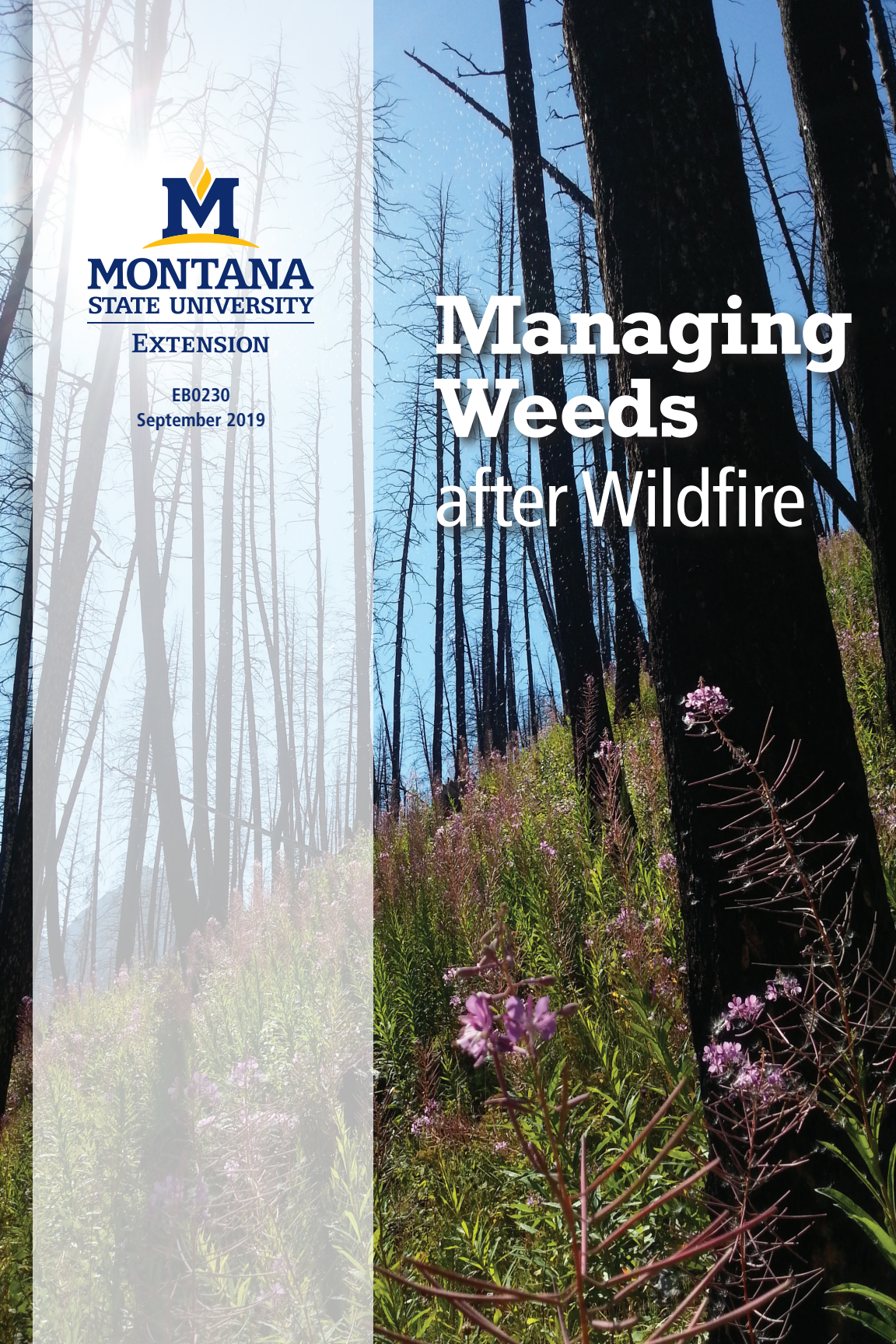


MONTANA STATE UNIVERSITY
EXTENSION

EB0230
September 2019

# Managing Weeds after Wildfire

**AUTHORS:**

**Stacy Davis** Research Associate (former), Montana State University, Bozeman

**Jane Mangold** Extension Invasive Plant Specialist, Montana State University, Bozeman

This publication was revised and updated in 2019 from the original publication titled, *Integrated Noxious Weed Management After Wildfires* (EB160), written by Goodwin, Sheley and Clark, printed in 2002 by the USDA-Forest Service through the Montana Department of Agriculture Noxious Weeds Trust Fund grants program. Design and layout by MSU Extension Publications.

Funding for this publication was provided by the Montana Noxious Weed Trust Fund and Missoula County Weed District.



Common chemical and trade names are used in this publication for clarity of the reader. Inclusion of a common chemical or trade name does not imply endorsement of that particular product or brand of herbicide and exclusion does not imply non-approval.

Herbicide usage suggestions provided in MSU Extension materials are intended to serve only as a guide and are published for educational purposes. If any suggestions conflict with a product label, follow the product label instructions. Read and follow all product labels carefully.



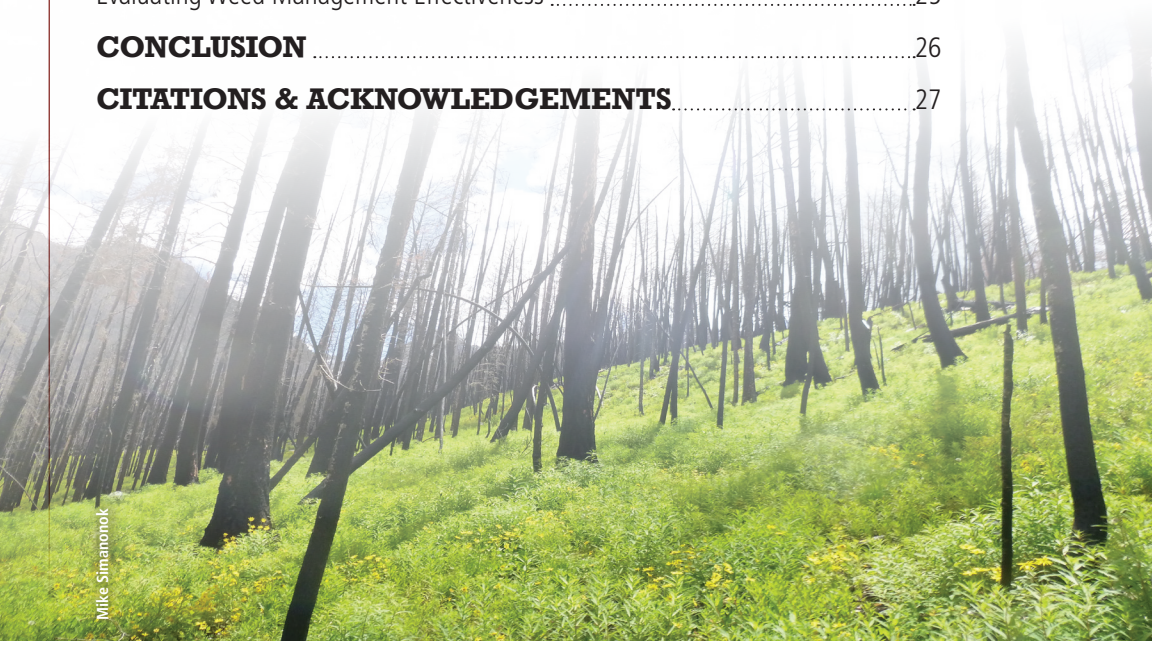
Copies of this booklet and other resources available from MSU Extension Publications, *email:* orderpubs@montana.edu, *online:* store.msuextension.org, *telephone:* (406) 994-3273, or *mail:* P.O. Box 172040, Bozeman, MT 59717-2040



Front cover and back cover photo: Mike Simanonok

MONTANA STATE UNIVERSITY | EXTENSION

Mike Simanonok


Mike Simanonok

# Introduction

**If you had a wildfire on your property recently, you may be wondering if the vegetation will recover and what to do about any weeds that may show up. Wildfire is a form of disturbance that can result in an increase in weeds, but our plant communities are adapted to fire, so generally they will recover and be able to compete with the weeds after a few years. However, in areas that are more highly disturbed and already have weeds, wildfire can be thought of as an opportunity to manage weeds - they are often the first species to appear post-wildfire because they germinate and grow quickly. If your other vegetation has been consumed by the fire, it will be easy to see the weeds and plan treatment options. This guide will help you determine how big of a threat weeds will be after the fire based on how severely your property burned and other factors, how to monitor for weeds and the plants you want, and explain different management strategies you can use to control weeds if they are present on your land.**

**Wildfires can affect a variety of landscapes, including conifer forests and grasslands.**



## History of wildfires

Many plant communities in the western U.S. are adapted to a long history of wildfires that vary in frequency and intensity. Fire maintains certain habitat types, for example it prevents woody plants from encroaching onto grasslands, and fire is necessary for some plants to reproduce. Fire stimulates germination of some seeds stored in the soil or encourages growth of conifers, some of which need extreme heat to break open their cones. However, over the last 100 years, fire frequency and intensity has shifted with changing land use practices, natural disturbances, and climate

change. Frequency refers to how often wildfire occurs; intensity refers to how much energy is released during a fire, commonly represented by how hot and for how long a fire burns. We are now experiencing more frequent and intense fires that result in higher burn severity. With climate change, it is expected we will see an increase in wildfires in Montana (Whitlock et al. 2017)[1].

[1]See list of cited literature on p. 27

## How wildfires affect plant communities

A variety of habitats found in Montana, including conifer forests, grasslands, sagebrush steppe, meadows, and others, can experience wildfire. The response of a plant community to wildfire is complex, but some generalizations can be made. Wildfires typically expose bare ground, may cause a flush of nutrients in the soil, and increase the amount of sunlight reaching the ground. Such conditions are conducive to plant growth, and many native plants will survive and reinitiate growth soon after a fire. For example, a low-to-medium severity wildfire in rangeland in Montana (dominated by big sagebrush, bluebunch wheatgrass, and Idaho fescue) resulted in similar native grass cover compared to unburned areas three years post-fire (Seipel et al. 2018). However, the ability of desired plants to re-establish, thrive, and reproduce in subsequent years can be impeded by weeds, particularly if the soil is further disturbed or if weeds are already present. Weeds have high growth rates, produce many seeds, and thrive with high resource availability (e.g., nutrients and sunlight), conditions that are common post-wildfire. Some native species also respond well to high resource availability, e.g. fireweed *(Chamaenerion angustifolium)*.

Activities associated with fighting wildfire can also affect plant communities. Fuel breaks and fire lines disturb the ground and remove existing vegetation, thus creating bare ground. One study in Montana followed the response of vegetation in a fire break; cheatgrass *(Bromus tectorum)*, which was already present in the area at low densities, increased greatly in the fire break and did not decline over time, whereas cheatgrass increased initially in the adjacent burned area but then returned to pre-fire levels after the first year (Seipel et al. 2018). Fire retardant, which has high levels of ammonium and phosphorous, can act as a fertilizer. Although retardant typically covers small areas on the landscape, it can cause localized shifts in plant competition and influence which species dominate. One study from Montana showed that cheatgrass, which was again already present in the area, increased in abundance when fire retardant led to a pulse in high resource availability (Besaw et al. 2011).


**Fire retardant, often aerially applied to wildfire, can act as a fertilizer on the ground.**

## Plant survival and wildfire

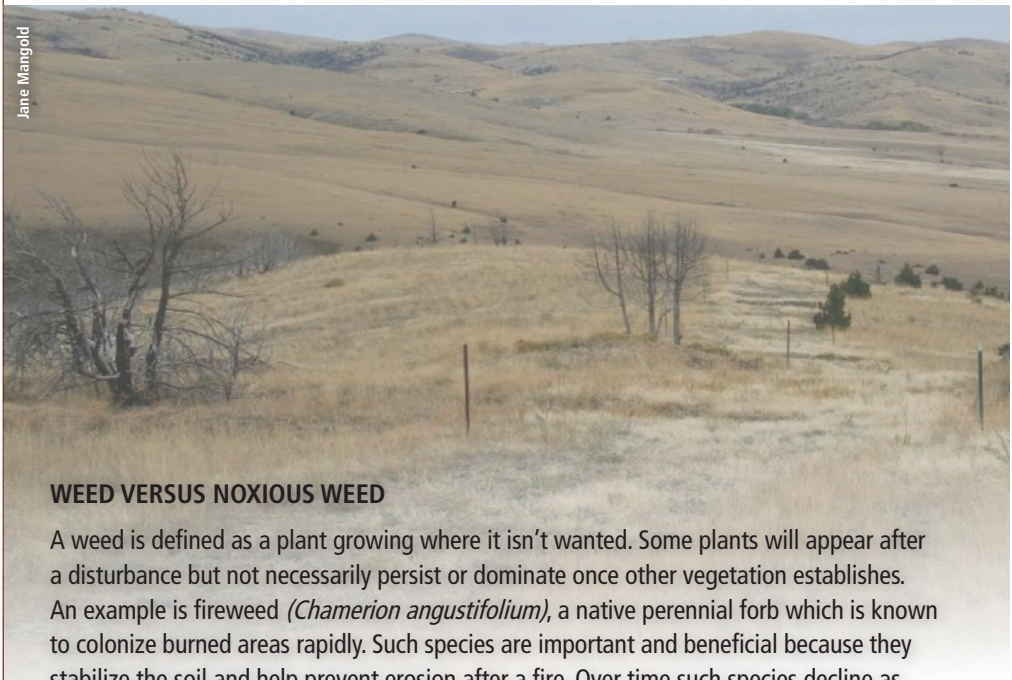
As a rule, grasses, forbs and shrubs that can re-sprout from roots, soil surface crowns or rhizomes (underground stems that have vegetative root buds capable of producing new plants) survive fire and often come back quickly following fire, compared to species whose growth points are elevated above the soil surface or species that reproduce only from seed. However, seeds produced by some species evolved to require fire for germination, for example lodgepole pine *(Pinus contorta)* cones in the western U.S. require heat from fire to open and shed seeds. Generally, brief exposure to high fire temperatures can also improve survival because it is less damaging to plants than extended exposure.

Perennial broadleaf forbs are common post-wildfire, especially those with deep root systems. Because even the most severe fires typically damage roots only down to four inches below the soil surface, weeds with root systems below that depth often endure and prosper post-burn. Rhizomatous weeds have extensive root systems that can grow quite deep. Examples include leafy spurge *(Euphorbia esula)*, whose roots can extend 15 feet deep, and Canada thistle *(Cirsium arvense)*, whose roots can grow to 22 feet deep. When fire removes the top growth of a rhizomatous weed, it stimulates the production of new shoots from the vegetative root buds. Because of nutrient reserves in the roots, these new shoots can grow quickly and are highly competitive.


**Musk thistle, above, is a common species found growing after wildfire.**

**Fireweed (below), a native forb, commonly shows up after wildfire, but usually does not persist or dominate once other vegetation establishes.**

Native and non-native annual species and perennial forbs and grasses that regenerate from seeds tend to germinate in the fall after precipitation or the early spring when the snow melts. Some post-fire weeds that reproduce from seeds that you might see after fire in the western U.S. include cheatgrass, common dandelion *(Taraxacum officinale)*, common mullein *(Verbascum thapsus)*, Japanese brome *(Bromus japonicus)*, musk thistle*(Carduus nutans)*, and redstem stork's bill *(Erodium cicutarium)*. These species and other non-natives thrive with disturbance. Species that germinate in the fall, for example cheatgrass and Japanese brome, can colonize a burned site quickly. This has been particularly true in the Great Basin region of the western U.S. where invasive annual grasses are common. Research to date in Montana does not indicate that invasive annual grasses increase after wildfire. However, cheatgrass can increase in disturbed areas resulting from wildfire suppression activities (i.e., fire breaks, see below).


Jane Mangold

**WEED VERSUS NOXIOUS WEED**

A weed is defined as a plant growing where it isn't wanted. Some plants will appear after a disturbance but not necessarily persist or dominate once other vegetation establishes. An example is fireweed *(Chamerion angustifolium)*, a native perennial forb which is known to colonize burned areas rapidly. Such species are important and beneficial because they stabilize the soil and help prevent erosion after a fire. Over time such species decline as other vegetation re-establishes. In contrast, some weeds may use disturbances like fire to establish and then persist or even expand into other areas. Some of these persistent weeds are noxious weeds, which are non-native plants that were introduced to North America from another continent and cause injury to livestock, agriculture, and/or the environment. A list of noxious weeds in Montana can be obtained via the Montana Department of Agriculture. We use the term "weed" throughout this guide, with much of the information applying to those species that are "noxious."

# Monitoring and Evaluation

**The first step in managing weeds after wildfire is to look for them! In a perfect world, you would know what weeds and desired plant species were present and where they were growing before wildfire came through your property. However, if that is not the case, monitoring for weeds after a wildfire is even more important. Knowing what weeds and other plants are present on your property and in what abundance can help you decide if weeds will be a serious concern or if the native community will outcompete them over a few years. It is also important to figure out how severely the fire burned, hereafter referred to as "burn severity." All this information will help determine if natural recovery of the plant community is likely or if you should consider revegetation.**

## Monitoring for weeds pre- and post-wildfire

Inventorying weeds and desired plants on your property is the first step in weed management following wildfire. If the burned area is large, it should be divided into smaller, more manageable areas and methodically examined for weeds. Such smaller areas might be based on boundaries (e.g. fencelines), vegetation, or soil types. When thinking about weeds on your property, estimate total weed cover into one of three classes: absent to low (up to 20%), moderate (20-80%), and high (over 80%). If you didn't know the degree of weed cover beforehand, don't worry!

**Resources for noxious weed identification:**

- Montana noxious weed list
- Montana's Noxious Weeds, a booklet for identifying noxious weeds in Montana
- Weed Seedling Identification Guide for Montana and the Northern Great Plains, a booklet for identifying weeds at the seedling stage
- Montana Weed Control Association weed identification web page


**Monitoring is an important step in weed management after wildfire.**

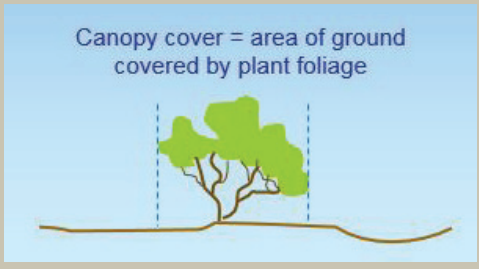
If there are areas immediately adjacent to the burned area with moderate weed cover, it is possible that the burned area had a similar degree of cover by the same weeds. Depending upon the severity of the burn and weed characteristics, you can expect some degree of weed survival in the burned areas. Remember that it may take weeks to months for vegetation to start growing again, so exercise patience when monitoring for weeds and desired plants.

## Burn severity

After considering what weeds and desired plants were present before the wildfire and are likely to be present afterwards, the next step is to estimate the burn severity on your property; this should be done within one month of the burn (assuming it is safe–standing dead trees can be a hazard). This information, paired with your estimate of weed cover, will help determine if revegetation is recommended or if habitat can recover without intervention.


**One characteristic used to help determine burn severity is the level of charring on trees and stumps.**

### How do you estimate cover?




Cover is an estimate of the percentage of ground covered by vegetation or other attributes (e.g., bare ground). Canopy cover is the area of ground covered by the natural spread of plant foliage when viewed from above. It can be thought of as a "bird's-eye" view of vegetation or the area shaded by vegetation if the sun was directly overhead. Cover can be estimated by using quadrants or frames made of PVC pipe or rebar to view an area consistent in size.


**High severity fires have uniformly gray or white ash and shrub stumps, and small fuels are entirely consumed.**

Things to look for to determine burn severity include the color of soil, amount of remaining duff and debris, color of ash, level of charring on shrub stumps and small fuels, as well as the presence of hydrophobicity (Table 1, below). Hydrophobicity occurs when the soil repels and beads water at the surface and occurs mainly in moderate- to high-severity fires. Test for hydrophobicity by scraping ash away and dripping water on the soil surface. If water forms beads and does not soak into the soil, hydrophobicity may be a problem.

**Table 1. Characteristics used to determine burn severity (Adapted from DeBano et al. 1998).**

| Characteristic | Low severity | Medium severity | High severity |
|---|---|---|---|
| **Soil** | Normal color | Up to 2″ of soil may be darkened brown or reddish-brown | 2-4″ of soil is darkened reddish-orange; soil can be physically affected-crusted or crystallized |
| **Duff and debris** | Present but partly burned | Duff consumed; debris charred or consumed | Entirely consumed |
| **Ash color** | Mostly dark-colored | Dark-colored | Uniformly gray or white ash present |
| **Shrub stump, small fuels** | Slightly charred | Mostly consumed except for charred logs and stumps | Entirely consumed |
| **Hydrophobicity (soil repels water)** | Low to absent | Low to medium on surface soil and to 1″ deep | Medium to high, to 2″ deep |

Plant survival is largely determined by burn severity. Low-severity fires favor plant survival over high-severity fires. With low-severity fires, you may see an increase in weeds initially, but they may not increase or persist over time. High-severity fires are more likely to favor non-native and some native, weedy plants. With high-severity fires, there may be fewer weeds initially (because much of the plant material was consumed by the fire), but they are more likely to increase quickly and persist for a longer period of time. The habitat type burned by wildfire influences the relationship between burn severity and weed persistence.

Generally, fires at lower elevation, drier sites (e.g., grasslands or Ponderosa pine *(Pinus ponderosa)* forest) are more susceptible to weed invasion and persistence than higher elevation, wetter sites (e.g., Douglas fir *(Pseudotsuga menziesii)* or sub-alpine fir *(Abies lasiocarpa)* forests).

## Evaluating the likelihood for natural recovery

Combining your estimates of weed cover, cover of desired plants, and burn severity can help determine the likelihood for natural recovery. As a rule, less severe burns with lower amounts of weed cover are more likely to recover naturally (Table 2, below).

**Table 2. Determining the likelihood of natural recovery and the necessity of revegetation in the burned area.**

| Degree of noxious weed cover | Burn severity | | |
|---|---|---|---|
| | **Low** | **Medium** | **High** |
| **Absent to low (up to 20%)** | Revegetation not necessary; natural recovery within 1-2 years | Natural recovery in 2-5 years | Natural recovery possible; monitor for plant survival and revegetate if necessary |
| **Moderate (20-80%)** | Natural recovery within 1-2 years with weed management | Natural recovery in 2-5 years likely with weed management | Natural recovery limited; revegetation likely needed |
| **High (over 80%)** | Natural recovery within 1-2 years but intense weed management needed; revegetation likely needed | Natural recovery possible, but intense weed management needed; revegetation likely needed | Revegetation and intense weed management needed |

If it is decided that revegetation is not needed and you opt for natural recovery of the plant community, monitor the burned area frequently for new weeds until the plant community has recovered. Afterwards, monitor for weeds occasionally.

The more severe the burn and the greater the cover of weeds, the more likely that revegetation will be necessary. This rule of thumb may not apply uniformly across your property because of patchiness in burn severity, weed cover and vegetation type. Consider focusing revegetation efforts on highly disturbed patches (i.e., severe burn and high weed cover) that may coincide with areas disturbed by fire suppression activities, for example fuel breaks, fire lines, and equipment staging areas. Research in Montana has shown that fuel breaks and fire lines are particularly susceptible to invasion by cheatgrass.


**Many areas naturally recover from wildfire. Seeing a flush of green growth can be common after wildfire.**

# Integrated Weed Management

**Integrated weed management (IWM) uses multiple control tactics to prevent and manage weeds. It typically involves a combination of preventive strategies and management techniques that promote a healthy plant community that meets the goals you have for your property (e.g., livestock grazing, growing hay, improving native plant communities for wildlife or pollinator habitat). Prevention strategies can stop or slow the spread of weeds into weed-free areas, and detecting small weed patches early allows you to eradicate them. Large infestations are unlikely to be eradicated, but they can be contained or reduced to a tolerable level using mechanical (e.g., mowing), chemical (i.e., herbicides), biological (i.e., weed-eating insects), targeted grazing (i.e., livestock grazing certain weeds), and/or cultural (e.g., revegetation) management techniques. This publication focuses on key points of IWM in the context of wildfire.**

**Key components of an Integrated Weed Management plan for burned areas are:**

- Regular monitoring and evaluation
- Using multiple types of control strategies
- Sustained effort

**Resources for weed management:**

- Weed Management on Small Acreage in Montana, a booklet describing basic concepts and practices of weed management
- Herbicides and Noxious Weeds: Answers to Frequently Asked Questions, a brochure answering commonly asked questions about herbicides and noxious weeds

## Prevention and early detection

Preventing weeds from establishing in the first place is the most effective and least costly method of weed management. It is important to identify high-quality and valued areas that are relatively free of weeds with high desired plant cover and protect them from weeds.

### DETECTING AND ERADICATING WEED INTRODUCTIONS

Early detection of new weeds is crucial after wildfire. Monitoring the burned area can help you identify weeds early and start management on those small patches that might otherwise become large infestations. Monitoring should focus on highly disturbed areas (e.g. fire breaks, equipment staging areas, roads) as well as systematically cover your entire property. Walk the perimeter of your property to assess any weed-spread from adjacent property. It is a good idea to do multiple assessments per year for the first year or two after a wildfire. Thereafter, an annual assessment in early summer is recommended. Document changes in patch size and density of weeds. Flag patches or mark them using a Global Positioning System (GPS) to make them easy to find when you return to manage them.

It is easier and less costly to control small infestations compared to large-scale, established infestations. Eradication is most effective on newly established weed populations where individual weeds can be removed and steadily replaced with desired

Jane Mangold

**Key areas to monitor early and often are disturbed areas such as roads, trails, and fire breaks, shown here marked with posts and pin flags.**

plants (through natural replacement or revegetation) until all viable weed seeds have been depleted from the soil. For eradication to be successful, seed production must be prevented for several years in a row and seed bank longevity must be considered. Some species like spotted knapweed *(Centaurea stoebe)* have seeds that can live 12 years or more, so long-term management is necessary.

## LIMITING THE DISPERSAL OF WEED SEEDS

Preventing or greatly limiting seed dispersal is an important part of minimizing the introduction or spread of weeds after wildfire. If you imported hay as supplemental feed for livestock after a wildfire, ideally it was certified noxious weed seed-free, but even so it could contain undesired weeds that are not labeled as noxious. Feed hay to your livestock in a restricted area and closely monitor that area for new weeds for at least one or two years. Weed seeds can also be spread through vehicles and equipment. Thoroughly clean the undercarriage and tires of vehicles and heavy equipment before it enters a burned area. Except when necessary, travel should be limited to established roads. This will limit seed dispersal from vehicles and avoid compacting soil which could hinder the recovery of desired plants.


Kim Antonick

**One way to limit weed seed dispersal is to clean the undercarriage and tires of vehicles before entering a burned area. Shown here is a spotted knapweed flower head stuck in tire tread.**

**LIMITING WEED SPREAD FROM DONATED HAY:**

Donated hay to areas impacted by wildfire can come from different parts of Montana, other states, or Canadian provinces and could contain weed seeds. If possible, ask where the hay was grown or donated from to get an idea of potential weed species. If available, use certified weed seed-free hay. Other ways to prevent weed spread from donated hay include feeding or storing the hay in a designated area, preferably one that can be easily monitored for new weeds, and then monitor that area for several years. For more information on donated hay, consult Preventing Weed Spread from Donated Hay and the Montana Weed Free Forage Program.

### PROPER MANAGEMENT OF PLANT COMMUNITIES

Maintaining a healthy, desired plant community can help immensely in limiting weeds. Desired plants can compete with weeds for nutrients and resources. It is best to avoid spreading a fertilizer following a wildfire as weeds generally take advantage of extra nutrients more so than native plants, and the fire itself may have resulted in an increase in nutrient availability. Avoid additional disturbances after a wildfire. Limit mechanical disturbances on your property and avoid overgrazing areas so native plant communities can re-establish and compete with weeds.

## Mechanical Control

Mechanical control of weeds involves management strategies such as mowing, hand-pulling, or cutting. Hand-pulling can be effective for small patches of annual, biennial, and certain perennial weeds. Be sure to remove the taproot of perennials and bag all flowering weeds to reduce seed spread.

Mowing is an important management strategy, but it is important to limit disturbance on your property after wildfire. Using large mowing equipment can result in soil compaction, increased bare ground areas, and could spread weed seeds. If you decide mowing would be an effective strategy for weeds, check and clean any equipment or vehicles for weed seeds or plant parts before moving to a weed-free area, and avoid heavily disturbing the soil with tires. For perennial weeds that reproduce by seed only (e.g., spotted knapweed), the best time to mow is just before the flowering stage of the weed. For perennial weeds that reproduce vegetatively (e.g., Canada thistle), mowing frequently and to short heights can weaken the infestation over time by depleting root reserves. However, if weeds are intermingled with native species, try to avoid mowing before native species set seed.


**Be sure to bag weeds in garbage bags after hand-pulling to reduce the spread of seeds.**

## Chemical Control

Chemical control is the use of herbicides to reduce plant vigor. Herbicides can be applied using a backpack sprayer, broadcast-sprayed with ATVs, or aerially applied with planes or helicopters for large-scale infestations. Chemical control of weeds can be enhanced after wildfire because the standing litter will have been consumed by fire, and the herbicide will make better contact with the weeds. Another advantage to using herbicides after wildfire is the limited amount of soil disturbance compared to other methods like mowing or grazing. However, herbicides need to be used carefully so that recovering desired vegetation or seeded species are not damaged.


**Chemical control is the use of herbicides to reduce vigor of plants.**

## SELECTING THE HERBICIDE

It is important to select the right herbicide for your target weed while considering the effect on desirable plants and the environment. There are two general categories of herbicides: selective and non-selective. Non-selective herbicides are toxic to all plants that come in contact with the herbicide. A common example of a non-selective herbicide is glyphosate (Roundup®). Selective herbicides are toxic to either grasses or broad-leaved plants, but not both. Since most noxious weeds in Montana are broad-leaved plants, managers frequently use a selective herbicide that damages broadleaf plants but not grasses. Such selective herbicides will have limited impacts on desirable grasses when applied at recommended rates. It is very important to follow the herbicide label and consult with Extension agents, county weed coordinators, or Natural Resources Conservation Service staff, especially if using herbicides and planning revegetation.

### HERBICIDE SELECTION DEPENDS ON:

- The target weed
- Herbicide toxicity
- Herbicide degradation time
- Desired vegetation cover
- Soil attributes
- Proximity to water
- Environmental conditions

Land managers should familiarize themselves with each of these factors to select the most appropriate herbicide. Extension agents or county weed coordinators are good sources for herbicide recommendations. Local commercial herbicide applicators are available to help with choosing and applying herbicides and are particularly good resources when restricted-use herbicides are advised.

## WHEN AND WHERE TO APPLY YOUR HERBICIDE

When to apply herbicides during the year depends partially on the herbicide used and the growth stage of the target weed. Most herbicides used for noxious weeds are systemic, meaning they are applied to aboveground plant parts but then translocate, or move, to the roots or rhizomes and hinder growth. This is especially important for rhizomatous weeds. The most effective time to apply systemic herbicides is when the target weed is actively growing. In Montana, this is typically late spring to early summer before the plant flowers (seedling/rosette and early

bud growth stages) or in the fall when the base of the weed starts to regrow. Seedlings of winter annual grasses like cheatgrass, Japanese brome, and ventenata *(Ventenata dubia)* emerge in the fall. Because most wildfires occur in late summer, fall may be an ideal time to spray weeds. Weeds will likely be the first plants to start growing after fire and may be easy to locate and treat with an herbicide. This is especially true for winter annual grasses like cheatgrass, Japanese brome, and ventenata.


**The most effective time to apply systemic herbicides is when the target weed is actively growing. This could be in the fall, after wildfire, when the base of the weed starts to regrow.**

Soil-residual herbicides persist in the soil and continue to affect newly emerging plants or sprouting perennial shoots. If using a soil-residual herbicide to treat weeds, it is important to recognize this may negatively affect desired vegetation, including seeded species, depending on the herbicide used and whether you are seeding grasses or forbs.

## Biological Control

Classic biological control (biocontrol) involves the use of a living organism (e.g., plant-feeding insects, mites, or pathogens) to reduce a noxious weed population. Noxious weeds in Montana are not native to North America and usually do not have natural enemies here, which can be one reason why weeds grow so well. These natural enemies, referred to as "biocontrol agents," go through a rigorous testing process before being released in the United States. The goal in using biocontrol agents is to reduce the density and health of the target weed; biocontrol does not typically eradicate a noxious weed. If you are interested in using biocontrol agents on your property, consider the size of the weed infestation. Management by biocontrol agents is most effective on large-scale weed infestations (at least 5-10 acres) and is not recommended for small infestations or newly invading weeds that can be eradicated with management tools.


**How wildfire affects previously established biocontrol agents depends on a variety of factors, such as the size and timing of the wildfire.**

HOW DOES WILDFIRE AFFECT PREVIOUSLY ESTABLISHED BIOCONTROL AGENTS?

- It depends on size and uniformity of the burn, as well as timing of wildfire in relation to the insect's life cycle.
- If biocontrol agents have a belowground portion of their life cycle (e.g. root-boring larvae), they may not have been impacted by wildfire.
- If the wildfire was patchy in severity and/or unburned areas were nearby, it is possible biocontrol agents had a protected location during the wildfire to survive.

While there may be an up-front cost associated with establishing biocontrol agents over a one to three year period, there should be no recurring annual costs once the agents are established. As a result, biocontrol can be an economical, long-term solution to certain weed infestations. Biological control can be especially effective when integrated with other management techniques such as targeted grazing, revegetation, or herbicides.

**For more information on using biocontrol agents on your property, contact:**

- Montana Biocontrol Coordination Program
- Local Extension agent or county weed coordinator

## Targeted Grazing

Targeted grazing is the use of livestock grazing during a certain season with a specific duration and intensity that will reduce the target weed population. For example, grazing an infestation during the early bud stage can prevent seed development. Grazing pressure is usually directed toward the new growth of the weed, which can be high in crude protein and digestibility, and should be timed to minimize impact on desired species.

If using targeted grazing, you must consider the type of grazer and what plants they prefer. As a rule, domestic sheep prefer broad-leaved plants (forbs) to grasses, and cattle prefer grasses to forbs. Domestic sheep or goat grazing can be an effective and useful method of managing large infestations of weedy forbs or shrubs. These grazers can also be used to target certain areas of your property that may be particularly weedy, such as fire breaks or dozer lines.

If you are moving livestock from a weedy area, it is a good idea to dry-lot the livestock for a minimum of three days before moving


**Targeted grazing can be used to address specific problem areas such as fire breaks.**


This is a debated issue. Previous research and policy suggested deferring grazing from burned areas for two growing seasons. However, more recent research has suggested grazing can occur sooner, but the timing of grazing after wildfire and season of grazing should be considered on a case-by-case basis. Things to consider when planning grazing include dominant grasses on your property, pre-fire condition of plants (e.g., vigor, cover), revegetation efforts, season and severity of the fire, and climatic conditions.

The specific dominant grasses on your property are important to consider when deciding how soon to graze after wildfire. Rhizomatous grasses like thickspike *(Agropyron dasystachyum)* or western wheatgrass *(A. smithii)* should tolerate fire and subsequent grazing better than bunchgrasses, and certain bunchgrasses tolerate fire better than others. For example, bluebunch wheatgrass *(Pseudoroegneria spicata)* tolerates fire better than Idaho fescue *(Festuca idahoensis)* or needle-and-thread grass *(Stipa comata)*. For more information on specific species, see the Fire Effects Information System. Consider what types of grasses dominate your property and how robust they were before the fire. In general, grazing more susceptible bunchgrasses the first growing season following fire may result in significant plant mortality. Delaying grazing for one more year or grazing later in the season (after seed set) may lessen damage to desired bunchgrasses.

Changes in plant communities with grazing after wildfire may depend on the grassland type. For example, the northern mixed-grass prairie is fairly resilient to fire and post-fire grazing. A study in northern South Dakota found no differences in productivity between grazed and rested areas after moderate grazing one and two years after wildfire (Gates et al. 2017). Crested wheatgrass *(Agropyron cristatum)* and needle-and-thread grass *(Hesperostipa comata)* decreased with grazing after fire, but otherwise there were few effects overall on this type of grassland community.

It is important to remember that grazing is another form of disturbance, and newly established seedlings may benefit from limiting disturbance. This is especially important to consider if you have recently seeded grasses. Temporary fencing should be used around recently seeded areas to exclude livestock until those seedlings are more established.

them to a weed-free area. By doing so, you will concentrate any excreted weed seed in one area that will be easier to monitor and treat rather than spreading seeds further around your property. Monitor your grazing land annually to see whether the targeted grazing program is reducing weeds while encouraging competitive plant growth.

## Cultural Control

Cultural control methods promote the growth and competitiveness of desired plants and may include activities like fertilization, irrigation, grazing management, or revegetation. As mentioned earlier, fertilization following wildfire is not recommended, and irrigation is typically not available for burned areas. Revegetation is the intentional seeding of plants and serves to re-establish desirable vegetation. It is typically recommended in areas that burned severely and had high noxious weed cover before the fire (Table 2, page 12). Revegetation is typically not necessary in areas that experienced a low- to medium-severity fire, especially when the pre-burn noxious weed cover was low to moderate with adequate desired vegetation cover. Such burned areas are likely to recover without revegetation if good weed management practices are followed.

### DESIGNING SEED MIXES FOR REVEGETATION

Revegetation typically involves seeding grasses and sometimes forbs. Grasses are seeded because they can establish quickly, provide erosion control, and take up space that might otherwise be used by invading weeds. Historically, non-native grasses were seeded soon after the burn with the main goal of establishing vegetation on a hillside to help prevent soil loss/erosion. However, this practice is not always recommended because non-native grasses may hinder natural recovery of a site. Research and practice have shown that if non-native grasses are sown, you can expect them to persist, which may or may not be desirable depending on land use goals. Seeding native grasses is now more commonly recommended. Species should be


**Grasses are often seeded on hillsides susceptible to soil erosion after a wildfire.**


**Seed mixes should include species that match the area's soil, precipitation, temperature and elevation.**

suited to the site conditions (e.g. soil texture, precipitation, elevation) and intended uses of the land. It may take several years for native grasses to establish. Therefore, if seeding is necessary in a critical area susceptible to soil erosion, one recommendation is to seed non-invasive annuals, such as cereal grains or sterile cover crops. These species provide quick plant cover but do not persist at a site, so the native plant community can re-establish.

Seed mixtures should be certified weed seed-free to avoid introducing more weeds. You will typically want a mix of species, including some that grow early in the year, others that grow late in the year, and species that occupy different portions of the soil profile. Having species that occupy different places in space and time leaves less room for weeds.

## SEEDING METHODS

Areas in need of revegetation should be seeded the fall or winter immediately after the wildfire. Seeding can also occur in early spring (e.g., March through early April). Most burned areas require no seedbed preparation because ash from the fire helps cover and retain broadcasted seeds. The wet/dry, freeze/thaw action of moisture will work the seeds into the soil while also breaking down any hydrophobic soil layers. Frost heaving will break down ash crusts that form because of fall rains before or after reseeding.

A site accessible to equipment, for example gently rolling rangeland, can be seeded with a no-till drill. This tractor- or ATV-pulled machine opens a furrow in the soil,

**Hallmarks of a good revegetation plan typically include:**

- Determining whether revegetation is necessary based on burn severity and cover of weeds versus desired plants
- Using a site-adapted seed mix that is weed-seed free
- Using a no-till drill if the site is accessible to equipment
- Doubling recommended seeding rates if broadcast seeding
- Removing as many noxious weeds as possible (usually with herbicide applications) prior to seeding
- Deferring grazing by means of fencing or herding until newly seeded species successfully establish, usually after two growing seasons.



**Above: A no-till drill seeder can be pulled behind a tractor or ATV, depending on the size of the seeder. Right: Broadcast seeding by hand is useful on burned areas inaccessible to equipment.**

drops seeds in the furrow at a specified rate and depth, and rolls the furrow closed. This method of seeding enhances seedling establishment while minimizing the disturbance of soil and existing plants. Be sure to drill seed perpendicular to the slope. Sites inaccessible to such equipment are usually broadcast seeded, either aerially with an airplane or helicopter (large areas), by an ATV broadcast seeder, or by hand (small areas). Seeding rates should be doubled or tripled if broadcast seeding is used instead of drill seeding.

It takes time and the right climatic conditions to have a successful revegetation project. Heavy rainfall after seeding on severely burned slopes can cause erosion and wash seeds away. It may be several months to a year before you see the benefits of seeding, so be patient. It also may be helpful to combine revegetation with other treatments, such as mulching, mastication of downed woody debris, and placing cross-slope log terraces to help the seeds stay in place until they germinate.

## CASE STUDY: MANAGING SPOTTED KNAPWEED AFTER WILDFIRE

A study in Montana looked at herbicide and revegetation treatments with the goal of restoring spotted knapweed-infested areas to desired plant communities after a wildfire (Pokorny et al. 2010). Broadcast or spot-spraying picloram both decreased spotted knapweed, but spot-spraying had less of a negative effect on native plants. Seeding desired species had no effect on spotted knapweed in the short-term. Researchers suggested continued management of spotted knapweed using spot applications of herbicide while desired species continue to establish.


**Spotted knapweed is a common noxious weed in Montana and is shown here, re-sprouting after wildfire.**

## Evaluating Weed Management Effectiveness

Monitoring property post-wildfire and post weed management can assess what worked and what didn't, and help you decide if you are meeting management goals. Monitoring involves collecting and assessing information about your plant community. A monitoring plan can be simple. For example, you can establish photo-points to detect vegetation changes over time. Other options include using transects and PVC pipe frames to monitor changes in abundance of weeds and desired vegetation. Ideally, you should monitor weed abundance within the area that received weed management as well as outside the treated area. If monitoring reveals your management goals are not being met, modify your weed management plan.

**Additional resources on revegetation:**

- Seeding Rates for Conservation Species for Montana, a technical bulletin describing species and recommended seeding rates
- Revegetation Guidelines for Western Montana: Considering Invasive Weeds, a booklet describing steps to revegetate weed-infested plant communities

**For more information on evaluation, contact:**

- Local Extension agent or county weed coordinator
- Natural Resources Conservation Service field offices


**Monitoring after weed management is important to assess what worked and what didn't. Monitoring options include photo-points or transects.**

# CONCLUSION

**Wildfire can stimulate growth of both native plants and weeds. If weeds are present, they may benefit from the fire more so than native plants, particularly in the short term. Early detection and management can help to eradicate small patches of weeds on your property. If large infestations are present, work towards re-establishing healthy plant communities by integrating management methods (mechanical, chemical, cultural, biological) to control weeds while favoring desired plants. Monitor annually initially and then less often to help determine if your plan is working. If needed, adjust the management and don't hesitate to ask for help from local Extension agents or county weed coordinators. To find contact information, visit the Montana State University Extension directory or the Montana Weed Control Association directory.**

Mike Simanonok

## LITERATURE CITED


Besaw, LM, Thelen GC, Sutherland S, Metlen K, Callaway RM (2011) Disturbance, resource pulses and invasion: short-term shifts in competitive effects, not growth responses, favour exotic annuals. Journal of Applied Ecology 48:998-1006.

DeBano LF, Neary DG, Folliott PF (1998) Fire's effects on ecosystems. John Wiley & Sons, New York, NY. 331 p.

Gates EA, Vermeire LT, Marlow CB, Waterman RC (2017) Reconsidering rest following fire: Northern mixed-grass prairie is resilient to grazing following spring wildfire. Agriculture, Ecosystems and Environment 237:258-264.

Pokorny ML, Mangold JM, Hafer J, Denny MK (2010) Managing spotted knapweed *(Centaurea stoebe)*-infested rangeland after wildfire. Invasive Plant Science and Management 3:182-189

Seipel T, Rew LJ, Taylor KT, Maxwell BD, Lehnhoff EA (2018) Disturbance type influences plant community resilience and resistance to *Bromus tectorum* invasion in the sagebrush steppe. Applied Vegetation Science 21:385-394

Whitlock C, Cross W, Maxwell B, Silverman N, Wade AA (2017) Montana Climate Assessment. Bozeman and Missoula, MT: Montana State University and University of Montana, Montana Institute on Ecosystems. 318 p. http://montanaclimate.org/


## ACKNOWLEDGEMENTS


Thank you to Lisa Rew, PhD (Montana State University), Monica Pokorny (Natural Resources Conservation Service), Dominique Woodham (Montana State University Extension, Gallatin County), and members of the Missoula County Weed District for providing reviews. Funding for this publication was provided by the Montana Noxious Weed Trust Fund and Missoula County Weed District. This publication was originally developed by Kim Goodwin, Roger Sheley, and Janet Clark. We thank them and the people who contributed in the early 2000s.


Montana Noxious Weed Trust Fund

Missoula County Weed District

Montana State University Extension

Noxious Weed Trust Fund

Montana Department of Agriculture

Missoula County
WEED DISTRICT
& EXTENSION

MONTANA
STATE UNIVERSITY
EXTENSION