starting to emerge and grow. Herbicide applications during the two to three leaf stage are most effective in killing the plants. Pay close attention to field margins where seeds are likely to disperse in the field. Identify where in the field the highest concentrations of cheatgrass are. Using this information, you can apply treatments to focused areas, saving you time and money.
- **An ounce of prevention is worth a pound of cure.** Prevention of cheatgrass invasion is the best strategy. Make sure equipment is clean and seeds are not being transported from field to field or from storage areas to fields. Work together with neighbors to maintain desirable vegetation surrounding fields, which will limit sources of seeds that can establish in a crop field and eliminate the green bridge that can harbor diseases. Cheatgrass competes poorly with established perennial grasses, so desirable perennial grasses surrounding fields can limit cheatgrass seed production.
- **Diversify crop rotation.** Cheatgrass is a winter annual like winter wheat. Re-cropping of winter wheat promotes more cheatgrass because cheatgrass and winter wheat emerge at similar times and both are often susceptible to the same herbicides (think group 1 ACCase herbicides; e.g. Poast, Assure, or clethodim), while switching to a spring cereal allows for weed management using non-selective herbicides during the autumn or in early spring before planting. Similarly, broadleaf crops like pulses and oilseeds also allow for the use of a wider array of grass-specific herbicides (again think ACCase herbicides) and allow for dormant season applications with non-selective herbicides that helps improve cheatgrass management. Rotations are a key component to improved management of cheatgrass.

- **Physical control.** Physical methods to control cheatgrass should focus on removing plants, thus reducing seed production, but this is risky because the effectiveness of any physical control method is dependent on timing to minimize seed dispersal and vigilance in repeating this throughout the season. Physical control can also cause soil erosion. Discing and tillage will encourage more cheatgrass because disturbance and a fluffy seedbed provide ideal conditions for cheatgrass germination. If seed is buried six inches deep germination can be limited, but this doesn't work as well in rocky soils. Mowing repeatedly every couple of weeks in the spring and summer can be effective in preventing seed production by cheatgrass, however a single mowing event will not limit seed production.
- **Cultural and biological control.** Cheatgrass does not compete well with many other species, therefore a fall cover crop or competitive perennial species can greatly limit seed production of cheatgrass. Repeated grazing of cheatgrass can reduce seed production when it occurs in the spring using a short duration-high intensity approach. However, summer grazing will have almost no effect on cheatgrass seed production. There are no listed

biocontrol agents in Montana though some work continues to develop effective biocontrol agents.

- **Chemical control.** There are a number of options available to control cheatgrass using herbicides; however, read the label and consider herbicide carryover and potential for herbicide damage to crops. Glyphosate can be applied at low rates in autumn or early spring to suppress growth and seed production of cheatgrass in fallow. There are several other chemical management options available to reduce the abundance and impact of cheatgrass in winter wheat. Among them Maverick® (sulfosulfuron), Beyond® (imazamox), Olympus™ 70WDG (propoxycarbazone), Olympus Flex™ (propoxycarbazone), and PowerFlex™ (pyroxsulam) are registered as selective herbicides that provide suppression or control of cheatgrass in winter wheat. To be effective, all herbicides should be applied to actively growing cheatgrass seedlings. Keep in mind that evolved herbicide resistant biotypes of cheatgrass also occur in Montana and more herbicides and usage will only exacerbate the problem.

For more information on managing cheatgrass see the Montguide *Cheatgrass: Identification, Biology and Integrated Management*, <http://msuextension.org/publications/AgandNaturalResources/MT200811AG.pdf>.

FIGURE 2. Cheatgrass at the flowering stage. Seeds are viable once plants begin to turn reddish-purple Photo by Matt Lavin, MSU.



Paraquat mitigation measures approved by EPA

Cecil Tharp, MSU Pesticide Education Specialist

The active ingredient paraquat (i.e. dichloride salt of paraquat, ortho paraquat CL, paraquat dichloride) was first registered in 1964 for weed control and crop desiccation and is widely used across Montana; however, it is categorized as highly toxic through all routes of exposure by the Environmental Protection Agency (EPA), where as little as one sip can be lethal with no known antidote. These products have been under scrutiny due to many human poisonings through the ingestion of paraquat, either accidental or intentional, that have been reported to EPA from poison control centers, product registrants, health agencies, environmental agencies and individual consumers. The EPA has announced its final decision regarding proposed mitigation measures for paraquat in an effort to decrease future poisonings. This decision will soon impact all pesticide applicators using paraquat products. See the list at the end of this article for some common paraquat products.

EPA has ordered the following measures to adequately protect applicators and the public:

- Label changes emphasizing paraquat toxicity and supplemental warning materials.
- Targeted training materials for paraquat users.
- Closed-system packaging for all non-bulk (< 120 gallon) end use containers of paraquat.
- Restricting the use of all paraquat products to certified applicators only.

Prohibiting the use of handheld or backpack sprayers (when applying paraquat) was considered, however due to compelling public comments, EPA is

permitting the continued use of handheld and backpack equipment if use complies with new closed-system packaging requirements and contains a dye to aid in early detection of leaks and spills.

Label changes.

The EPA is requiring updated label language and supplemental warning statements including: 1) highlighting ingestion risk and clarifying toxicity statements, 2) targeted paraquat training statements, and 3) statements designating paraquat products to only be handled by certified applicators. Paraquat products sold/distributed by pesticide manufacturers shall contain these updated label statements no later than 12 months after the “label stamped date” by EPA. This is a variable deadline, however new labeling requirements could be distributed from manufacturers during the 2019 field season.*

Supplemental warning and toxicity statements. The Environmental Protection Agency is requiring supplemental warning statements consisting of: 1) a warning sticker affixed to the cap of all paraquat containers with the text “DANGER-ONE SIP CAN KILL” accompanied by the image of a skull and crossbones; 2) a “product package safety requirements sticker” reiterating important warning statements to be affixed to the opposite side of the label; and (3) a product warning handout called a “counter card” reiterating the same important warning information to be distributed with every paraquat container. All the supplemental warning materials must feature these messages in English, Spanish, and pictogram format.

Targeted paraquat trainings. The Environmental Protection Agency is requiring all applicators who handle paraquat to take an EPA-approved paraquat training program when indicated on the new product label. EPA-approved paraquat training programs must provide information on: (1) paraquat toxicity; (2) a summary of the new label requirements; (3) consequences and examples of misuse of paraquat; (4) how to apply paraquat; (5) what to do in case of accidental exposure, and (6) appropriate handling, storage, disposal, and personal protective equipment requirements and instructions. The paraquat training program will be available via an internet link included on all paraquat end-use labels. All persons handling paraquat are expected to take the training every three years and retain documentation of successful completion.

Certified applicators only. Paraquat products are only to be used or handled by certified applicators who have met



FIGURE 3. Proper handling is important when using paraquat. Photo by Cecil Tharp, MSU.

* Dealers may continue to sell and applicators may use existing stocks of paraquat products with the previously approved labeling until such stocks are exhausted. Always follow the product label requirements attached to the product container.

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certified applicator competency standards established by states, tribes, and federal agencies. They are not to be used by uncertified individuals working under the supervision of a certified applicator. The statement shall read “to be used by certified applicators only – not to be used by uncertified persons working under the supervision of a certified applicator.”

Closed System Standards.

The Environmental Protection Agency is requiring all paraquat non-bulk (less than 120 gallon) end-use product containers sold or distributed by product registrants comply with EPA-approved closed system standards no later than 12 months after the EPA label stamp date. This is variable, but final deadline will likely be after September 2020 (see footnote, page 4). The closed system packaging for paraquat products must be engineered so paraquat can only be removed from the container using closed system technology.

Additional paraquat information can be found on the EPA website or see the EPA Paraquat Mitigation Decision and Amendments. Contact the paraquat product registrant for more information on available trainings and exact implementation timeline. For additional paraquat regulatory information contact a Montana Department of Agriculture field agent or Cecil Tharp, MSU Pesticide Education Specialist (406-994-5067; ctharp@montana.edu) with general paraquat questions.

Some pesticide products containing paraquat:

Blanco®
Bonedry®
Cyclone SL 2.0®
Devour®
Firestorm®
Gramoxone SL 2.0®
Helmquat 3SL®
Para-Shot 3.0®
Paraquat Concentrate®
Willowood Paraquat 3 SL®

A perennial problem: Revisiting control methods for Canada thistle

Stacy Davis, Research Associate, Department of Land Resources & Environmental Sciences

Many of you have heard of Canada thistle (*Cirsium arvense*), but did you know it is the most frequently listed noxious weed in the U.S. and Canada and has been on Montana's noxious weed list since 1895? Over the years there has been a lot of research about controlling Canada thistle, but it certainly remains a management challenge. To help identify best management strategies and direct future research, we conducted a meta-analysis which can be thought of as “research about research.” Other researchers and I conducted a literature review and identified over 1,800 articles about Canada thistle! However, only 100 articles qualified for inclusion in our analysis focusing on management in annual cropping systems (e.g. row crops, fallow fields) or perennial systems (e.g. pasture, rangeland, natural areas). We gathered results from those previously-published studies and pooled them together for collective analysis, where one analysis focused on annual cropping system management and another on perennial system management. For each management strategy, we calculated an effect size, which is the abundance of Canada thistle in treated plots compared to the abundance of Canada thistle in non-treated plots. This analysis helped us understand what management strategies were effective, not effective, and how they compared to one another.

Annual cropping systems: Most studies in annual cropping systems took place in the U.S. and only looked at short-term efficacy. Less than a year after treatment, all strategies were considered effective. These included biocontrol, competition (e.g. planting competitive crops or manipulating row spacing), crop diversification, herbicide, herbicide integrated with at least one other strategy, and soil disturbance (e.g. tilling). Interestingly, combining



FIGURE 4. Canada thistle at the flowering stage. Photo by Matt Lavin, MSU.

one or more strategies with herbicide (i.e. herbicide integrated) was the most effective short-term control strategy. We also looked at studies more than one year after treatment and found that biocontrol, crop diversification, herbicide, herbicide integrated, mowing, non-herbicide integrated (combining two or more strategies not including herbicides), and soil disturbance all reduced Canada thistle. Applying fertilizer was not effective as a Canada thistle management technique. Combining one or more strategies with herbicide (i.e. herbicide integrated) or without herbicide (i.e. non-herbicide integrated) was more effective than simply applying herbicides to Canada thistle. Our results provided strong support for integrated weed management (IWM), particularly when dealing with such a persistent plant that forms an extensive root system.

Perennial systems: In perennial systems a variety of strategies were effective for short-term control. These included biocontrol, competition (e.g. seeding desirable species to compete with Canada thistle), herbicide, herbicide integrated, mowing, mulch, and non-herbicide integrated. Effective long-term strategies

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(more than one year after treatment) included biocontrol, herbicide, herbicide integrated, and mowing. Competition had no long-term effect on Canada thistle. While herbicide was the most frequently studied management technique, we found integrating different strategies with herbicide was more effective than applying herbicide alone for long-term control. Examples of strategies integrated with herbicides included burning, competition, mowing, and soil disturbance. Additionally, mowing alone was as effective as herbicide for providing Canada thistle control.

Summary and future research

In both annual cropping and perennial systems, land managers should consider integrating management techniques for enhanced long-term control of Canada thistle, as this approach proved to be more effective than solely applying herbicides. Despite herbicide being the most-studied management strategy, a variety of other management techniques resulted in similar control of Canada thistle in the short- and long-term in annual cropping and perennial systems. Non-chemical strategies and integrated weed management were under-studied and warrant future research and experimentation for Canada thistle control. We also found fewer studies evaluated the long-term efficacy of Canada thistle management so more long-term studies are needed to develop effective solutions to this persistent weedy plant.

To learn more about the study, see Davis et al. 2018. If you would like a full copy of the research article, please contact Jane Mangold at jane.mangold@montana.edu. This research was supported by the Montana Noxious Weed Trust Fund and the Montana Wheat and Barley Committee.

ASK THE EXPERT

Q. I plan to spray cheatgrass with imazapic on my native rangeland this fall. Imazapic is sold as Plateau® or Panoramic 2SL. Are both brands equally effective? I have also read that an “early fall” application is best. When is “early fall?”

Jane Mangold says: You are correct, the active ingredient imazapic is sold as Plateau® and Panoramic 2SL. My experience leads me to believe the two products are equally effective. Imazapic results in the best cheatgrass control if applied when cheatgrass plants are 1-2 leaves in size. This typically occurs between mid-September and mid-October in Montana. Because cheatgrass emergence and growth is driven by the weather—fall moisture and cool temps prompt cheatgrass emergence—the best application timing is driven more by plant growth and size at time of spraying rather than a date on the calendar. While general dates can be advised, the best decisions are made by observing cheatgrass growth in the field.

Q: I was hoping you could help clarify some confusion on the dicamba label (i.e. Banvel) regarding spraying kochia in a summer fallow field using dicamba. A producer would like to spray his summer fallow one more time. The label states one could go up to 4 oz/acre and then plant winter wheat next week. On summer fallow the label states that 1.5 pints/acre can be applied, but in another section there is a disclaimer that states “for all crop rotations you need to allow a 45-day interval per pint of dicamba applied for all crops.”

Tim Seipel says: The half-life of dicamba is 1 to 4 weeks in the soil, (hence the 45-day period). Dicamba is reduced through a combination of dissipation through volatilization (converting to a gas); and degradation primarily through microbial action, which is fastest in warm, moist soils. With heavier rates and drier soil conditions the plant-back date is 45 days because it

takes the herbicide longer to degrade to a level below the injury threshold. The lower rate will have a shorter plant back date, because it contains less herbicide that needs to degrade. Dr. Judit Barroso, Oregon State University, recently summarized options other than dicamba for chemical control in fallow in the Pacific Northwest. <https://pnwhandbooks.org/weed/agronomic/cereal-grain/chemical-fallow-east-cascades>

Q. Can I purchase and plant the new dicamba-resistant soybean ‘GMO’ in Montana?

Cecil Tharp says: Even if you could purchase or plant dicamba-tolerant soybeans (Xtend Soybeans) in Montana; you cannot currently use any pesticide products legally to justify the purchase. The following products are registered for use on dicamba-tolerant soybeans:

- **Engenia:** Not labeled for “in crop” applications on GMO crops in Montana.
- **FeXapan plus Vapor Grip Technology:** Not registered or labeled for use in Montana.
- **Xtendimax with Vapor Grip Technology:** Not registered or labeled for use in Montana.

Engenia can be purchased and used in Montana, however it can’t be used “in crop” for GMO applications. This includes GMO soybeans in Montana. As it currently stands, we don’t recommend Montana soybean growers to plant dicamba-tolerant soybeans in Montana unless we see Montana added to “in crop” applications to GMO soybeans on a pesticide product label. This may change as these labels are up for review this fall. Stay tuned for next spring. Contact your local MSU Extension agent or the MSU Pesticide Education Program (406-994-5067; ctharp@montana.edu) for more information next spring.



Meet Your Specialist

Tim Seipel, Extension Cropland Weed Specialist, Montana State University.



Where/when did you receive your degrees?

I received my Bachelor's in Biology and Master's in Plant Sciences at Montana State University. I earned my PhD at ETH – Zurich (aka Swiss Institute of Technology in Zurich, Switzerland). During my PhD I focused on population dynamics and distributions of invasive species in mountains around the world.

What is your field of interest (scholastic and research)?

I would call myself a plant ecologist. I focus on how plants interact with other plant species and their environment. I apply the ecological knowledge in agricultural systems.

When did you arrive in Bozeman?

I first moved to Bozeman in 1997 when I started as an undergraduate at MSU.

Where are you from originally?

To be honest, I have always disliked this question – mostly because the answer is complicated. I was born in Tennessee and grew up in Ohio. My mom is from west Tennessee and my father is from Bavaria in Germany. The short answer to the question would be “the world.”

Where have you worked/taught in the past?

I have had a lot of jobs, some of my highlights are greenskeeper, wild game butcher, Subway sandwich artist, landscaper, and mountain guide.

Most of my academic research and teaching has been at Montana State as a student, a post-doctoral researcher and an instructor.

What do you like to do in your spare time?

Any hobbies?

Most of my hobbies revolve around mountains and being outside. I am an avid skier, rock and mountain climber, and love archery hunting. I am an avid gardener and love camping and playing in the mountains with my family.

What are some important areas of focus in your field?

I focus on how plants interact with each other and other trophic levels (like microbes and insects). In croplands we face challenges that require us to better develop integrated weed management strategies using all tools available to us.

Describe some past research projects:

In the lab we just finished projects looking at the role of farming management and crop rotations on weed communities, and the role of climate in understanding winter wheat yield loss to cheatgrass (downy brome).

What are some of your current projects?

Currently, we have projects at the Northern Ag and Central Ag Research centers which look at the use of cover crops that compete with weeds. We are also assessing how cover crops affect soil moisture which can affect yields during the next season. I am also working on a learning module for understanding herbicide injury and carryover.

What projects would you like to focus on in the future?

One of my mid-to-long term goals is to understand how to use cover crops and crop rotations to maximize economic return and minimize weed seeds put into the seedbank. There are a lot of moving parts to the systems and I will be working hard to figure them out. We want to assess if soil moisture is affected in the following crop year, we also want to understand how cover crops compete with weeds, to understand if we can incorporate grazing, and how cover crops may affect microbial communities in the soil that affect plant growth.

Pest Management Toolkit

- **2018 Pesticide Education Program Update.** Bozeman. November 14-15. For pesticide trainers across Montana. This two day program will bring in new technologies while delivering pesticide law updates to pesticide trainers. Commercial applicator credits will be available. For program details contact ctsharp@montana.edu or to pre-register contact Amy Bowser (amy.bowser@montana.edu)

montana.edu; 406-994-5178) or view program agenda at <http://www.pesticides.montana.edu> by selecting “PEP Update.”

- **2018 Governor's Summit on Invasive Species.** November 15-16, Colonial Radisson Hotel, Helena.
- **Fumigant Training Tour.** December 18 in Havre. December 19 in Miles City. For individuals applying agricultural fumigants

for structural and/or vertebrate pest control. Primarily focused on the use of aluminum / magnesium phosphide products. Half day session offering private and commercial applicator credits in the categories of dealer (4), ag vertebrate pest (1), seed treatment (1), demo and research (4), rodent (1), and private ag pest (4).

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To register contact Amy Bowser (amy.bowser@montana.edu; 406-994-5178) or see online agenda at <http://www.pesticides.montana.edu> by selecting “Fumigant Tour” on the scrolling banner. Private and commercial applicator credits will be available.

- **Sign up for the Pesticide Education Program Newsletter.** This newsletter delivers pesticide updates, legal actions, alerts, and training information to private applicators on a quarterly basis. Delivered electronically at no cost by simply providing email. Sign up at <http://www.pesticides.montana.edu/index.html>. Call

Amy Bowser (amy.bowser@montana.edu; 406-994-5178) for more information.

- **Montana’s Noxious Weeds (EB0159) is now available as an electronic flipbook.** Download it onto your smart phone or tablet and take it anywhere!
https://store.msuxextension.org/Products/Montanas-Noxious-Weeds__EB0159.aspx
- **New fact sheet on *Ventenata dubia*,** a high priority invasive plant, is now available.
<http://msuxextension.org/publications/AgandNaturalResources/mt201810AG.pdf>
- **Take Action** is a website designed to help agricultural professionals understand

evolved herbicide, fungicide and insecticide resistance. The goal is to encourage farmers to adopt management practices that lessen the impacts of resistant pests and preserve current and future chemical crop protection technology. Take Action started as an industry and trade group collaborative focused on the growing threat of herbicide resistant weeds. The website contains useful information on principles and need for developing integrated weed management plans. Some handy tools are available under resources that include lists of herbicides and pre-mixes by trade name and mode of action. www.iwilltakeaction.com

DO YOU HAVE A COMMENT OR QUESTION REGARDING THE MONTANA IPM BULLETIN?

Send your questions or suggestions to:

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Common chemical and trade names are used in this publication for clarity by the reader. Inclusion of a common chemical or trade name does not imply endorsement of that particular product or brand of herbicide. Recommendations are not meant to replace those provided in the label. Consult the label prior to any application.



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EXTENSION

If you wish to have the Montana IPM Bulletin emailed to you for free, contact the MSU Pesticide Education Program office: ctharp@montana.edu.