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Wyoming WEED CONTROL
in Turf and Ornamentals

A comprehensive IPM approach for commercial, residential, and schools

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University of Wyoming
EXTENSION

Scan for School Integrated Pest Management information

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A comprehensive IPM approach for commercial, residential, and schools

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INTRODUCTION

Wyoming landscapes provide areas of beauty and practical use. Many ornamental plantings are visually interesting and provide windbreaks and structure in the landscape. Turf is used for play fields and increases visibility around buildings while reducing heat and glare. Turf also often requires a substantial amount of maintenance.

Weeds interfere with management goals and are an expensive part of caring for a Wyoming landscape. Weeds also trigger allergies, create fire and safety hazards, and reduce property value. The main reason they are unwanted is that they detract from the appearance of the landscape and consume water and nutrients. Weed seed can provide food for rodents, homes for insects, and weeds can be rough to play on.

They can also grow in areas intended to be free of vegetation, such as parking lots. No single factor can be viewed as a solution to weed control; understanding the big picture is important.

1. A dense, healthy and actively growing competitive stand of grass is the foundation for control of weeds in turf.

2. How the landscape is established affects how much controlling weeds in the area will cost.

Elements of good site preparation enhance future weed control and a basic understanding of site preparation provides the foundation for most effectively controlling weeds. There is much that can be done so the environment of the landscape favors desirable plants and excludes weeds. Good, deep soil without too many rocks or weed seeds is the best starting point for optimal plant growth and weed control.

This bulletin, after explaining the elements of landscape preparation, will cover Integrated Pest Management and methods of controlling weeds in landscapes around facilities.

SITE PREPARATION MAKES FUTURE WEED CONTROL EASIER

A properly designed, built, and managed landscape can make weed control easier, safer, and cheaper, especially for public areas. Eyesores and much of the cost can be reduced by planning certain elements into a landscape. Starting with a weed-free site and establishing a strong, healthy planting is better than trying to fix weed problems that occur after the area has been established. Remediation will take more resources and be less effective when there are significant problems with the landscape. Once weeds reach the economic threshold, the level at which weeds must be controlled, more resources will be consumed to control weeds.

Site preparation is the basis for weed prevention in turf or ornamental planting. Planting time is important so seeds are not too cold to germinate or hot and dry for seedlings to tolerate. Spring planting will work if there is six weeks of good growing before it gets too hot. Summer heat can be avoided by planting in late summer, prior to September, allowing enough growing time (about six weeks) for the grass to fill in before the first frost. Remove any weeds prior to planting since they may interfere with establishment of the grass.

Test the soil to determine the amount of soil nutrients and organic matter needed to prepare the site for planting. Improve the soil structure prior to planting. Amend topsoil if necessary to achieve an ideal balanced soil structure. Too much clay will have less air and water movement, less root growth, and will compact easier. The addition of organic matter will reduce the soil compaction and increase moisture retention. The soil should be able to contain available moisture for up to a week while not having water stand on the surface for more than a few minutes following irrigation.

The ideal soil pH for many turf grasses and shrubs is between 6 and 7. A pH within this range is suitable for plants, soil microbial action, and may improve the performance of some pesticides. Since much of Wyoming's soils have higher pH, selecting plant varieties that grow well in these conditions is essential. See Wyoming Extension bulletin "Landscaping: Turf in Wyoming" B-1129 for some recommended varieties. For soils where the pH is greater than 7, adding compost or sulfur can help lower alkalinity. Since phosphorus and potassium move very little in soil, these should be incorporated by tillage at establishment. Starter fertilizer should be applied to the top of the prepared soil.

Make sure the topsoil is as free from weed seed as possible. Ensure there is at least 6 inches of firm topsoil over a layer of 3 inches of topsoil mixed with subsoil to reduce compaction and help with drainage. The topsoil should be tilled to be crumbly but not powdery. Slope the topsoil between 1 to 4 percent away from buildings. Since rough soil will reduce the seed-to-soil contact, fine grade the area so seeds will have greater contact with the soil. Additional tips for preparing the site for shrubs can be found in the Wyoming Extension bulletin "Landscaping: Recommended Shrubs for Wyoming" B-1108.

For weedy areas where the grass will be planted in the fall, pre-plant a cover crop to grow and control weeds near the surface. This allows the use of specific herbicides and monoculture to reduce weed seed, but be careful chemical residual won't harm the new turf. Prevention also includes initially selecting grass varieties that will grow dense enough to keep weeds crowded out. Some varieties will also have less thatch build up. Seed purchased should have high purity, high viability, and be sown at recommended rates. If some parts of the area have shade or other environmental differences, a blend of seed varieties allow the grass to adapt to the various micro-climates within the area. The amount of irrigation

available is also a major factor in selecting grasses and planning the landscape. Once the landscape is established, management of weeds falls under various categories, such as, preventive, cultural, mechanical, biological, and chemical. Well-planned cultural practices including aeration, mowing, watering, fertilizing, and overseeding can help turf grow against weeds.

The combination of all weed management components is included within Integrated Pest Management (IPM). Start IPM with as healthy a landscape as possible and there will be fewer problems to deal with over the life of the system. In IPM where the pest's biology is taken into account, indiscriminant spraying is eliminated and pesticides are used to maximum benefit when applied.

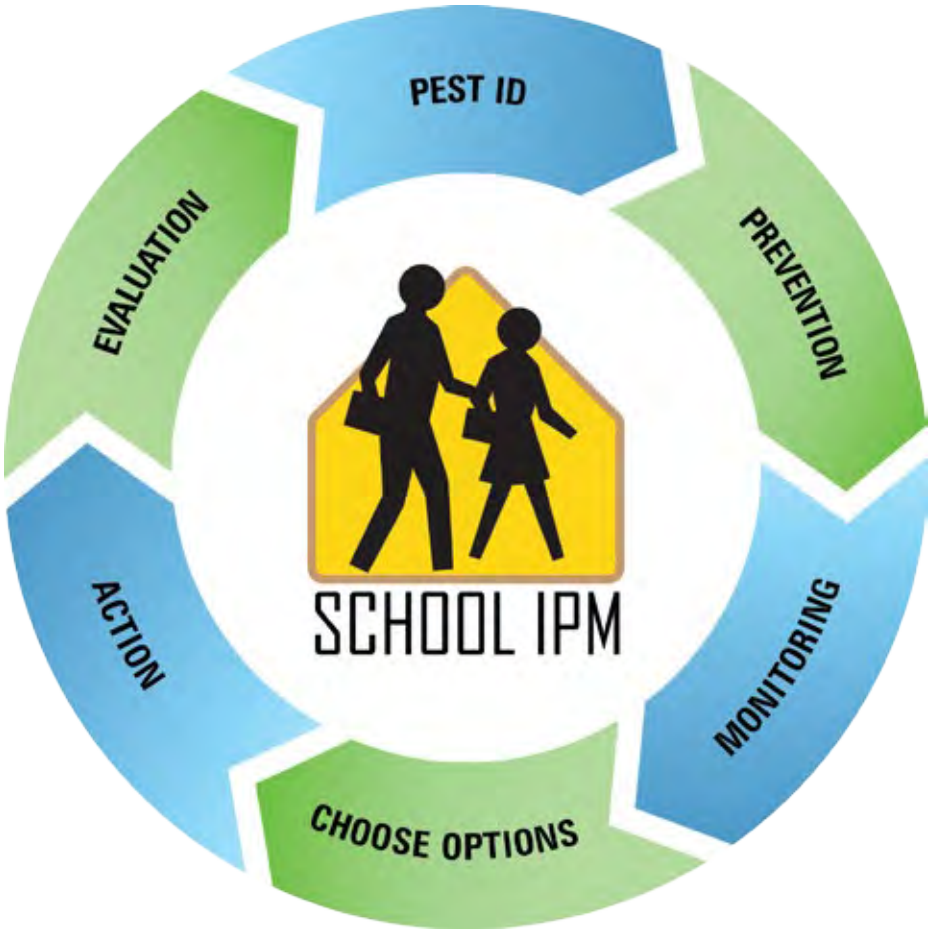
WHAT IS INTEGRATED PEST MANAGEMENT

IPM includes a strategic process of prevention, monitoring, decision making, action, and evaluation to meet the goals of the landscape management in an environmentally and economically sound manner. It includes knowledge of the landscape system and utilizes the most appropriate biological, cultural, mechanical, and chemical strategies to manage weeds. One of the early incentives for developing IPM was to overcome the chemical resistance developing in orchard pests in the 1950s. Pesticide prices and increased interest in human safety caused IPM to become more widespread. IPM can make areas safer for people, including children who learn, play, touch and taste things in landscapes. IPM choices will be influenced by the overall goals and resources of the management. An IPM program includes the judicious and careful use of pesticides when necessary and generally reduces dependence upon them. When herbicides are used in an IPM program, there can be better control per dollar spent over time; in a sense, more bang for the buck. Strategizing is central in IPM and involves clear and easy steps. IPM won't reach goals instantly but will improve efficiency and safety in meeting goals over time. IPM considers all options for each situation and doesn't specify how many methods are included to do the job. While a single method, such as hoeing, non-selective herbicide, or mowing, can be the best choice in a certain situation, usually a combination of control methods blended and adapted to the area will be more effective than any one method.

BENEFITS OF IPM

IPM of weeds in turf grasses and ornamental plantings is an approach that includes looking at the big picture to solve problems in the best way. Understanding the overall system that promotes healthy, competitive plants and prevents weeds is the foundation of IPM. Using IPM can lead to reduced costs, reduced re-entry intervals, greater safety by reducing issues related to pesticide residue, and more biologically sustainable management of landscapes. The steps to IPM are easy to follow, repeatable for all pests, and can be communicated to other people who work in the same or similar landscape. In general, IPM is an ongoing activity.

KEY COMPONENTS OF IPM



There are 11 components of IPM. Six of these are cyclic action steps that occur continuously in order and are underlined in blue;

Weed Identification Step 1

Prevention Step 2

Maps
Recordkeeping
Set Action Thresholds

Monitoring Step 3

Analyze and Choose Options Step 4

Notification

Implementation/Action Step 5

Evaluating Step 6

Educating

Weed Identification ***Cyclic Action Step 1***

Accurate identification of the weed and its life stage is critical. Without it, making a decision about how best to control the weed, or whether control is necessary at all, can be very flawed. Identification is also important to understand the life cycle and biology of the weed to know how much of this pest is tolerable, what will happen if no control is used, what is the most vulnerable stage of the weed, and when is the best time to apply pesticides if needed. The person responsible for scouting will benefit from training in weed identification and biology. Sources of additional information and training are listed at the end of this bulletin. Cases of mistaken identity may result in reduced or no control and a waste of time and money.

Prevention ***Cyclic Action Step 2***

Weed prevention saves time and money. Prevention is always the preferred strategy over remediation and is the first line of defense. Eliminating habitat for weeds and growing turf that is very competitive reduces the need for weed control.

The aim of prevention is to create an environment not conducive to weed colonization, growth, and reproduction.

By learning the weed life cycle and biology, we find out which stage of its life cycle is most susceptible to preventative actions and how to efficiently limit the weed.

Maps ***Key component***

Make maps for each location. Maps should have enough detail to aid in monitoring in and around buildings. Maps should depict overall grounds, buildings, playgrounds, other turfgrass areas, sidewalks, and parking lots, athletic fields, high visibility areas, and other areas like open courtyards and special gardens. These maps should be drawn to scale and overlaid with an identifying grid. They should note all pertinent factors including high-pest risk areas and sensitive areas. Copies of maps can be used when scouting and monitoring. Identify location by names and numbers on the map to correspond with points on the monitoring data sheets.

Recordkeeping ***Key component***

Recordkeeping is an essential part of IPM as it helps establish a history of weed trends and problem areas as well as track which activities have worked best to control weeds and anticipate seasonal weed problems. IPM records allow for more informed decision making in managing school weed problems around buildings. Knowing where, when, and what weeds have been seen on facility grounds can focus weed control efforts and be helpful to professional pest control operators. Such documentation is critical in an IPM program, as treatment is based on monitoring and other information.

IPM records document proper pesticide use and can save money. They allow comparison of results obtained from using different products, formulations, and equipment. They can also provide information about products used or site conditions if a problem arises. Good records can help you better determine the exact amount of pesticide you'll need.

The more information there is on record, the more useful the records will be. Records are best kept on a standard form to ensure all necessary data is logged every time. The Pest Control Application Form includes the information that must be recorded for each applica-

tion. Since the data sheets are inclusive, not all items need recorded each time. For example, if no products are used when performing a certain action, entries relating to products are left blank. On every report, there should be a space for the applicator to make comments regarding the action taken including any unusual occurrences that could have an impact on results. Fill out the scouting forms and control activity forms in the IPM logbook at the time the scouting and/or control activity is conducted.

Records can be maintained in an IPM logbook and may include:

Maps of building and grounds
Maps help specify problem areas, show weed distribution, explain the situation to others, and track changes.

Landscape history data sheets
Provide site details that help in future decision making. ***(Form 1)***

Weed scouting data sheets
Note what was found, species and life stage, location, and the day it was found. Keep careful records of scouting to identify seasonal risk factors and areas with a high frequency of problems. Records should also include all corrective and follow-up actions. ***(Form 2)***

Weed control action/application form
Records are not only required for pesticide applications but help document preventive measures and how well various actions or products work. These records can serve in forecasting when a weed may appear or when an outbreak may occur and can help the pest manager to evaluate the success of the IPM program. ***(Form 3)***

Material Safety Data Sheets and product labels
While Material Safety Data Sheets (MSDS) and product labels could be included in the IPM logbook, they need to be kept in a separate record located in an area accessible to product handlers.

Set Action Thresholds ***Key component***

An action threshold is the point at which an IPM technician takes action to reduce weed populations. These thresholds can vary in different areas and at different seasons. Since tolerances vary for different management goals, determine the levels of infestation where various control methods, such as hand weeding and spraying will be applied. In one area, weekly hand weeding may be acceptable. In another area, an herbicide application might be warranted when there are more than a certain percentage of weeds per area. The threshold for action can be anywhere from one weed to a higher level like 10 percent. The more practical or environmentally friendly the management goals are, the more acceptable other species at certain stages may be. Levels of acceptable weed populations will vary with individual management systems. In some cases, a more wild landscape is fine, whereas other areas, such as play fields, may require uniformity. Setting tangible levels at which weeds need to be removed saves time and money and can be adjusted, as need arises.

Monitoring ***Cyclic Action Step 3***

Knowing what is happening in all areas of the landscape is critical to stay ahead of weeds. Monitoring can help solve problems when they are smaller instead of reacting when they are more difficult. Correctly identifying the weed or other pest is important. Knowing the particular life cycle and biology of an invasive species helps to understand how much of this weed is tolerable, what will happen if no control is used, what is the most vulnerable stage of the weed, and when is the best time to apply if herbicides are used. The person responsible for scouting will benefit from training in weed science. Sources of additional information and training are listed at the end of this bulletin.

Begin record keeping by setting up a Weed IPM Record book (three ring binder) to collect data, landscape maps, and to set up a landscape history sheet that lists attributes of the landscape. ***(Form 1)***

While control methods in an IPM program may or may not be scheduled, a regular schedule of monitoring for weeds is important. Monitoring involves scouting to make visual counts or observations and recording data regarding problems, successes, and landscape conditions on a regular basis. Scheduled monitoring allows comparison between dates and shows trends in weed populations and conditions on the grounds.

Maintain good records in a way that is easy to use. Unless a handheld data recorder is used, print Excel spreadsheets in hardcopy form to carry on a clipboard. Transfer data from the Excel spreadsheets to a three ring binder and a computer at the end of each scouting session. Taking digital images of patterns or problems in the landscape to save for future reference is also helpful. List any underlying reason for the problems on the scouting data sheet. ***(Form 2)***

Use copies of maps of landscape management areas that can be written on when scouting. Be flexible but persistent. Employ a good monitoring system of walking, looking, and recording data on a regular basis. Scout in a systematic pattern allowing that some areas can be managed differently depending on challenges and goals. Walk or ride in a pattern for covering a large area. When an unknown weed is found take samples and digital images for identification. When scouting, don't just look for weeds, look for thin patches, shade, and other things that may hinder grass health. Note the location of weeds or other problems on the scouting map. Scouting frequency can vary, but it's good to scout weekly when plants are actively growing. Late summer can be a key time to do an overall evaluation of the landscape because weeds of various types are obvious and some are best controlled going into late fall.

Scouting and monitoring also helps assess how effective past efforts were. In fact, the last step of IPM, the evaluation step, can often be combined with the ongoing monitoring step. These records not only determine weed patterns but also assist management in verifying if best practices are used. Involve others for input and scouting where practical. A team effort is more powerful, when possible, working together for maximum benefits.

Analyze and Choose Options ***Cyclic Action Step 4***

After monitoring, evaluate the information collected, explore the options, and decide what, if any, action to take. Investigate if there are preventive strategies that will control the specific weed problems. Decide if the weed numbers are acceptable or if they can be out-competed by changes in cultural practices. Determine what cultural methods can help the situation, such as a change in mowing height or frequency. Decide how soon the control must take effect to stay within management goals. If herbicides are an option under consideration, what are the best ingredients? Other factors to consider for herbicides are discussed in a later section of this bulletin. In the case of controls that require increased expense, determine if the weeds have reached the unacceptable level (economic threshold) at which the weeds are at a levels control treatments will provide economic returns. Controlling an invasive species when small may be cheaper than dealing with it when bigger. On the other hand, pulling a few larger weeds just prior to them going to seed may be acceptable in some situations. Selection of the safest and least costly weed control tactics that are effective is central to weed control.

Notification ***Key component***

Advanced notification of pest control practices and pesticide applications can play an important role in an IPM program. Building occupants and parents may be interested in a facility's pest management and may wish to be informed in advance of pesticide applications. Keeping occupants informed can encourage assistance in keeping the area clean, exterior doors closed, and pest sightings recorded. The Wyoming Environmental Pesticide Control Act of 1973 requires notice be provided by school districts prior to pesticide application, and specifics of this statute are described in detail later in this bulletin. Follow all directions on product labels regarding notification and re-entry periods.

Implementation/Action ***Cyclic Action Step 5***

Implementation of the control activities should be deployed in a timely manner and with precision. These strategies may include *cultural, biological, mechanical, and chemical* control methods.

IMPLEMENTATION TIPS

- Control should match the proper stages of development of the weed to have the greatest impact.
- If pesticides are used, read and follow the label thoroughly, since "the label is the law" and includes information regarding the most effective use of the product.
- Consult the label for proper rate and timing.
- Make sure equipment is calibrated properly and in good working condition.
- Select timing of activities that will be most effective while not interfering with other activities in the area.
- A calm part of the day is desirable for most herbicide and irrigation activities.
- When hoeing around ornamentals, not watering immediately following hoeing may reduce the re-rooting of weeds that have been hoed.

Always record which methods and actions were used. Record all details regarding the control methods used on the Weed Control Action/Application Form. ***(Form 3)***.

Evaluating ***Cyclic Action Step 6***

The last, yet integral step in IPM is to evaluate and record how well the method or actions worked and what happened. Understanding the effectiveness of the IPM program allows the site manager to modify the IPM plan prior to pests reaching the action threshold and requiring action again.

Evaluation is built into on-going landscape monitoring and recorded on the Pest Control Activity Form. Make notes regarding the following questions:

- Did actions have the desired effect?
- How much has the situation changed in a week?
- Was the pest prevented or managed to satisfaction?
- Was the method itself satisfactory?
- Were there any unintended side effects?
- What can be done in the future for this pest situation?
- Was this season wetter or drier, etc.?

Additionally, record any changes (to the management tactics) that could improve control if the same pest problem occurs in the future. Documentation of the results of monitoring, control methods, and how well they worked is an essential component of IPM so we don't have to relearn how to deal with the same problems over and over. The evaluation also shows where there is need for improvement and helps fine-tune future actions.

Educating ***Key component***

Employees and others can help pest control efforts by understanding some of the key issues that pest control staff members have to deal with. Information regarding preventing pests can be made available from sources such as the Wyoming School IPM website. The Wyoming SIPM website (http://www.uwyo.edu/wyschool_ipm/) is your source of up-to-date school IPM forms, information, and resources.

WEED BIOLOGY

Knowledge of the biology and life cycles of weeds and their interactions with the environment helps understand how to control them. Target vulnerable periods in the life cycle of problem weeds, such as the seedling stage. While hand pulling works well for annual weeds, perennial weeds are more difficult to control because they can regrow from pieces of the plant still in the soil. Underground or above ground stems (rhizomes or stolons) enable perennials to regrow and spread quite readily if broken or cut.

Knowing the weed types is important in selecting the best approach to control. Summer annuals sprout in the spring, flower, produce seed, and die, during one year. Winter annuals germinate in the fall or winter, live through the winter, and grow more in the spring. They flower and die within the year following the first spring. Biennial plants are plants that take two years to complete their lifecycles. Perennials are plants that live for more than two years.

For a description of weeds in Wyoming landscapes, see Index 1 on Page 35.

WEED MANAGEMENT METHODS

PREVENTIVE CONTROL

Prevention of weed invasion is one of the most essential weed-control methods. As with many of human endeavors, "An ounce of prevention is worth a pound of cure." Preventive measures include pre-germination of and killing weeds prior to final seedbed preparation and using of certified seed. Use only seed with high levels of seed purity. Adding only thoroughly composted manure can greatly reduce the introduction of weed seeds and difficult weed species. The establishment of hedgerows can limit or trap windblown seeds. If grass sod is used, only purchase a product that is weed-free. All soil amendments and seed should first be inspected to be free of weed seed. Control of other kinds of pests in the landscape that compromise the health of plants is also important. Always remember vigorously growing turf can withstand weeds better. When turf is not growing vigorously, more weeds will result from traffic, drought stress, water logging, and from aerating or dethatching.

CULTURAL CONTROL

Cultural practices are the primary method for weed control once a healthy landscape has been established and it's important to promote environmental advantage for the desirable plants. These practices include soil building, precision irrigation, mowing heights and frequencies, fertilization, removal of excessive thatch, core aeration, and overseeding with competitive varieties. Cultural controls can help prevent weed populations from exceeding economic thresholds. Promoting competitive and vigorous plant growth is the best defense against weeds in turf. Anything that weakens turf will help weeds invade. The landscape can be managed in a way that leaves almost no room for weeds. Additionally, cultural methods will limit most of the weed problems and make other methods more effective. Landscapes management can decrease the suitability of the environment for weeds.

SOIL DEFENSE AGAINST WEEDS

Healthy soil is the foundation for sustained, vigorous plant growth and management of weeds. The biological activity of the soil forms the primary basis for fertility and favorable physical structure. Microorganisms and organic material in the soil are essential to holding soil nutrients in the root zone. Soil organic matter is a source of plant nutrients and nutrient holding capacity. Healthy soil structure aids air infiltration, water storage, plant root growth, and microbial growth. Soil structure has a great effect on the ability of plants to withstand weeds and other pests. The presence of weeds can indicate a compaction or fertility problem in the soil.

Nutrients do not work independently of each other. Deficiencies or excesses of many nutrients may affect the availability of other nutrients. Getting a response to one nutrient doesn't necessarily mean there is a deficiency of that nutrient when the soil fertility is out of balance. For example, dramatically raising phosphorus levels can induce what appears to be a zinc deficiency. Micronutrient deficiencies and imbalances will tip the balance in favor of weeds such as those with long tap roots or those that thrive on depleted soils. Fertility recommendations need to be based on soil tests. Likewise, fertility analysis of soil amendments like well-finished compost can be helpful. Soil tests should be conducted before planting and repeat testing every year or two afterward.

Soil health benefits from worm activity. Reduced pesticides will help microbial and earthworm populations contribute to overall soil health. Worm activity helps soil health therefore contributing to plant health. Using less insecticide and fungicide allows microbes, insects, and worms to breakdown thatch and cycle nutrients. Healthy soil can also reduce the incidence of plant disease, again encouraging the competitiveness of desirable plants.

FERTILIZATION AGAINST WEEDS

Precise fertilization can help desirable vegetation grow the best and compete with weeds. Soil testing provides accurate detailed information to plan what fertility to add. When soil fertility is lacking, weeds, like black medic thrive, where as too much nitrogen can result in more annual bluegrass and chickweed. Accurate fertilizer blends and amounts for desirable plants result in healthier plants, discourage weeds, and will not harm beneficial soil organisms. Avoid applying excess nitrogen. At least half of the annual application except for foliar feeding should be slow release.

Water soluble nitrogen sources can speed recovery following periods of stress. Micronutrients and nitrogen can often be accurately monitored and evaluated through leaf tissue samples. For example, yellow grass can be tissue tested for iron deficiency. Adding well-finished compost can feed soils while adding organic matter, however, avoid applying manure to turf in mid-summer to reduce attracting June beetles, the adult form of lawn grubs. Finally, fall fertilizing can reduce winter dormancy and vulnerability to weeds by encouraging growth in the spring.

GRASSES THAT COMPETE

Wyoming can be a challenging place to grow plants in general. Use varieties adapted to Wyoming's cool, arid plant zone. The more adapted and competitive the plant varieties are for the site, the fewer problems there will be. If the turf is thinly populated, weeds will invade and have more room to grow. In IPM, careful selection of turf varieties is essential to provide excellent density to keep weeds out. Sources of grass trial information include the Sheridan Research and Extension Center near Sheridan and the National Turfgrass Evaluation Program. The Sheridan research plots demonstrate the appearance and drought tolerance of different lawn grasses. More grasses are evaluated by the National Turfgrass Evaluation Program in the states that border Wyoming. Choose plant species that have a competitive advantage in the local environment. In addition to being best suited for the site, plant varieties should be selected for other factors also such as disease resistance. *Acremonium* endophytes are a beneficial fungus in plants. Grass varieties with plant endophytes can have more healthy resistance to insects and drought.

For examples of grasses adapted to Wyoming, see Index 2 on page 57.

AERATION

Aeration can reduce soil compaction, assist thatch breakdown, and enhance air exchange and water infiltration for stronger roots and results in more competitive grass. When soils are compacted, this encourages weeds like prostrate knotweed, annual bluegrass, and many others. Compaction also causes thin spots in the turf. Aerating equipment may be available on a rental basis, and landscape companies will do the job on a custom basis. Better aeration equipment removes soil cores, whereas solid tines may increase soil compaction. If a power rake is used, vertical motion may be less destructive than rotary action and could be used when the thatch layer is more than one-half inch thick.

The best time for aeration is when desirable grasses are growing vigorously and soil temperature is at least 55 degrees. Target aeration for when grass is coming out of summer dormancy and beginning a period of vigorous growth. Lawns should be thoroughly watered two days prior to aerating so hollow tines can penetrate deeper into the soil and soil cores easily fall out of the tines. Top dressing compost in combination with core aeration can make turf healthier when there are compaction issues.

WATERING SO WEEDS FAIL

Irrigation is both art and science. Too much or too little water will encourage weed invasion. There is a need to take natural precipitation into account when planning irrigation so weeds are not favored and nutrients are not flushed below the root zone. Accurate weather data will allow better scheduling of irrigation and a variety of other practices, such as, effective hoeing, mowing, and spraying. Not watering right after hoeing or tilling will help kill weeds and reduce weed seed germination. Irrigate down to the depth of roots so each set of irrigation lasts a week to 10 days. Pay attention to details, such as excessive worm castings, which can indicate there is too much moisture. Additionally, carefully managed irrigation can reduce summer dormancy.

OVERSEEDING

Overseeding is a process of spreading seeds on an already established lawn. Overseeding can fill thin areas to make turf more competitive. The timing for overseeding can vary but avoid the hottest part of summer. Overseed when the existing grass is starting to grow well or prior to the first fall frost. Time overseeding with the beginning of active turf growth so there is optimum rejuvenation. This is a prime opportunity to add a blend of new and improved varieties to the turf. Use only highly pure, certified seed blend of the best varieties for the location. For example, chewings fescue would be a good option for shaded areas. Newer seed varieties have improved aggressiveness, drought hardiness, and disease resistance.

Before spreading the seeds, prepare the soil to create a good seedbed. Small areas can be prepared by hand raking to loosen the soil surface. Larger areas can be prepared by aerating. Apply a “starter” fertilizer with your overseeding to make sure the new seedlings have nutrients for a rapid start. Keep the new seeding moist until the new grass is growing, then gradually decrease the amount of water applied. Water deeply and infrequently to encourage deep rooting. Avoid walking on the overseeded areas and allow the new grass to get tall enough that the mower won’t dislodge the new seedlings.

CREATE N0-WEED ZONES

Weeds can be limited in areas where creative design excludes them. Creative design in landscapes can also reduce or eliminate the need for extra water by including rocks or other items. Consider designing areas that will require fewer inputs to control weeds. These are zones that receive little or no water other than what the desired plants use. Including xeriscaping (the use of drought-tolerant plants, mulch, and efficient irrigation) into the landscape will not only reduce water consumption and weeds but add beauty and create greater sustainability in the landscape.

Image Courtesy of Lifescape and Associated Landscape Contractors of Colorado Excellence in Landscape Awards.

Since traffic can harm turf, consider paths for people and animals that are mulch, bare ground, or some solid material. Xeriscaping can also be designed into problem areas with soil compaction or too much slope. A variety of items including utility shed type structures can take up space that would otherwise be weedy. Groundcovers like blue rug juniper will exclude weeds once established. Ground covers can also provide habitat for natural enemies of plant pests. Mulch, hand weeding, and pre-emergent herbicide can work until the groundcover is growing in a solid stand. Inanimate objects like rocks, logs, and breathable weed barrier covered with gravel or bark will displace weed habitat. Dense plantings can create attractive spots that out-compete weeds for limited water once established and growing densely. See the Colorado Extension bulletin "Xeriscaping: Ground Cover Plants" no.7.230 for a list of xeriscape plants. The basic idea would be to plant so many good plants there will not be any room for weeds to grow. Wildflower mixes on the other hand are not generally weed-free zones. While wildflower mixes can be attractive, they are often invaded by weeds. They would need to be very well planned to be less work.

ALLELOPATHY

Allelopathy is when plants produce compounds that inhibit the growth of other plants. A dense patch of horseradish or rhubarb could be used for a patch of greenery that will exclude weeds. Similarly, low-growing juniper also excludes weeds once established.

MECHANICAL CONTROL

Mechanical control includes physical methods such as tilling, hand pulling, burning, mowing, and mulching. Some methods can be particularly useful for small infestations and in areas around ornamentals. Remember that cleaning tillage or mowing equipment between uses can prevent weed spread.

HAND PULLING WEEDS

Annual weeds tend to be more susceptible to hand pulling. Perennial weeds are less effectively controlled by pulling because of the difficulty of removing the entire root. Many species can re-sprout from root segments left in the soil. Hand weeding is effective, especially when weed numbers are low. Hand pulling is often preferred when possible as it is more precise. A dandelion digger is a tool designed to remove dandelions and other weeds by the root with minimal soil disturbance or harm to neighboring plants. Dandelion diggers typically look like large screwdrivers with the sharp V-like digging end shaped like a fish tail.

MOWING

Mowing can be a very successful control method for many annual weeds. Mowing a perennial weed like Canada thistle a couple of times during the summer followed by a fall herbicide application can provide control. However, the biology of the weed must be considered before mowing since some weeds respond aggressively to being mowed. Mowing weeds around the edges of the landscape can prevent weeds from going to seed. When mowing turf, make sure the blades are sharp to reduce stress and yellowing on the turf. Mowing more frequently can reduce thatch buildup because the clippings are smaller and break down easier. The leaf clippings break down easier than stem clippings so more stems equals more thatch buildup. Mowing height that is too close and frequent can stress grass and may allow annual bluegrass, and chickweed to compete. Various grasses have optimal mowing heights for maximum competitiveness.

MULCHING

Mulch is a layer of material spread on the ground around ornamentals. Mulching smothers the weeds by excluding light and providing a physical barrier to impede emergence. Mulching is successful with most annual weeds. When the mulch resembles a natural layer on the “forest floor,” it can promote nutrient cycling. Organic material decomposition can provide a healthy environment for worms and beneficial insects that aerate the soil and convert some forms of nitrogen to be more useful for ornamental plants. When fallen leaf material isn’t disturbed beneath trees, there will be less soil compaction, and fewer weed seeds will germinate. Mulched areas can become weedy over time. When there are too many weeds to manage by hand, herbicides and additional mulch can help.

TILLAGE

Rototilling can be an effective method of controlling weeds around ornamentals or walkways. While tilling can kill weeds, it also brings more weeds seeds to the surface. Tillage practices can help decrease compaction and aerate the soil. On the other hand, tillage has also been shown to decrease soil moisture, increase soil erosion and runoff, and decrease soil microbial populations.

SOIL SOLARIZATION

Soil solarization can be useful for preparing an area for planting. This is a simple, non-selective method of weed control accomplished by covering the soil with a layer of clear plastic. Plastic covering the ground traps heat energy from the sun and raises the temperature of the soil. Many weed plants and seeds are not able to withstand the temperatures and are killed. For this method to be most effective, the soil should be moist. Clear plastic has been shown to produce higher soil temperatures than black plastic.

BURNING

Weeds can be killed between paving slabs and on driveways by burning them with a flame gun. Use only when the foliage is dry and allow sufficient burn-time for weeds to be killed. Flaming is used on a smaller scale and includes the use of a propane torch. Flaming may be used to control weeds along chain-link fences and paved areas or places where the soil may be too wet to hoe. Flaming is most effective on young weeds.

HOEING

For maximum effectiveness, choose a dry, sunny day with wind so the seedlings will dry out on the surface of the bed rather than re-rooting into moist soil. When the weather is wet, it's also easier to spread plant disease. The sharper the hoe, the easier the work will be. Hoeing when weeds are smaller requires shallower hoeing and exposing less new weed seeds.

BIOLOGICAL CONTROL OF WEEDS

Biological control of weeds includes grazing, insect feeding, and pathogen damage. Biological control of weeds is usually more for suppression than eradication. This would be very useful in weed-infested rangeland near schools and other facilities.

INSECTS

Biological control using insects to control weeds is limited in turf and around ornamentals, but there are a few bio-control agents for weeds available for these areas. Biological control insects should be released with proper timing on stands of weeds near the landscape if there are weed patches that will not be chemically controlled. In most effective scenarios, the weed infestation is suppressed to a 'tolerable level,' a level where the insect agents are significantly limiting distribution and abundance of the target weed species. While the nearby weeds are a source of seed, they are also a source of habitat for the bio-control agents. Bio-control agents are for weed suppression and can be good to use if management determines lower costs and a few more weeds are acceptable.

Puncturevine Weevil *(Image Courtesy of http://www.arbico-organics.com)*

Puncturevine (Tribulus terrestris), also known as goathead or tackweed, is one weed for which there is biological control available. The stem weevil, *Microlarinus lypriformis*, and the seed weevil, M. lareynii, can be purchased for biological control. Obtain the bio-control agents from a source with a colder climate to match Wyoming. These biological control agents can keep puncturevine populations in check, but the suppression is cyclic at best. Adults of both species overwinter in plant debris.

While hoeing may be a better choice for control of puncturevine in some landscapes, releasing weevils on nearby infestations so there is a natural lowering of the puncturevine population in the general area makes sense. The same approach can be used for Canadian thistle, field bindweed, and a few other weeds that infest areas near facilities.

GOATS

Goats are best used in combination with low maintenance turf grasses. Some landscape managers use goats to eat weeds and eliminate fuel costs of mowing. A wide variety of goats can be used for weed control ranging in size from pygmy goats to larger cashmere goats. Some goat owners use them on their own properties and also rent the goats out to neighbors. Other entrepreneurs primarily own the goats as a weed control enterprise that supplies goats to landscape managers in the area. Rental companies usually provide the goats on a daily basis.

CHEMICAL CONTROL

There are more than 2,500 herbicides registered in the United States. The safe and accurate application of herbicides can be a time-efficient component of managing weeds. Herbicides combined with the other weed control methods can be more effective. There are many selective herbicides available that provide effective weed control while not injuring the desirable species. Always apply herbicides when you can get the greatest effect on the weeds and least damage to non-targets. There are times a non-selective herbicide that kills all vegetation can be better than hoeing when it's important not to disturb the soil surface. Use spot spraying for isolated outbreaks and more uniform applications for weeds growing over a wider area. Herbicides can be especially practical for controlling weeds along borders to prevent an influx of weeds.

***It is not the intent of this bulletin to endorse certain ingredients or products. Ingredients used herein are for example only.

CONSIDERSATIONS FOR CHEMICAL CONTROL AROUND FACILITIES

HERBICIDES ON SCHOOL GROUNDS (NOTIFICATION REQUIRED)

FIFRA

RESTRICTED USE PESTICIDES

PRODUCT LABEL

HERBICIDE MODE OF ACTION

REDUCING WEED RESISTANCE TO HERBICIDES

PAN BAD ACTOR PESTICIDES

HERBICIDE SELECTION

HERBICIDES IN THE ENVIRONMENT

TIME OF APPLICATION

HERBICIDE FORMULATIONS

ADJUVANTS

SAFETY INFORMATION

APPLICATOR TRAINING

HERBICIDES ON SCHOOL GROUNDS

The Wyoming Environmental Pesticide Control Act of 1973 requires notice be provided by school districts not less than 72 hours prior to herbicide application on school property, and the district shall further notify students, teachers, and staff. All notices distributed under this subsection shall be marked with a distribution date and include information indicating date of application, location of application or treatment area, pest to be controlled, name and type of pesticide to be applied, and a contact for additional information. All notices distributed under this subsection shall be retained by the school or school district for two years. Additionally, the licensed commercial applicator or other school employee applying pesticides shall post signs on the school building or property stating the date of application, the location of the application or treatment area, the name and type of the pesticide to be applied and a contact for additional information. Upon request, the licensed

commercial applicator or other school employee shall provide information on how to obtain additional information on the pesticide. Not less than 12 hours before application of pesticides within school buildings, signs shall be posted at main entrances to school buildings and at the entrances to the specific application area within buildings. If pesticide application is made outdoors to any area adjacent to a school building or on property used by the district for student activities or playgrounds, signs shall be posted immediately adjacent to the treated area and at the entrance to the district property. The signs shall remain posted for 72 hours.

FIFRA

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) was passed in 1947 and has been amended numerous times, most recently by the Food Quality Protection Act (FQPA) of 1996. FIFRA requires users of pesticides to follow the labeling directions explicitly on each product. The following statement appears on all EPA-registered product labels under the DIRECTIONS FOR USE heading: "It is a violation of federal law to use this product in a manner inconsistent with its labeling." An EPA inspector is authorized to examine personal protection equipment, pesticide application equipment, and pesticide storage areas. Typical records an EPA inspector may ask to review for FIFRA compliance include records of pesticides purchased, pesticide application records, description of the pest control program, certification status of pesticide applicators, pesticide disposal manifests, and contract files. If you violate FIFRA, or regulations issued under it, you are subject to civil penalties. They can be as much as $5,000 for each offense ($1,000 for private applicators). Before EPA can fine you, you have the right to ask for a hearing in your city or county. Some violations of the law also may subject you to criminal penalties. These can be as much as $25,000 or one year in prison, or both, for commercial applicators; $1,000 and/or 30 days in prison for private applicators. States may establish higher penalties.

RESTRICTED USE PESTICIDES

Restricted use pesticides are products not available to the general public. The "Restricted Use" classification restricts a product, or its uses, to use by a certificated pesticide applicator or under the direct supervision of a certified applicator. This means that a license is required to purchase and apply the product. In Wyoming, certification programs are administered by the Wyoming Department of Agriculture. There is a list of restricted use products available at http://www.epa.gov/opprd001/rup/. The other major group, General Use pesticides, includes pesticide formulations that are not classified as restricted use. Unclassified pesticides have no designation on the product label.

PRODUCT LABEL

Pesticide product labeling is a legal document and the main method of communication between a pesticide manufacturer and pesticide users. With more than 2,500 herbicides registered in the United States, the product label is essential for making herbicide selections.

Always read the entire herbicide product label and follow the directions on the herbicide label. The herbicide user is legally responsible to comply with all product label requirements for herbicide handling, use, and cleanup. Read the label before purchasing the herbicide, to determine if the herbicide is best for the job. Read the label before you mix the herbicide to determine what protective equipment is needed for safe handling, what you

can mix with the product (compatibility), how much product is required, and the proper mixing procedure. Water quality can affect how well pesticides perform. Read the label before applying the herbicide to determine which safety measures are necessary, when to apply, where the pesticide can be used, how to apply, and any restrictions of use. The label also provides information regarding cleaning containers and the storing or disposing of surplus herbicide and containers.

HERBICIDE MODE OF ACTION

Herbicide families are grouped by mode of action. Mode of action refers to how the herbicide works. The Weed Science Society of America (WSSA) has developed a summary of herbicide modes of action with group numbers for each mode of action (Figure 1). The WSSA group number is on most herbicide labels and is intended to serve as a tool to aid in herbicide selection. Identify the WSSA group of the herbicide and rotate modes of action to limit herbicide resistance. If a label does not have the group number, it can be accessed through the Weed Science Society of America at http://wssa.net/. For questions regarding mode of action, consult the individual product label and support literature from the manufacturer or contact your county agricultural extension educator for more information.

WSSA Mode of Action Group Numbers	
1	Acetyl-CoA Carboxylase (ACCase) Inhibitor
2	Acetolactate Synthase (ALS) Inhibitor
3, 15, 23	Mitosis Inhibitors
4	Synthetic Auxins
5, 6, 7	Photosystem II Inhibitors
8, 16	Fatty Acid and Lipid Biosynthesis Inhibitors
9	Enolpyruvyl-Shikimate-Phosphate (EPSP) Synthase Inhibitor
10	Glutamine Synthetase Inhibitor
11, 12, 13, 27	Carotenoid Biosynthesis
17, 25, 26	Potential Nucleic Acid Inhibitors
18	Dihydropteroate Synthetase Inhibitors
19	Auxin transport Inhibitor
20, 21, 28, 29	Cellulose Inhibitors
22	Photosystem I Inhibitors
24	Oxidative Phosphorylation Uncouplers
NC	Not Classified

(Figure 1)

REDUCING WEED RESISTANCE TO HERBICIDES

A number of weed species once susceptible and easily managed by certain herbicides have developed resistance. While some weeds are naturally tolerant or resistant to herbicides the first time they are exposed to them, other plants change over time to resist herbicides. When herbicide resistance develops in weeds, the products with the same mode of action are no longer effective. Management programs for herbicide resistance should emphasize an integrated approach that stresses prevention. Evolved herbicide resistance happens when plants survive and reproduce following an herbicide application. When the same herbicide mode of action is used time after time, weeds that survive can become resistant to the particular active ingredient or mode of action. Annual weeds that produce a lot of seeds develop resistance to herbicides faster than plants that produce few seeds. Herbicide resistance tends to be a bigger problem in turf where the crop is not rotated. Dependence on a single strategy or herbicide family for managing weeds will increase the likelihood of additional herbicide resistance and product failure in the future. Using the labeled herbicide rate for recommended for the target weed sizes and growth stages increases effectiveness. Two primary ways to prevent herbicide resistance is to rotate herbicide modes of action and ensure there are no surviving weeds after application. Integrating cultural and mechanical methods with chemical weed control also helps. More information on herbicide resistance is available at http://www.wssa.net/Weeds/Resistance/.

PAN BAD ACTOR PESTICIDES

The Pesticide Action Network (PAN) Pesticide Database is a website resource for toxicity information for pesticides. PAN Bad Actors are chemicals that are one or more of the following: highly acutely toxic, cholinesterase inhibitor, known/probable carcinogen, known groundwater pollutant, or known reproductive or developmental toxicant. NOTE! Because there are no authoritative lists of Endocrine Disrupting (ED) chemicals, EDs are not yet considered PAN Bad Actor chemicals. The Pan Bad Actor database was constructed to identify the toxicity of various pesticides. This database is searchable by chemical, product name, or EPA number. A pesticide toxicity search engine is available at http://www.pesticideinfo.org/Search_Products.jsp. One reason herbicides with higher toxicities can be a viable option is that sometimes a more toxic herbicide used according to the label is safer and easier on the environment than another type of herbicide that is used more frequently or continuously. The PAN Bad Actor status can help understand potential dangers of using various herbicides.

HERBICIDE SELECTION

Use the safest and most effective ingredients for a particular application. A search of the Pesticide Information Center Online (PICOL) site (http://cru66.cahe.wsu.edu/labels/Labels.php) will show which herbicides control certain weeds as well as other items of information that help in narrowing the choice to the best herbicide. Start by finding out which active ingredients will control the problem weed. There are several factors to consider when selecting an herbicide. After figuring out which ingredients will do the job and finding which products are available and at what cost, consider the levels of safety and rotating product modes of action. The Crop Data Management Systems, Inc. site (http://www.cdms.net/LabelsMsds/LMDefault.aspx) lists and provides labels and MSDS for those products registered in Wyoming. The National Pesticide Information Center site (http://npic.orst.edu/) includes some pesticide ingredient fact sheets and a wide range of pesticide information resources. For assistance,

Wyoming Weed and Pest Council, University of Wyoming Extension, pesticide distributors, or other experts may be able to help you choose a product best for a specific situation. Table 1 includes examples of herbicide ingredients including modes of action and pesticide action network (PAN) Bad Actor status.

HERBICIDES IN THE ENVIRONMENT

Before use, read and follow all safety precautions on the label of each herbicide. The label contains legal requirements for using the product.

Special care should be taken around sensitive areas where an herbicide could potentially do harm. These places include: areas near schools, playgrounds, hospitals, and other public areas; areas with honeybees or other beneficial insects, fish, wildlife refuges, or parks; areas near ornamental gardens, food or feed crops, or other sensitive plantings; areas near surface water and areas where ground water is near the surface or easily accessed.

There are several ways herbicides can be less effective and affect non-target areas. These include runoff, drift, and volatilization. Runoff can move an herbicide away from target weeds. The chemical is wasted, weed control is reduced, and there is more chance of damaging other plants and polluting soil and water. Drift is the airborne movement of spray droplets away from a treatment site during application. Higher pressure and finer mists increase the likelihood the herbicide will drift and injure non-target plants. Spray drift is also affected by spray droplet size, wind speed, and the distance between nozzle and target plant or ground. Drift can damage nearby sensitive plants or can contaminate playground equipment. Drift may also be a hazard to people, domestic animals, or pollinating insects. Drift can contaminate water in ponds, streams, and ditches and harm fish or other aquatic plants and animals. Excessive drift also reduces the pesticide applied to the target and can reduce the effectiveness of a treatment. In some cases, less pressure, larger nozzles, and spray shields may help keep the application from reaching non-targets. Volatilization is the process of solids or liquids converting into a gas, which can move away and damage desirable vegetation. Hot, dry, or windy weather and small spray drops increase volatilization.

Make sure desired grasses are well-watered the day before herbicide application. Drought and herbicide together can overly stress the grass. Do not irrigate treated areas until one day after spraying to assure the chemicals have been absorbed by the plants. Do not place soluble and residual (long-lasting) herbicides in the root zones of susceptible, desirable plants. The chemicals could be leached down and absorbed by roots, causing damage or death to plants. Follow reentry restrictions on the product label and keep people and animals away from the area until the herbicide has dried. Minimize the potential for environmental issues by following label directions. Help safeguard the health of people and the environment by practicing IPM. The Journal of the American Medical Association explains some pesticide exposure and illness tracking, and the authors recommend IPM (Alarcon, W, et.al. 2005).

Mode of Action and Known Toxicity of Some Herbicide Ingredients (2014)

ACTIVE INGREDIENTS	WSSA M.O.A. GROUP	PAN BAD ACTOR STATUS
2,4-D + DICAMBA + MCPP-P	4 and 4 and 4	Acute Toxicity (MCPP-P)
2,4-D + DICAMBA + MCPP-P + DITHIOPYR	4 and 4 and 4 and 3	Acute Toxicity (MCPP-P)
BENEFIN (BENFLURALIN)	3	Not Listed
DIMETHENAMID-=P	15	Not Listed
FENOXAPROP-P ETHYL	1	Not Listed
FLORASULAM	2	Not Listed
INDAZIFLAM	29	Not Listed
ISOXABEN	21	Not Listed
MESOTRIONE	27	Not Listed
ORYZALIN	3	Carcinogen
OXADIAZON	14	Carcinogen + Developmental of Reproductive Toxin
PENDIMETHALIN + DIMETHENAMID-P	3 and 15	Not Listed
PRODIAMINE	3	Not Listed
QUINCLORAC	4	Not Listed
SETHOXYDIM	1	Not Listed
SIDURON	7	Not Listed
SIMAZINE	5	Water Contaminate + Developmental or Reproductive Toxin
SULFENTRAZONE	14	Not Listed
SULFOMETURON-METHYL	2	Not Listed
TRICLOPYR	4	Not Listed

(Table 1)

TIME OF APPLICATION

Various herbicides are designed to be applied either before the weeds emerge or after they emerge and at certain stages of weed development. Timing of applications is one of the most critical aspects within the weed manager's control. Applying a product too early or too late can be like swinging a bat at a baseball without paying attention; the results are usually poor.

Preemergent Herbicides

Preemergent herbicides affect germinating seeds so they are most effective against annual weeds. For these products to be effective, the herbicide needs to be applied before weed seeds germinate. After application, these herbicides need rainfall/irrigation for activation. As weeds begin to germinate, they absorb the herbicide and fail to emerge. Improper timing is a major cause of poor control with these herbicides. Wait until after the last killing frost and follow the timing of application according to the label. Spring crabgrass applications can be timed when soil temperatures are increasing. Because preemergent herbicides are absorbed by roots and inhibit root growth, improperly calibrated equipment and excessive overlap can damage turf grass.

Postemergent Herbicides

Postemergent herbicides kill weeds already up and growing. They are usually most effective when weeds are young and growing vigorously. Postemergent herbicides in turf are selective herbicides usually used to control annual, biennial, and perennial weeds without damaging the turf species. Turf herbicides can damage or kill trees, shrubs, and flowers so they should be used with great care near ornamentals. While many postemergent herbicides are also effective around ornamentals, they can additionally be used for spot treating isolated areas.

Nonselective herbicides that kill all plants, both desirable and undesirable, can be used to spot treat perennial weeds and eliminate weeds within dirt and gravel walkways. Post-emergent herbicides can be brushed on individual weeds or applied with shielding devices to prevent harm to non-target plants.

Time of Day

There are advantages to applying herbicides during very early morning hours, in the evening, and days when it is less likely that people other than pesticide handlers will be present. It is more likely to be cooler, reducing concerns about heat stress and pesticide vaporization. The wind is likely to be low, and indoor ventilation systems may be off or reduced. There will be less direct sun in outdoor and glass-roofed sites. Bees sensitive to some products are not out early in the morning. When working alone, it is good to make sure someone knows you are doing the application and, that it went safely.

HERBICIDE FORMULATIONS

The active ingredient in an herbicide is the chemical that controls the target weed. Active ingredients are often sold in several formulations. The formulation can influence the properties of a product for handling, storage, and application and may substantially influence effectiveness and safety. The product label will include the type of formulation along with specific instructions regarding its use. Formulation may be designated by a letter or let-

ters following the trade name. For liquid formulations, amount of active ingredient contained is expressed as a percentage of the total ingredients and the number of pounds in a gallon of product. Active ingredients contained in dry formulations are expressed only as a percentage by weight.

Dry formulations

Granule (G) and Pellet (P)

Pellets are similar to granules, only larger. Both have a coating of some type of inert material such as clay, vermiculite, or sand. These materials may be applied with a fertilizer spreader. Drop spreaders are more accurate and uniform than broadcast spreaders. After calibration, the preferred method of application is to apply one-half the recommended rate in one direction and one-half at a right angle to that direction. Granules have minimum drift potential, but they may be trapped in the whorls of some plants. They can be difficult to spread uniformly around obstacles. The size of bulk quantities of granules and pellets can present a logistical problem.

Wettable Powder (WP or W)

Wettable powders are dry preparations that look like dust, contain a high percent active ingredient, and are mixed with water for application. They require good agitation (mixing) in the spray tank to maintain the suspension.

Soluble Powder (SP)

Soluble powders look like wettable powders, but they form a true solution when added to water. After dissolving, very little or no more agitation is usually needed. Soluble powders are nonabrasive to equipment.

Water-Dispersible Granule or Dry Flowable (WDG or DF)

This formulation contains larger granular particles. Constant agitation is required to avoid settling. Because of their larger particle size, inhalation hazard for the applicator is reduced. Water-Dispersible Granules are abrasive to sprayers.

Liquid formulations

Water-Soluble Concentrate (WSC)

Since the active ingredients of water-soluble concentrates are highly soluble, they readily mix with water to form a true solution. Agitation is not necessary to maintain the herbicide in solution. They are essentially nonvolatile and not abrasive to equipment.

Emulsifiable Concentrate (EC)

An emulsifiable concentrate formulation usually contains the active ingredient, one or more petroleum solvents, and an emulsifier that allows the formulation to be mixed with water. The milky colored appearance when mixed with water is typical of emulsifiable concentrates. They require less agitation to stay in suspension, are easily absorbed through skin, and have a volatility potential with higher temperatures.

Flowable or Aqueous Suspension (F, L or AS)

This liquid formulation has the same major characteristics as a wettable powder; it forms a suspension when added to water, and it enables the application of water-insoluble herbicides in water. They require good agitation in the spray tank to maintain the suspension. If the solution is left to sit for long periods of time, the material can settle or clog equipment.

ADJUVANTS

An adjuvant is any material added to an herbicide solution to enhance or modify the performance. They are either included in the herbicide formulation or added to the spray tank to improve herbicidal activity or application characteristics. The target species can influence the appropriateness of the adjuvant. To choose the correct adjuvant, first read the herbicide label. While an appropriate adjuvant improves performance and crop safety, the wrong adjuvant increases the risk of poor performance and crop injury.

SAFETY INFORMATION

For a poison emergency anywhere in the United States, call the **NATIONAL POISON EMERGENCY NUMBER** at **1-800-222-1222.** Specialists are available to answer any questions about poisoning or poison prevention 24 hours a day seven days a week. During an emergency, or if a person is unconscious, call **911.** All pesticide labels must bear the statement **"KEEP OUT OF REACH OF CHILDREN**".

Signal Toxicity Wording

Signal words are placed on the herbicide label based upon the acute toxicity of the herbicide. The signal word provides the user with an idea of the relative toxicity of the herbicide. The following words are used:

"Danger"	EPA Category I	Highly toxic
"Warning"	EPA Category II	Moderately toxic
"Caution"	EPA Category III	Slightly toxic
"Caution"	EPA Category IV	Very low toxicity

While category I herbicides are corrosive, category IV are usually not irritating. Some examples of the potential hazards of a product in the Danger category include "Fatal if swallowed," or "Can kill you if swallowed." "Poisonous if inhaled," or "Can kill you if breathed," combined with the statement "Do not breathe dusts, vapors, or spray mists." "Corrosive — causes severe skin burns," combined with the statement "Do not get on skin." "Fatal if absorbed through the skin," or "Can kill you by skin contact," combined with the statement "do not get on skin or clothing." "Corrosive — causes irreversible eye damage," or "Causes severe eye burns or blindness," combined with the statement "Do not get in eyes." For products classified as toxicity category I for acute oral, acute dermal, or acute inhalation toxicity, the word "**POISON**" and the **skull and crossbones** symbol are also required in addition to the signal word Danger.

Personal Protective Equipment

By law, personal protective equipment and other clothing listed on the pesticide label is required for applicators. This equipment may include safety goggles, unlined liquid-proof gloves, long sleeves, long pants, and boots. Avoid wearing anything made of leather or canvas as these materials absorb and retain pesticides.

Spill Assistance

Chemtrec, the Chemical Transportation Emergency Center, is a public service of the Chemical Manufacturing Association. Located in Washington, D.C., Chemtrec is staffed 24 hours a day by trained personnel who can advise you how to manage herbicide emergencies. Chemtrec number for emergencies is **1-800-424-9300**. Have the product label in hand when you request help from Chemtrec or any other source. Many pesticide labels list an emergency telephone number that allows direct access to the manufacturer and people who know how to manage emergencies for that product. If the spill occurs on a highway, call the highway patrol or highway department right away. Call the county sheriff, city police, or fire department if the spill occurs on a county road or city street. These authorities are trained for such emergencies and will be able to assist you in your cleanup. Notify the **Wyoming Department of Agriculture at 1-307-777-6574** for a large herbicide spill. The website for the Wyoming Department of Agriculture is http://wyagric.state.wy.us/. Call the fire department for assistance if you suspect that a large spill is flammable. If anyone is poisoned by contacting the spill or if you suspect that an exposure may lead to poisoning, call the emergency room and provide them with the brand name, active ingredients, and any other labeling information, such as symptoms of poisoning and antidotes.

Pesticide Wastes

Any extra rinse material you create when you clean equipment contain herbicides and potentially can harm people and the environment. Do not create puddles children or animals could get into. Minimize waste and clean equipment in an area away from public access. Excess pesticides and rinsates that cannot be used must be disposed of as wastes. Other pesticide wastes include such things as contaminated spill cleanup material and personal protective equipment items that cannot be cleaned and reused. Whenever possible, avoid creating pesticide wastes that require disposal. Dispose of excess chemicals and their containers in accordance with label directions. Never burn, bury, or dump excess pesticides, and never dispose of them in a way that will contaminate public or private ground water, or surface water, or sewage treatment facilities.

APPLICATOR TRAINING

Certain pesticides may be applied only by or under the direct supervision of specially trained and certified applicators. Certification for pesticide applicators is conducted by Wyoming Department of Agriculture in accordance with national standards. Proper applicator training leads to more successful use of herbicides. When a pesticide fails to perform as expected, often the cause is applicator error or equipment failure. Training also minimizes the hazards to the applicator, others, and the environment. The Wyoming Department of Agriculture and the University of Wyoming Extension offer pesticide applicator training materials at http://wyagric.state.wy.us/component/content/article/50-technical-services/236-pesticide-applicator-training

http://www.uwyo.edu/plantsciences/wyopest/trainingmaterial.html

OTHER RESOURCES

Weed Identification

http://www.uwyo.edu/ces/wyoweed/wyoweed.htm

Soil Testing

http://www.soiltestinglab.colostate.edu/

The Colorado State University Soil Testing Laboratory will send courtesy copies of soil testing reports to Wyoming county extension offices if the client indicates their county and state on the soil sample submission form.

Insect Identification

http://www.uwyo.edu/ces/entomology/insect-identification.html

EPA - Pesticide Product Label System

http://iaspub.epa.gov/apex/pesticides/f?p=PPLS:1

SELECTED REFERENCES

Feucht, James R. 2009. Xeriscaping: Ground Cover Plants For Low-water Landscapes. Colorado State University Extension Fact Sheet No. 7.230. http://www.ext.colostate.edu/pubs/garden/07230.html

Leslie A. (ed) 1994 Hand book of Intergated Pest Management for Turf and Ornamentals. CRC Press. Boca Raton,FL.

Senseman, S. (ed.)2007. Summary of Herbicide Mechanism of Action According to the Weed Science Society of America (WSSA). http://wssa.net/wp-content/uploads/WSSA-Mechanism-of-Action.pdf

Panter, K.L., A.J. Koski, and R.M. Hybner. 2002. Landscaping: Turf in Wyoming. University of Wyoming Cooperative Extension Service Bulletin B- 1129. http://www.wyomingextension.org/agpubs/pubs/B1129.pdf. Accessed 21 October 2011.

Panter, K.L. and E.E. Ewart. 2001. Landscaping: Recommended shrubs for Wyoming. University of Wyoming Extension Service Bulletin B- 1108. http://www.wyomingextension.org/agpubs/pubs/B-1108.pdf.

Pesticide Applicator Training Manual, University of Wyoming Extension Service. Laramie, Wyoming. http://wyagric.state.wy.us/divisions/ts/sections-a-programs/pesticide/210

Turgeon A. J., L. B. McCarty and, N. E. Christians. 2009 Weed Control in Turf and Ornamentals. Prentice Hall. Upper Saddle River, NJ.

Whitson, T. D. (ed.) 2001. Weeds of the West. 9th ed. Laramie: University of Wyoming

Wyoming School Integrated Pest Management, University of Wyoming Extension Service. Laramie, Wyoming. http://www.uwyo.edu/wyschool_ipm/

Form 1

Landscape history data sheet

LANDSCAPE HISTORY DATA SHEET	Location:				
	Address:				
Date:					
Names of contact:					
Phone number:					
Email:					
Area size	Soil N	Soil P	Soil K	Soil pH	% O.M.
Soil type	Soil drainage	Spring fert. app.	Irrigation schedule	Mowing schedule	Mowing height
List of plants					
List problems (e.q. species and amount)					
Additional information					

*Attach map of site

Form 2

Weed scouting data sheet

WEED SCOUTING DATA SHEET	Location:
	Address:
Date:	
Time:	
Name:	
Email:	
Phone number:	

Weed/Problem	Amout of problem	Stage of weed	Pattern of problem

Soil moisture	Turf height	Draw map of infestations

Comments

Form 3

Weed Control Action/Application Form

WEED CONTROL ACTION/APPLICATION FORM	Date:
Name of APPLICATOR:	
License number:	
Phone number:	

Time of application	Location, application site	Weather conditions	Target pest (species)	Target pest (growth stage)	Type of control

Size of area treated	Product brand name or biocontrol agent	Product formulation	Active ingredient	Percentage active ingredient	Product reg. number

Rate used	Total amount applied	Equipment used	List equipment settings	Results

General comments (e.g., source of bio-control agents, stage of host agents came from and other factors)

Annual Bluegrass *Poa annua* L.

Annual bluegrass thrives best during cool weather. Germination of seeds occurs in fall and early spring. The plant matures, develops seeds, and then dies in early summer, leaving brown areas in the lawn. Annual bluegrass is often lighter green than Kentucky bluegrass. Repeated mowing that cuts off the ends of the stems causes annual bluegrass to branch more near the ground surface. The plant then sets its seeds below mowing height, giving the lawn an unsightly appearance. Since annual bluegrass can only be produced from seeds, the key to control is twofold: prevent seed production and keep seeds in the soil from germinating and establishing new plants. If an infestation is small, the plants can be loosened and removed by hand. Raking a lawn before mowing tends to lift the branches upright, and they are more likely to be cut off by a mower.

Annual Bluegrass. Image: Ohio State Weed Lab Archive, The Ohio State University, Bugwood.org

Annual Bluegrass. Image : Joseph M. DiTomaso, University of California - Davis, Bugwood.org

Black Medic *Medicago lupulina* L.

Black medic is a perennial that may form coarse, unsightly mats of vegetation resembling small clover plants. This plant tends to do well where soils are compacted. Three leaflets emerge from approximately the same point of the long petiole (leaf stalk). The leaflets, covered with fine hairs, are slightly toothed at the tip. Bright yellow flowers form a dense head, and the seeds closely resemble those of alfalfa. Preventing black medic seed production is important in its control.

Black Medic. Image: Bruce Ackley, The Ohio State University, Bugwood.org

Black Medic. Image: Karan A. Rawlins, University of Georgia, Bugwood.org

Canada Thistle *Cirsium arvense* (L.) Scop.

Canada thistle is a perennial developing from deep and extensive horizontal roots. Stems are 1 to 4 feet tall, ridged, and branching above. Leaves are alternate and attached to erect stems without a petiole and are divided into spiny-tipped, irregular lobes. Flowers are purple with heads occurring in July and August. This perennial weed is difficult to control because of the ability of its roots to regenerate. Large amounts of wind-blown seed are also produced.

Canada Thistle. Image: Phil Westra, Colorado State University, Bugwood.org

Canada Thistle. Image: Ohio State Weed Lab Archive, The Ohio State University, Bugwood.org

Common Mallow *Malva neglecta* Wallr.

Common mallow may invade ornamental plantings and often infests thin lawn areas. This plant can act as an annual, biennial, or perennial plant. This plant can be mistaken for ground ivy at first glance because of its round leaves. Common mallow has a deep taproot, and the leaves are light green, nearly round, or slightly heart-shaped with toothed margins. The flowers are whitish blue, bell shaped, and produced in the leaf axils.

Common Mallow. Image: Ohio State Weed Lab Archive, The Ohio State University, Bugwood.org

Common Mallow. Image: Ohio State Weed Lab Archive, The Ohio State University, Bugwood.org

Annual or Common Chickweed *Stellaria media* L.

Common Chickweed. Image: Mary Ellen (Mel) Harte, Bugwood.org

Common chickweed, an annual, is usually found in shady areas, such as around shrubs, flowers, or buildings. These areas can be moist and overwatered. The plant spreads through seeds and rooting at the stem joints. Common chickweed can easily be distinguished from perennial chickweed by the bright green, smooth, heart-shaped leaves. Small, white, star-shaped flowers are produced throughout the growing season and continue flowering in protected areas during mild winters.

Common Chickweed. Image: Theodore Webster, USDA Agricultural Research Service, Bugwood.org

Broadleaf Plantain *Plantago major* L.

Broadleaf plantain is a perennial that can be found scattered throughout lawns. It spreads by seeds and new shoots from the roots. Leathery leaves form a basal rosette which is prostrate and protects the shallow roots. Leaves are green, egg shaped, and parallel-veined with all veins merging at the leaf stalk (petiole).

Broadleaf Plantain. Images: John Cardina, The Ohio State University, Bugwood.org

Crabgrass *Digitaria sanguinalis* (L.) Scop.

Crabgrass is common in lawns and gardens in lower elevations of Wyoming; however, large quantities of commercial crabgrass killer are purchased for control measures even where this weed does not grow. Positive identification should be made before applying control measures. Crabgrass is an annual that spreads by seeds and stem rooting at the lower joints. The stems are erect or slightly prostrate. Leaves are 2 to 4 inches long and covered with hair. Racemes (flower stalks), two to 10 in number, branch off near the top of the stem. Flowering parts are grayish brown to purple in color.

Pre-emergence (before seeds germinate) treatments provide effective control and result in less chance of damage to bluegrass. Several effective fertilizers plus crabgrass-control herbicide mixtures are available.

Crabgrass. Image: Charles T. Bryson, USDA Agricultural Research Service, Bugwood.org

Crabgrass. Image: Joseph M. DiTomaso, University of California - Davis, Bugwood.org

Creeping Bellflower *Campanula rapunculiodes* L.

Creeping Bellflower. Image: Mary Ellen (Mel) Harte, Bugwood.org

Creeping bellflower, sometimes called bluebells in Scotland, has become a serious problem in lawns throughout Wyoming. This plant can escape from adjacent flower gardens and can form dense clusters of leaves that completely take over a lawn. It is a perennial that spreads through seeds and underground rootstocks. Seeds of the plant can disperse onto sidewalks where the seeds can be tracked onto lawns. The upper leaves are rough, egg-shaped, and taper to a long point. Lower leaves are heart-shaped and have notches near the petiole (leaf stalk). Flowers are bright blue to violet.

Creeping Bellflower. Image: Richard Old

Dandelion *Taraxacum officinale* G.H.Webber ex Wiggers

Dandelion is probably the most common lawn weed found in Wyoming. This perennial can spread through seeds or through lateral crown shoots from fleshy, deep taproots. A dandelion may produce bright yellow flowers from early spring until autumn frost.

Dandelion. Image: Mary Ellen (Mel) Harte, Bugwood.org

Cutting off the plant well below the crown can control dandelions; this is a good option if there are not too many weeds. Special digging tools are available for reaching and cutting below the crown. Seed heads can be removed before they send seeds blowing in the wind. Dandelion is susceptible to 2, 4-D sprays and can be effectively controlled with this herbicide. Early springs treatments are not effective at higher elevations in Wyoming because the temperature is not conducive to active plant growth and chemical activity. Fall treatment provides consistently better control. Both, however, are advisable during the first year of treatment. Afterward, treatment can be reduced to a single application each fall as needed.

Dandelion. Image: Ohio State Weed Lab Archive, The Ohio State University, Bugwood.org

Field Bindweed *Convolvulus arvensis* L.

Field Bindweed. Image: Mary Ellen (Mel) Harte, Bugwood.org

Field bindweed, found commonly in tilled soil areas, is a deep-rooted perennial growing from an extensive underground root system. Stems are prostrate, 1 to 4 feet long, forming dense, tangled mats. Leaves are similar in shape to arrowheads with sharp lobes at their bases. Flowers are about 1 inch across, are funnel or trumpet shaped, and range in color from white to pink. This introduced perennial is widely distributed in all cultivated areas of Wyoming and is commonly found near ditch banks and in waste areas. Healthy and rapidly growing turf grass is a good competitor with field bindweed.

Field Bindweed. Image: Joseph M. DiTomaso, University of California - Davis, Bugwood.org

Goosegrass *Eleusine indica* (L.) Gaertn.

Goosegrass is a summer annual that is common to lawn areas in some sections of Wyoming. Goosegrass may look like crabgrass at first glance, but differs since it has a flat stem and does not take root at the lower joints of the stem. Goosegrass is an annual grass that reproduces by seeds. Flowers and seed are produced in two rows along one side of the stem.

Goosegrass. Image: Rebekah D. Wallace, University of Georgia, Bugwood.org

Goosegrass. Image:Aaron Patton, Purdue

Ground, Ivy *Glechoma hederacea* L.

Ground ivy grows in shaded areas near trees and buildings. This perennial spreads through seeds and underground rootstocks. The creeping stems are smooth and square, and roots form at the lower joints. Leaves are round with scalloped edges and occur in pairs along the stem. Flowers are purple and arranged in clusters at the leaf-stem attachment (axils).

Ground Ivy. Image: Theodore Webster, USDA Agricultural Research Service, Bugwood.org

Ground Ivy. Image: Ohio State Weed Lab Archive, The Ohio State University, Bugwood.org

Henbit *Lamium amplexicaule* L.

Henbit. Image: John D. Byrd, Mississippi State University, Bugwood.org

Henbit may be troublesome in thin areas of a lawn, in areas around ornamental plants, and in flower gardens. It is a winter annual or biennial that reproduces by seeds and rooting stems. The stems are square (four-sided) and are prostrate at the base; the upper portions are erect. The upper leaves are clasping (wrapped around the stem) while the lower leaves are attached to the stem by petioles (leaf stalks). The plant produces pink to purplish flowers in early spring.

Henbit. Image: Steve Dewey, Utah State University, Bugwood.org

Longspine Sandbur *Cenchrus longispinus* (Hack.) Fern.

Longspine sandbur is an annual growing to 3 feet in height that may grow upright, but usually branches and spreads flat out on the ground. It generally occurs on sandy soils. This plant can be a serious problem in lawns. Upon the plant's maturity in early summer, the seeds develop in hard, spiny burs.

Longspine Sandbur. Images: Joseph M. DiTomaso, University of California - Davis, Bugwood.org

Orchardgrass *Dactylis glomerata* L.

Orchardgrass is a desirable forage species but considered a weed when growing in a lawn. This perennial grows in clumps and spreads through seeds and root shoots. Stems are 2 to 4 feet tall and are terminated by compressed spikelets (flowers). At the base of each leaf are a membranous collar and smooth auricles (without claws such as are present on quackgrass).

Orchardgrass. Image: Ohio State Weed Lab Archive, The Ohio State University, Bugwood.org

Orchardgrass. Image: John Cardina, The Ohio State University, Bugwood.org

Prostrate Knotweed *Polygonum aviculare* L.

Prostrate Knotweed. Image: Robert Vidéki, Doronicum Kft., Bugwood.org

Prostrate knotweed is often a problem near walkways and in lawns in some areas of Wyoming. This plant usually infests lawns that have a thin grass stand and are in a weakened condition due to traffic or poorly watered edges. It is an annual that reproduces only from seeds. The prostrate stems spread in all directions forming a mat. The leaves are bluish green, lance shaped, and attached to the stem at prominent joints.

Prostrate Knotweed. Image: Bruce Ackley, The Ohio State University, Bugwood.org

Common Purslane *Portulaca oleracea* L.

Common Purslane is drought tolerant, may grow in flower beds, and can infest lawns that are thin and improperly watered. An annual reproducing by seeds; stems are prostrate, fleshy, up to 22 inches long, and form a reddish mat. Leaves are very fleshy, succulent, and wedge shaped with a blunt tip. Small yellow flowers are produced in the leaf axils and give rise to an urn-shaped capsule that contains many small, black seeds.

Common Purslane. Image: Forest and Kim Starr, Starr Environmental, Bugwood.org

Common Purslane. Image: Joseph M. DiTomaso, University of California - Davis, Bugwood.org

Quackgrass *Elytrigia repens* (L.) Gould

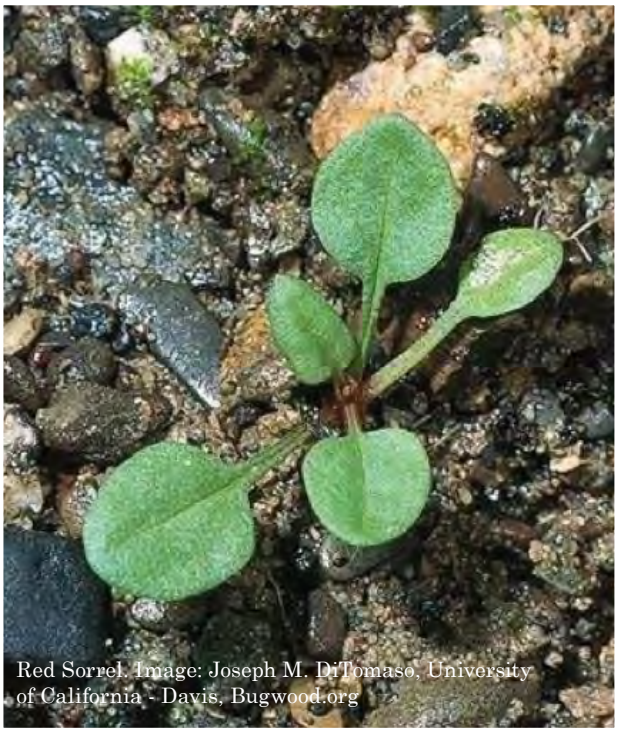
Quackgrass. Image: Ohio State Weed Lab Archive, The Ohio State University, Bugwood.org

Quackgrass can be found in most areas of Wyoming, and forms coarse clumps that distract from the fine-bladed grass most desirable for lawns. It is a perennial that spreads through seeds and underground rootstocks. Stems are hollow, 1 to 3 feet tall, and terminated by a slender, wheat-like spike (flower head). Leaves are narrow, dark green, and rough on the upper surface. At the base of each leaf are a small pair of claws (auricles) and a ragged, membranous collar.

Quackgrass. Image: Steve Dewey, Utah State University, Bugwood.org

Red Sorrel *Rumex acetosella* L.

Red sorrel is not found in abundance in lawns; however, it can become a problem in some isolated areas. This perennial spreads through seeds and red underground rootstocks. Leaves are arrow shaped with elongated basal lobes forming a dense rosette at the plant base. Flowers are of two types - pistillate and staminate. The female flowers are reddish while the male flowers are yellowish-green. Both flower types are borne on the same stem.



Red Sorrel. Image: Joseph M. DiTomaso, University of California - Davis, Bugwood.org

Red Sorrel. Image: Forest and Kim Starr, Starr Environmental, Bugwood.org

Skeletonleaf Bursage *Ambrosia tomentosa* Nutt.

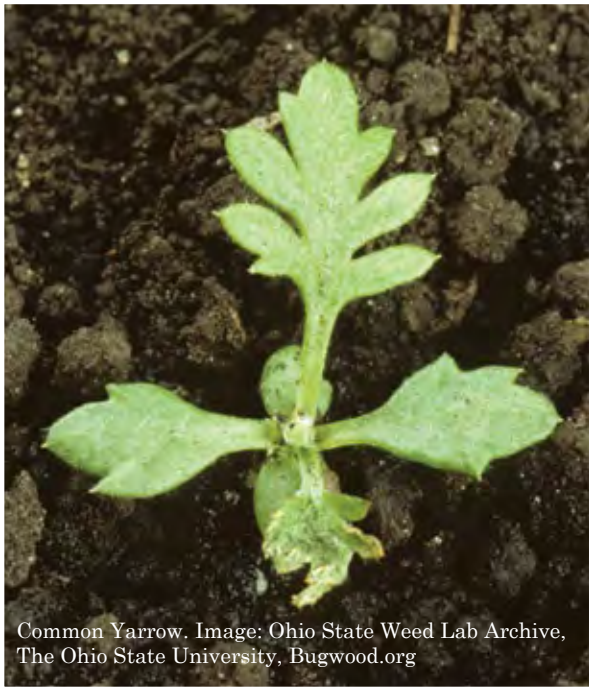
Skeletonleaf bursage is a perennial growing up to 18 inches tall with extensive creeping roots. Stems are branched, and leaves are alternate. Leaves are dark green on the surface and have leaf undersides covered with fine hairs giving them a silvery-gray color. Leaves are coarsely toothed and deeply segmented. Flowers are inconspicuous and green, hanging in terminal clusters. This native perennial reproduces from creeping rootstocks and seed. Flowering and seed production occur from June to August.

Skeletonleaf Bursage. Image: Howard F. Schwartz, Colorado State University, Bugwood.org

Skeletonleaf Bursage. Image: L.L. Berry, Bugwood.org

Common Yarrow *Achillea millefolium* L.

Common yarrow has become a problem in lawns in many areas in Wyoming. This perennial spreads through seeds and underground stems. If allowed to grow uncut, it becomes an erect plant, but when mowed frequently, it forms a low-growing, gray-green mat in the lawn. The fernlike leaves are finely divided and covered with fine hairs. The flowers, commonly white, but may also be pink or yellow, are formed in a dense, flat-topped cluster at the end of the stem.



Common Yarrow. Image: Ohio State Weed Lab Archive, The Ohio State University, Bugwood.org

Common Yarrow. Image: Mary Ellen (Mel) Harte, Bugwood.org

Index 2

GRASSES ADAPTED TO WYOMING

Kentucky bluegrass *Poa pratensis* L.

Kentucky bluegrass is rhizomatous and excellent for ball fields and other heavy use areas. It has been the most popular grass for parks and home lawns. There are varieties resistant to diseases, such as Fusarium patch, melting out, leaf rust, stripe rust, crown rust and patch diseases. A blend of three or four different Kentucky bluegrass cultivars helps maximize the desirable traits of each for your location and to minimize any undesirable plant characteristics. Kentucky bluegrass produces many rhizomes and has good ability to repair itself following damage. Some lower maintenance varieties of Kentucky bluegrass use less water and fertility, having more summer dormancy than varieties that require higher maintenance. Improved varieties of Kentucky bluegrass have less stem and more leaf growth making them more competitive.

Perennial ryegrass *Lolium perenne* L. ssp. *perenne*

Perennial ryegrass establishes quickly and can also be inter-seeded in existing weak stands of grass with fairly good results. Some varieties have improved winter hardiness. Since diploid varieties are used for turf, check to make sure you are not getting tetraploid varieties that are usually more suited for forage. Some perennial ryegrasses contain endophytes that provide protection from insects.

Chewings fescue *Festuca rubra* subsp. *commutata* Gaudin

Chewings fescue is an aggressive, bunch-type fine fescue used in mixes and sometimes to overseed lawns. Chewings fescues are among the most shade and drought tolerant of the cool-season grasses. One endophyte enhanced variety is Windward. Windward is an example of a grass that could be considered low maintenance and with disease resistance.

Creeping red fescue *Festuca rubra* ssp. *arenaria* (Osbeck) F. Aresch.

Creeping red fescue makes excellent lawns, golf greens, and turf for ground cover in landscaping. It is a low-maintenance grass that does well in shady locations. This grass has moderate watering and fertilization requirements, and in some areas will survive well with little care.

Buffalograss *Buchloe dactyloides* (Nutt.) Columbus

Buffalograss is a perennial, native, low-growing, warm-season grass. It is low-maintenance grass that does well in sun but not in shade. This drought-tolerant grass can be used in public areas, golf course roughs, and open lawns when planted at elevations below 6,500 feet. Buffalograss is more competitive at low fertility levels. While great for low maintenance, it will go dormant in cold weather sooner than cool season grasses.

The following grasses could be used alone in areas primarily for the exclusion of weeds in the landscape near turf and ornamentals or included in low maintenance mixes.

Hard fescue *Festuca brevipila* Tracey

Hard fescue is a desirable plant for low-maintenance, long-term cover. This grass can be used to create interesting areas for weed suppression as well as dry-land lawns, fairways, rural landing strips, and roads.

Sheep fescue *Festuca ovina* L.

Sheep fescue is an excellent weed control species because it has an extensive and dense bunch-type root system. Once a good stand is established, sheep fescue resists the invasion of most weeds. This grass can be used as an ideal ground cover and in areas that are driven on.

Tall fescue *Festuca arundinacea* Schreb.

Tall fescue is mainly for areas of low-input management. This species could be maintained in borders for an interesting look and to compete against weeds. Weed invasion is more likely when stands of tall fescue are new until they are well established. As stands mature with good management, weed invasion is reduced. Tall fescue likes shade. This grass can look big and coarse in Kentucky bluegrass.

Idaho fescue *Festuca idahoensis* Elmer

Idaho fescue is a bluish-colored native, perennial, cool-season grass. Idaho fescue has excellent cold tolerance but is not as drought tolerant as sheep fescue and its drought tolerance is similar to that of hard fescue. This species can keep weeds out once it has a tight mature canopy. Idaho fescue is slow to establish, but once established, has abundant growth of fine leaves that provide effective ground cover preventing the invasion of weeds.

Water conserving blends of indigenous and naturalized grasses are available in Wyoming from local sod producers. For example, a blend could include hard fescue, creeping red fescue, chewing fescue, and sheep fescue.