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MontGuide

Cheatgrass: Identification, Biology and Integrated Management

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This Montguide describes cheatgrass biological and ecological characteristics. It also provides mechanical, cultural and chemical management options to control this species in crop and non-crop situations.

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CHEATGRASS (*BROMUS TECTORUM* L.), ALSO known as downy brome, military grass, downy cheat and downy bromegrass, is a problematic annual weed in many areas of Montana. It can grow in a wide variety of habitats, and is troublesome in winter wheat-based systems, alfalfa, Conservation Reserve Program (CRP) lands, rangelands, fencerows, and railroad right-of-ways. Not only does cheatgrass reduce crop quality and yield, it creates fire hazards after it matures in late spring. Although cheatgrass is palatable as spring and fall forage before emergence of seed heads, mature plants decline in forage quality and can injure livestock by causing infection in the eyes or mouth.

Origin and Distribution

Cheatgrass, native to southwestern Asia, was introduced to North America in several independent events. The first introduction is believed to have been from ship ballast dumps near St. Louis, Missouri. Cheatgrass first appears in North American botanical records in 1861 in Pennsylvania. The first report of cheatgrass in western North America came from British Columbia in 1890. Early infestations were often found near wheat fields and railroads, probably because wheat seeds were contaminated with cheatgrass seeds, and straw infested with cheatgrass seeds was used to pack goods transported via railroad.

Cheatgrass spread rapidly through the Intermountain West in the 1800s, benefitting from pre-adaptation to environmental conditions of the region and utilizing degraded plant communities that resulted from improper livestock grazing. In addition, cheatgrass colonized homesteads abandoned during the Great Depression. By 1950 cheatgrass was widespread across the Intermountain West. In Montana, cheatgrass was first reported in 1898 in Missoula County, and by 1980 every county in the state had reported its presence. Currently, cheatgrass is one of the most problematic weeds in the western U.S., Canada, and northern Mexico.

FIGURE 1. Cheatgrass plant, enlarged spikelet, and seed. (Source USDA NRCS PLANTS Database)

Cheatgrass Identification and Biology

Cheatgrass plants grow from 6 to 24 inches tall, depending on available soil moisture, fertility, and plant competition. At emergence and before seed set, plants are green. Mature plants are red-brown and have erect and slender stems. Leaf sheaths and flat, twisting blades are covered with soft hair. Leaves are approximately 1⁄32 inches wide and 2 to 6 inches long. Ligules are membranous. Panicles are 2 to 6 inches long with slender branches that droop to one side (Figure 1). Cheatgrass plants produce numerous, five-to-eight-flowered spikelets with ⅜ to ⅝ inch awns that are slender, straight, and purple at maturity. Each awn is attached to the lemma of a hairy, buff brown, ½ inch long and narrow seed. The awns stick to the clothing of humans and the hair and fur of animals, an important vector of seed dispersal. Cheatgrass is prolific, producing up to 500 seeds per plant. Seeds can germinate soon after maturation, but typically do not remain viable for more than two or three years. Roots are fibrous, relatively shallow, and grow many root hairs which enable the plants to extract soil water very effectively.

Damage and Impacts

As a highly competitive winter annual weed, cheatgrass gains an advantage over crops and rangeland plants by initiating growth earlier in spring and growing more throughout fall and winter. Soil water depletion is one of the primary mechanisms by which cheatgrass competes with vegetation. This is especially problematic when attempting to revegetate land infested with cheatgrass. As spring precipitation diminishes and summer temperatures rise, perennial grass seedlings may not be big enough to survive, while cheatgrass plants could be already producing seed.

In some Intermountain West rangelands cheatgrass can impact fire regimes by increasing the continuity of fine textured fuel which promotes larger and more frequent fires. Because the fire return interval is shortened, perennial vegetation is unable to completely recover before the next fire. At the same time, cheatgrass abundance continues to increase, promoting larger and more frequent fires. Perennial vegetation is eventually removed from the system, resulting in a near monoculture of cheatgrass. While cheatgrass is a fire hazard, its effect on fire regimes has not been observed to occur in Montana to date, but this trend could be reversed in predicted climate scenarios (e.g. hotter and drier summers).

In cropland, cheatgrass is problematic in winter wheat-based cropping systems where heavy infestations have potential to reduce crop yield and quality. It has been estimated that cheatgrass abundance of 50 plants per square foot can remove soil water to the permanent wilting point to a depth of about 2½ feet, meaning this weed is very competitive for soil water and nutrients. Several factors have contributied to the increase in cheatgrass abundance, including an increased number of acres seeded to winter wheat production, widespread adoption of conservation tillage practices, and the use of selective herbicides for control of grassy weeds in wheat.

Integrated Management of Cheatgrass

Once established, cheatgrass can be very persistent. In general, the integration of cultural (e.g. grazing, revegetation, competition) with chemical management tools is recommended for successful cheatgrass control. Because the majority of cheatgrass seeds usually do not remain viable in the seedbank for more than two or three years, preventing seed production reduces the number of seeds in the soil which may improve the outcome of integrated management programs.

Integrated Management in Range, Pasture and CRP Systems

As with any invasive plant, prevention is an efficient and effective means of management. Recent research has suggested that initial colonization of cheatgrass into native perennial plant communities in the western U.S. is caused by soil and plant community disturbance. Low abundance of perennial grasses and large gaps between them make a plant community more susceptible to cheatgrass encroachment. Maintaining the vigor of desired plant communities and preventing soil disturbance are good ways to prevent cheatgrass invasion.

How does cheatgrass grow?

Annual plants such as cheatgrass grow from a seed, flower, set seed, and die every year. Cheatgrass is considered a winter annual plant because it usually germinates in the fall and grows rapidly until cold temperatures arrive, but germination may also occur in spring, depending on conditions. Growth may continue through the winter, especially in the root system. In early spring, cheatgrass seedlings resume growth, produce seeds and die sometime between early and mid-July. Other winter annual weeds include common chickweed *(Stellaria media* (L.) *Vill.*), field pennycress *(Thlaspi arvense* L.*)*, jointed goatgrass *(Aegilops cyclindrica* Host*)*, and shepherd's purse *(Capsella bursa-pastoris* (L.) *Medic)*.

Discing and other mechanical control treatments alone are typically not recommended for cheatgrass management because disturbed soil and a fluffy seedbed can favor cheatgrass establishment. However, mechanical control can be useful when renovating pasture or CRP stands. If mechanical control is used, multiple treatments are required to bury cheatgrass seeds at least 4 to 6 inches deep to suppress their germination. Mechanical control followed by chemical application may help reduce cheatgrass seeds in the seedbank. However, caution should be taken to reduce the risk of soil erosion.

Roundup® (glyphosate) can be applied at low rates in early spring to suppress cheatgrass growth and seed production. Care should be taken to only apply glyphosate when desirable perennial vegetation is dormant to avoid injury to those species. Plateau® or Panoramic 2SL® (imazapic) provides control of cheatgrass, and its selective activity allows many desirable native grasses and forbs to re-establish after treatment. For the most effective control of cheatgrass using products containing imazapic, fall applications during the early post-emergent growth stage (1-2 leaves) are recommended. Matrix® (rimsulfuron) and Landmark® (sulfometuron-methyl + chlorsulfuron) can be applied in the fall followed by seeding in the spring, or applied in the spring followed by seeding in the fall. See Table 1 for more details on chemical control.

Prescribed livestock grazing in spring or late fall may be effective in localized areas. Grazing should occur when cheatgrass is tall enough to be accessible to livestock, but prior to plants turning purplish-red so as to prevent seed production. As a general rule, two grazing periods within a year are recommended to keep cheatgrass from producing seed, and grazing is required for a minimum of two to three consecutive years to deplete the seed bank. Grazing should be carefully monitored to prevent damage to perennial vegetation. Where livestock is not available, mowing can be used to stop seed production and reduce seeds in the seed bank over time. As with grazing, mowing should occur prior to plants turning purplish-red.

Prescribed fire is typically not recommended for controlling cheatgrass as it may increase cheatgrass populations, and timing can be difficult. However, some success has been observed when burning cheatgrass, or its close relative Japanese brome (*B. japonicus*), before seed set and/or seed rain.

When cheatgrass forms extensive monospecific stands, revegetation in combination with control measures may be necessary to re-establish a perennial plant community that meets management objectives. For example, in a meta-analysis of over 100 studies that investigated various cheatgrass control measures on western U.S. rangeland, revegetation decreased cheatgrass abundance more than any other practice in studies lasting longer than one year. Integrating drill or broadcast seeding along with an herbicide application is a common tactic to manage cheatgrass, but care must be taken to seed species that are tolerant to herbicides used. Prescribed livestock grazing may also be used as site preparation for revegetation to reduce vigor of cheatgrass plants and decrease seed banks.

TABLE 1. Examples of herbicides that can be used to manage cheatgrass. Consult herbicide labels for additional rate, application, and safety information. Additional herbicide information can be found at http://www.greenbook.net.

Herbicide Active Ingredient Trade Name	Mode of Action	Product per ACRE	Application Time or Growth Stage
Range, Pasture and CRP Systems			
Glyphosate Roundup Pro	Inhibition of EPSP synthase	6 to 12 ounces	Apply early spring prior to seed production and prior to growth of desired perennial grasses
Imazapic Plateau Panoramic 2SL	Inhibition of acetolacetate synthase (ALS)	6 to 12 ounces	Apply early fall shortly after cheatgrass emergence and prior to planting desirable species
Propoxycarbazone-sodium Lambient	Inhibition of acetolacetate synthase (ALS)	2 to 12 ounces	Apply early fall shortly after cheatgrass emergence (2-leaf to 2-tiller growth stage)
Rimsulfuron Matrix	Inhibition of acetolacetate synthase (ALS)	0.9 to 1.2 ounces	Apply late summer to early fall before cheatgrass emergence; if planting desirable species, wait until spring
Sulfometuron methyl + chlorsulfuron Landmark	Inhibition of acetolacetate synthase (ALS)	0.75 ounces	Apply late summer to early fall before cheatgrass emergence; if planting desirable species, wait until spring
Cropping Systems			
Alfalfa			
Glyphosate Roundup and generic products	Inhibition of EPSP synthase	Maximum single application = 1.56 lb ae	Apply only in Roundup Ready alfalfa
Clethodim Select Max	Inhibition of acetyl CoA carboxylase (ACCase)	9 to 16 ounces	Apply when cheatgrass is 2 to 6 inches tall
Ammonium salt of imazamox Raptor	Inhibition of acetolacetate synthase (ALS)	4 to 6 ounces	Apply before cheatgrass is 3 inches tall
Clearfield® Wheat			
Ammonium salt of imazamox Beyond	Inhibition of acetolacetate synthase (ALS)	4 to 6 ounces	Apply when cheatgrass has 1 to 5 leaves and no more than 2 tillers
Imazamox + MCPA ClearMax	Inhibition of acetolacetate synthase (ALS) + Auxin Growth Regulator	4 + 8 fl oz Winter wheat: Up to 18 fl oz.	Wheat: 4-leaf to prior to jointing. Weeds: 1 to 3 inches tall.
Winter Wheat			
Propoxycarbazone-sodium + mesosulfuron-methyl Olympus Flex	Inhibition of acetolacetate synthase (ALS)	3½ ounces	Apply from wheat emergence up to jointing
Sulfosulfuron Maverick	Inhibition of acetolacetate synthase (ALS)	⅔ ounces – Fall or ⅜ ounces – Fall + ⅜ ounces – Spring	Crop stage: apply from 2-leaf up to jointing
Pyroxsulam Power Flex	Inhibition of acetolacetate synthase (ALS)	3½ ounces	Crop stage: apply from 3-leaf up to jointing
Spring Wheat			
Pyroxsulam + florasulam + fluroxypyr GoldSky	Inhibition of acetolacetate synthase (ALS) + Inhibition of acetolacetate synthase (ALS) + Synthetic Auxin	1 pt (0.21 oz + 0.04 oz + 1.42 oz)	Wheat: Up to jointing. Cheatgrass: Up to 2 tillers
Fallow			
Dicamba and *Glyphosate* Fallow Master Broad Spectrum	Action like indole acetic acid (synthetic auxins) and inhibition of EPSP synthase	32 ounces	Apply before cheatgrass is 6 inches tall
Peas and Lentils			
Imazamox ammonium salt Raptor	Inhibition of acetolacetate synthase ALS (acetohydroxyacid synthase AHAS)	4 ounces	Apply before cheatgrass is 3 inches tall

Biological control options for cheatgrass are in various stages of development. Current work is focused on three strains of the naturally-occurring soil-borne bacteria *Pseudomonas fluorescens*: D7, ACK55, and MB906. These bacteria stunt cheatgrass root growth and decrease overall plant vigor. Strain D7 is registered in Montana as a bio-herbicide for use on wheat, barley, triticale, oats, and rangeland. Strain ACK55 is under review by the Environmental Protection Agency (EPA) as a bio-herbicide. Strain MB906 is marketed as a liquid soil inoculant that enhances soil biodiversity. To date, there is no peer-reviewed research demonstrating effectiveness nor lack thereof of *P. flourescens* in field trials in the Northern Rocky Mountain Region.

Integrated Management in Crops

It is important to prevent the introduction of cheatgrass via contaminated seeds or equipment and limit seed production in established cheatgrass patches to reduce abundance and spread. Other approaches include diversifying crop rotation and enhancing crop competitiveness by increasing seeding rate and decreasing row spacing. Banding N fertilization enhances crop competitiveness, thus decreasing cheatgrass growth. Finally, while tillage is a very effective tactic to reduce cheatgrass density, take caution to minimize soil erosion.

As a general rule, early fall herbicide treatments are more effective to control emerged plants than spring treatments. Herbicide applications after spring wheat emergence usually fail to provide effective control, allowing cheatgrass plants to produce seeds. There are several chemical management options to reduce the abundance and impact of cheatgrass in winter wheat crops. Registered selective herbicides that provide suppression or control of cheatgrass in winter wheat include Finesse® (chlorsulfuron), Maverick® (sulfosulfuron) applied postemergence, Powerflex HL® (pyroxsulam), Beyond® and ClearMax® (imazamox), Olympus™ (propoxycarbazone), and Olympus Flex™ (propoxycarbazone). In pulse crops (e.g., lentils) Assure II®(quizalofop) and Select Max ® (clethodim) can be used to manage cheatgrass infestations. Producers who grow pulse and other broadleaf crops should check labels for re-cropping intervals in order to prevent herbicide carryover and injury. Other herbicide-based management options can be found witht the Herbicide Selection Tool available on-line at http://www.sarc.montana.edu/php/weeds/.

To be effective, herbicides should be applied to actively growing cheatgrass seedlings. Products that have soil activity (Maverick®, Olympus™ and PowerFlex™) require moisture after application to perform properly. Beyond® and ClearMax® herbicides must be used with crop cultivars that contain the gene that confers tolerance to imazamox as part of the Clearfield® Production System. Tolerance to imazamox means that the crop with the gene is able to withstand a recommended rate of Beyond® or ClearMax® with minimal risk of crop injury. Varieties that do not contain this gene are either killed or seriously injured by these herbicides.

Preventing Herbicide Resistance

Herbicide resistance is the ability of a weed biotype to survive and reproduce after treatment with a normally lethal herbicide dose. In Montana, cheatgrass biotypes resistant to ALS herbicides (inhibitors of the acetolactate synthase enzyme) have been confirmed. Biotypes resistant to ALS herbicides and ACCace herbicides (inhibitors of Acetyl CoA Carboxylase) have been selected in Oregon. Other cases of herbicide resistance in cheatgrass include Ureas and Amides (Spain), and Photosystem II inhibitors (Spain and France). To reduce the risk of selecting herbicide-resistant biotypes, producers should rotate among herbicides with different sites of action and management practices, such as incorporating timely cultivation. Finally, crop rotation is an excellent tool to reduce selective pressure on herbicide-resistant weeds. More information can be found in Montguide MT200506AG, *Preventing and Managing Herbicide-Resistant Weeds in Montana*.

Note: Information in this document is provided for educational purposes only. Reference to commercial products or trade names does not imply an endorsement by MSU Extension. 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 product or brand of herbicide and exclusion does not imply non-approval. This publication is not intended to replace the product label.

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