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## **APPENDIX 5. CONTROL METHODS**

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## CONTROL METHODS

There are many options available for controlling invasive species, which are summarized below. Each control option has its benefits and limitations, and specific management guidelines will need to be developed that utilize the most effective method, or combination of methods, for a particular species and treatment site.

### **Biological**

Biological control involves organisms (usually insects) that are deliberately introduced to an area to control invasive species. The aim of biological control is not eradication, but rather to exert enough pressure on a species to reduce its abundance to acceptable levels (Wilson and McCaffrey 1999).

Biological control works best for:

- reducing seed production or weakening plants;
- large, dense infestations where other control methods are not cost-effective; and
- situations where a reduced but effectively permanent presence of an invasive species is acceptable.

Biological control pitfalls include:

- failure to eradicate the target plant species;
- feasibility for only a handful of species due to the high cost of finding, screening and testing potential control organisms;
- rarely successful as the sole source of control for a particular invasive species;
- degree of control is variable and will take several years to achieve;
- insects may attack beneficial, non-target plants; and
- inability to establish populations of biological control organisms for reasons relating to climate, soils, and so forth that are not well understood.

### **Chemical**

Chemical control involves the application of herbicides (chemical compounds) that kill or injure plants. There are many kinds of herbicides; some are derived from plants and others are manufactured synthetically. Herbicides are generally classified in terms of their mode of action, and interfere with plant metabolisms in a variety of ways. The choice of which herbicide is best for a particular situation depends on the target species, the presence of desirable plant species, soil texture, depth and distance to water, and environmental conditions (Bussan and Dyer 1999).

Chemical control works best for:

- eradicating pure stands of a single species where desirable non-target plants are scarce or absent;
- rhizomatous species that are unpalatable to wildlife and livestock, require repeated pulling or cutting for control, or are located in remote areas where pulling or cutting are not feasible; and

- small patches of invasive species where hand pulling or cutting is not effective or feasible.

Chemical control pitfalls include:

- may require additional approval procedures prior to use (e.g., completion of an Environmental Impact Assessment);
- may cause damage to or kill non-target plants;
- difficult to use to control small plants when they occur among taller, desirable plant species;
- toxicity to humans to varying degrees;
- herbicides must be applied in conformance with the label;
- proper equipment, licensing, and requisite knowledge is necessary to apply herbicides safely;
- can move beyond the area where they are applied and affect non-target plants and animals;
- populations of invasive plants can develop resistance to certain herbicides over time;
- simplifying diverse plant communities by suppressing certain plant species although this effect may be temporary; and
- herbicide applicators who cannot distinguish invasive species from desirable plant species, resulting in accidental damage to the latter.

### **Fire**

Prescribed burning is planning, setting, and managing fires to accomplish resource management objectives. In some parts of the Sonoran Desert, an infrequent fire regime prevailed prior to the introduction of fire-adapted species, and many native plants, such as the giant saguaro (*Carnegieia gigantea*) and palo verde trees (*Cercidium* spp.), are not adapted to frequent fires (Esque and Schwalbe 2000; Phillips and Comus 2000). Therefore, caution should be used if fire is chosen as a control method for invasive species within the region.

Fire control works best when:

- the invasive species to be controlled is more susceptible to the effects of burning than are the intermingled desirable plant species;
- controlling cool-season grasses in prairie restoration; and
- a proper monitoring plan is in place to evaluate the effects and success of the project.

Fire control pitfalls include:

- the need for intensive planning to ensure that the burn will be safe and accomplish the intended resource management objectives;
- environmental conditions adequate to ensure proper fuel load and weather
- smoke management problems may limit the time-frame for burning;
- availability of crew members who have “red cards” that signify a minimal level of fire training;

- availability of experienced crews to manage the prescribed fires in a particular fuel type;
- the possibility of fires getting out of control and damaging property or endangering human life, and the liability issues that follow;
- arid environments can not tolerate frequent burning; and
- massive germination and establishment of invasive species following burning may occur, which may obligate a companion control method, such as chemical treatment.

### **Mechanical**

Mechanical control involves the removal of plants by force, which may be accomplished either manually or with a mechanical device. There are a variety of mechanical methods that can be used for invasive species removal. The choice of which mechanical method is best for a particular situation depends on the site location and condition, the site status (e.g., wilderness designation), the target species, soil texture, and other environmental conditions.

#### ➤ **Pulling**

Pulling refers to using hands or simple implements (e.g., shovel, digging bar or pulaski) to uproot plants.

Pulling works best for:

- small infestations that can be pulled one patch at a time;
- annual and biennial plants (although seed banks will remain for some time);
- shallow-rooted plant species that do not respond from any residual roots;
- plants growing on sandy or gravelly soils;
- situations where chemicals, motorized equipment, or livestock can not be used or are undesirable; and
- eliminating or reducing seed production in small infestations.

Pulling pitfalls include:

- soil disturbance, which stimulates germination of seeds in soil;
- it is not cost effective for large infestations, due to the labor involved;
- generally does not remove the entire plant root system except under the most favorable conditions;
- temporarily creates bare soil and provides more sites for invasive species seed germination and establishment; and
- some invasive species produce chemicals that can cause allergic reactions or dermatitis in some people.

#### ➤ **Mowing and Cutting**

Mowing and cutting employ mechanical or hand tools to sever the above ground portion of a plant from its roots.

Mowing and cutting works best for:

- large, relatively flat and dry areas that can be mowed with few safety or equipment concerns;
- preventing tall, erect biennial species from setting seed when other control techniques are not feasible;
- weakening invasive species by depleting root and rhizome reserves through repeated mowing;
- large-scale restorations where invasive species need to be controlled during the first growing season or two; and
- relatively small areas where adequate labor is available.

Mowing and cutting pitfalls include:

- the action rarely kills invasive species;
- sites that are inaccessible or too rocky cannot be mowed, although weed whips and machetes can be effective in such situations;
- having to repeat mowing frequently for control to be effective;
- cut plants resprout to larger sizes than prior to cutting;
- failing to remove and dispose of cut stems if they contain seeds may allow the plants to resprout;
- dislodging rocks from the mower may be dangerous to the mower operator;
- turning annual or biennial plants into short-lived perennials through repeated mowing; and
- invasive species spread by mowing equipment to areas previously free of infestations.

### ➤ **Livestock Grazing**

Implementers can use cattle, sheep, or goats to selectively graze certain invasive species, thereby weakening them. In cases where desirable, palatable native species are present, livestock may favor these species over invasive plants.

Livestock are most useful for:

- invasive plants that are palatable (at least at some point during the year) and non-toxic to livestock; and
- low-level, widespread invasive species infestations where other control techniques are not cost-effective.

Livestock have limitations such as:

- lack of availability of goats and sheep or even cattle when and where they are needed;
- need for water and fencing or herding to control livestock movements;
- the need to manage the intensity and duration of livestock grazing carefully to avoid overgrazing, and allow desirable species to recover from grazing impacts;
- using the proper kind of animal to manage the invasive species on a given site;
- need for someone with knowledge of animal husbandry to manage the animals;
- palatability of invasive species may vary widely throughout the growing season;
- expecting livestock to control invasive species without close management;

- failing to manage the intensity and duration of livestock grazing to prevent the animals from depleting the desirable plant species they are grazing, or creating disturbances that favor the establishment of invasive species;
- spreading invasive species seeds in fur or in manure when animals are moved from one area to another; and
- toxicity of some invasive species to grazing animals.

### **Cultural**

Cultural controls seek to control invasive species problems by establishing desired plant species. Cultural techniques manipulate the plant community through cultivating (cutting through and turning over the soil), re-seeding, fertilizing, and irrigating. Cultivation is not usually appropriate for natural areas because cultivation causes major disruption of established plant communities, and renders them susceptible to invasive species infestations. Therefore, cultural control methods may be most appropriate for fallow fields, agricultural land, or highly disturbed lands where a natural community is undesirable (e.g., military drop zones or landing strips).

Cultural controls are most useful for:

- large restoration projects; and
- re-establishing native plant communities on disturbed or depleted areas so desirable plants can prevent or reduce invasive species infestations.

Cultural controls have limitations that include:

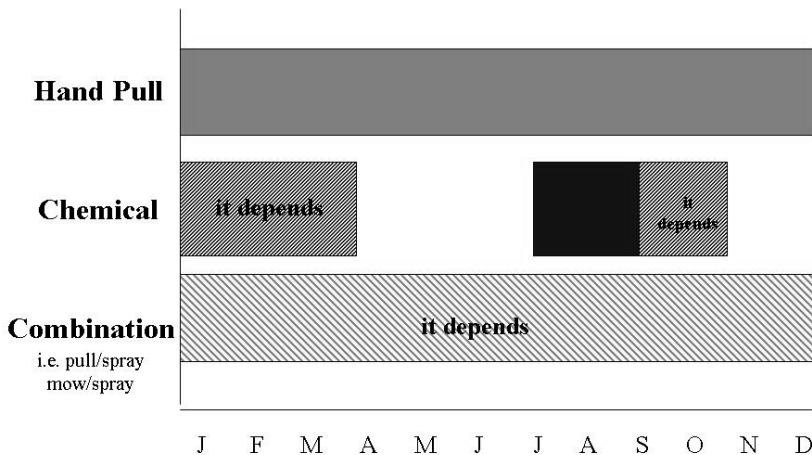
- cultivating is not normally suitable for natural communities or wildlands;
- cultivating is appropriate only for restoration of drastically disturbed sites;
- lack of seeds from locally adapted plants;
- lack of seeds of certain native species, especially forbs and shrubs;
- seed mixes may be contaminated with invasive species;
- cultivation may result in wholesale germination and establishment of invasive species if there is not adequate follow-up control;
- promoting invasive species growth by adding unnecessary fertilizers;
- common components of commercial seed mixes are often considered invasive species in the context of natural areas; and
- importation of invasive species seeds on borrowed or rented equipment.

### **Strategy Selection and Timing**

As illustrated in the figure below, pulling is the only control method that can be employed year-round on most sites. Of course, pulling is easiest when the soil is moist and temperatures are cool, making the late fall, winter, early spring months the favored times. Chemical control requires green, actively growing grass, which occurs most reliably for a 2-6 week period following the onset of the summer rainy period from mid July to the end of August, and sometimes into September. A second green-up period may occur in warm, moist springs, and the grass can also be stimulated to grow vegetatively through mechanical treatments like mowing, which can promote a second spraying opportunity in the spring or fall months if temperatures are warm enough.

Mowing as a stand-alone treatment is not recommended and is likely to further the spread of the grass.

## Control Strategies & Timing



*It depends on green-up which depends on rain*

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