
VEGETATION REMOVAL FOR SITE PREPARATION

TECHNICAL GUIDANCE DOCUMENT



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INTRODUCTION

The removal of existing perennial vegetation is often necessary to prepare a site for planting. This process includes the removal of individual species (i.e. reed canary grass) or the removal of a whole field of existing, undesirable vegetation (i.e. smooth brome grass). The removal of existing vegetation often involves a combination of strategies including herbicide application, mowing, grazing, and tilling.

The planting of herbicide-ready corn or soybeans for one or two years before seeding a site can be an effective method to prepare for seeding. Repeated herbicide applications that are part of crop production can effectively remove many weeds. This technique should be used with caution if a native species seedbank may be present, as it can deplete the seeds of native species as well as those of weeds. Grazing, mowing, or prescribed burning can be conducted prior to herbicide application as a means to decrease biomass and promote new growth that will more effectively take up herbicides. The timing of grazing, mowing, or prescribed burning in preparation for herbicide application should be planned to correspond to the time of year when herbicides will be most effective for individual species.



Invasive species present prior to restoration

The impact of herbicide application on non-target plant species and other organisms limits its use in some situations. If all vegetation will be removed from a site, the effect on non-target plant species is less of a concern but there may still be an influence on soil microflora and fauna. It is essential that only aquatic-certified herbicides be used near water. Some grass-specific herbicides currently being used for reed canary grass control do not have aquatic certification.

There are many types of herbicide used for perennial species; some target broad-leaf weeds while others target grasses. Broad-spectrum herbicides target both broad-leaf weeds and grasses. Herbicides should be selected based on the type of vegetation to be removed. [Appendix 5-A](#) of the *Minnesota Wetland Restoration Guide* contains a table that compares herbicides commonly used for natural resource management. Herbicide is applied with booms, backpack sprayers, and wands.

In many cases, projects that are transitioning from agriculture or other uses may not have significant perennial weed problems and will not require herbicide application. In situations where there are sensitive aquatic resources adjacent to a project, adjacent organic farming, or other concerns, non-herbicide methods of site preparation can be used, such as repeated tilling, flooding, application of heavy mulches, grazing, mowing, and scraping.

APPLICATION

Methods of perennial vegetation removal vary depending on program requirements, acres of treatment, weed species present, the herbicide to be used, and whether tilling is conducted.

Converting from Crop Production

The production of crops such as corn and soybeans can be beneficial when preparing old fields for native plant establishment. In the case of cornfields where Atrazine (an herbicide that can inhibit growth of native plants) has been applied, it is recommended that soybeans be planted for an additional season. Glyphosate is a contact herbicide that does not persist in the soil, so there is not a risk to new seedlings following agriculture.

After harvesting corn, stubble needs to be cut and baled, as it will interfere with planting. Species such as Canada thistle may not be fully removed during agriculture, so follow-up treatments may be needed before seeding. Fields may also need to be sprayed once in the spring before planting to kill newly-establishing weeds. If small grains are harvested in the summer, the field can be sprayed once or twice followed by seeding in the fall (Fuge 2000). In most cases, tilling and harrowing is not necessary before seeding unless the field is excessively rough or compacted.

Removing Specific Invasive Species - The long-term control of reed canary grass can be a challenge in wetland restorations. Other common invasive species include hybrid cattail, purple loosestrife, Canada thistle, and wild parsnip. If not controlled thoroughly before seeding, invasive species may lead to decreased diversity and abundance of native species. In instances where desirable native species are present, spot treatment with broad-spectrum herbicides may be used (avoiding desirable species), or herbicides that specifically target grasses or broad-leaf species to minimize damage to native species.

Example Site Preparation Schedule for Fields in Agricultural Production	
September	Harvesting (with bailing of stubble if in corn)
Late Sep.-Early October	Herbicide treatment of problem weeds (such as Canada Thistle)
Mid-October	Broadcast Seeding
Mid-October	Cultipacking or Rolling
<p><i>Note: Spring seeding can also be conducted following crop production; the same site preparation techniques apply for spring planting. Timing and techniques vary depending on location, weather, and site conditions.</i></p>	

Example Site Preparation Schedule for Fields Dominated by Perennial Vegetation (Option 1)	
Late May	Mow to reduce vegetation height
June/July	Spray 2%-4% solution of glyphosate with surfactant as weeds reach 10-12 inches
July	Prescribed Burn (optional)
August	Spray 2%-4% solution of glyphosate with surfactant as weeds reach 10-12 inches
August/Sept.	Till soil with disc or tractor mounted cultivator 4-5" deep
Sept until seeding	Till every two weeks until planting
Mid-October	Pack with cultipacker to create firm seed bed
Mid-October	Conduct seeding with native grass drill
<i>Planting can also be conducted in the spring but additional weed control may be necessary prior to seeding.</i>	

Example Site Preparation and Establishment Schedule for Fields Dominated with Perennial Vegetation (Option 2)	
Early June	Disk in two directions to level surface and stress brome grass
Early August	Mow* to reduce veg. height to stimulate fresh growth and enhance herbicide kill
Mid September	Spray 2%-4% solution of glyphosate with surfactant
Late October	Heavy tillage** to tear up brome sod
Early May (year 2)	Disk to reduce lumps (may not be necessary on fields with light soils)
Early May (year 2)	Field cultivate to create smooth, level seed bed
Early May (year 2)	Pack with cultipacker to create firm seed bed
May/June (year 2)	Conduct seeding with native grass drill, seed after 1st flush of annual grasses and broadleaves are 3-4" high
5-7 days post seeding	Apply glyphosate herbicide to kill all emerging competition
As vegetation reaches 15-18 inches	Chop/mow 2-3x during the growing season to reduce competition and allow sunlight to penetrate to new seeding
<i>*This mowing pass may not be absolutely necessary ***"Heavy tillage" means a disk ripper, disk chisel, or equivalent (not moldboard plow or heavy disk)</i>	

Appendix 5-A contains additional discussion and specific techniques on how to remove invasive species. Many of the control strategies presented for these species can be used for project maintenance as well as for site preparation. Species in the appendix include: Hybrid cattail (*Typha glauca*), Narrow-leaf cattail (*Typha angustifolia*), Purple loosestrife (*Lythrum salicaria*), Reed canary grass (*Phalaris arundinacea*), Common buckthorn (*Rhamnus cathartica*), Glossy buckthorn (*Frangula alnus*), Common reed grass (*Phragmites australis*, syn. *P. communis*), Canada thistle (*Cirsium arvense*), Crown

vetch (*Coronilla varia*) Bird’s foot trefoil (*Lotus corniculatus*), Sweet clover (*Melilotus officinalis* and *M. alba*), Wild parsnip (*Pastinaca sativa* L.), Spotted knapweed (*Centaurea maculosa*)

Preparing Fields Dominated with Perennial Vegetation - Upland fields, such as those in CRP, that have been out of production for several years, are often dominated with weedy and invasive grasses such as smooth brome, timothy, redtop, Kentucky bluegrass, and goldenrods. Transitioning old fields to soybeans or corn for two years will aid in the removal of these species. If agricultural production is not an option due to site conditions or program restriction, the following sequence is recommended:

First cut and mow remove existing vegetation at a low setting (4-6 inches). After mowing, allow vegetation to grow 10 to 12 inches tall, and then apply a two to four percent solution of glyphosate (depending on species present/see label specifications). If the vegetation and thatch layer is thick, a burn is recommended. Burning can eliminate some weed seeds while improving effectiveness of subsequent herbicide treatments. If regrowth occurs, herbicides should be applied again when weeds are 10 to 12 inches high.



Smooth brome grass

After successful die off from the herbicide application, till the field to stimulate and germinate any remaining weed rhizomes and produce green growth. Tilling can be conducted with a disc or tractor-mounted cultivator to a depth of four to five inches. If weed seeds germinate, the site should be tilled again or additional herbicide applied. This sequence of site preparation should be started in late May to allow enough time to prepare the site for a fall dormant seeding. If spring seeding is planned, a final one-inch deep till or an herbicide application is recommended after the first good rain to kill germinating weeds before they emerge (Fuge 2000). A cultipacker should be used on a site prior to seeding if the site has recently been tilled. A no-till drill will be used.

Removing Vegetation in Fields that Contain Sod

Fields in sod (turf grasses) should be treated with glyphosate herbicide similar to the strategy discussions above. Repeated herbicide applications may be required. In most cases, sites will not require cultivation unless broadcast seeding will be conducted. Once weeds have been killed with herbicide, the site can be planted with a no-till drill (Fuge). In the case of sod, it is important that seed from all seed boxes fall into slots cut by the seeder as seed that falls on top of dead sod is unlikely to germinate. In the case of sod farms where wetland hydrology will be restored and the site will be broadcast seeded, tilling will be necessary to prepare the seedbed. The use of no-till drills without cultivation is a good method on sites with steep slopes, as the seed will be secured by the soil and roots and stems of dead plant material.

Example Site Preparation and Seeding Schedule for Removing Vegetation in Sod Fields	
Fall	Glyphosate herbicide application
Mid-April	Glyphosate herbicide application if necessary
Late April	Seeding with a no-till drill to cut through sod
<i>Note: Weeds should be thoroughly controlled before seeding is conducted</i>	

Non-herbicide Site Preparation

A variety of non-herbicide site preparation methods including tilling, flooding, mulching, grazing, mowing, and prescribed burning



can be used for projects, depending on site conditions and the species present. When tilling will be used to control perennial vegetation, it is beneficial to plow the site first to create more disturbance for existing vegetation. Repeat tilling every two to three weeks to a depth of four to five inches with a disc or rototiller when perennial weeds are present. It is important to till often, as rhizomes can spread with longer intervals. In some cases, this treatment needs to be conducted for a year or more, particularly when a field has been in perennial weeds for several years. There is a risk of erosion on sites that are tilled repeatedly; as a result, this technique should not be used near waterways or on hilly sites.

Example Tilling Schedule for Weed Control (transition from annual and biennial weeds)

Early April	Deep plow if the site has been in vegetation for one full season or longer.
Late April	Disc or till site to 4-5 inches at earliest opportunity in spring or following spring plowing.
May – seeding	Disc, till, or harrow approximately every two weeks 4-5-inches deep until seeding. If seeding right away, conduct seedbed preparation and install seed.
<i>Note: Time and frequency of tilling may vary greatly depending on site conditions</i>	

Tilling is not necessary in every instance, particularly if there is little weed competition. It is not recommended when soil disturbance may increase the threat of erosion or destroy intact soil structure and microorganisms. Tilling can expose the seed of invasive species. It should be done as part of a thorough site preparation process that lasts a season or longer.

Flooding can be an option for perennial weed control in some wetlands, primarily on sites that already have water control structures installed. In situations where flooding can be conducted it is recommended to graze or mow vegetation before flooding and ensure that water levels remain above the height of the vegetation. Dead stems must be removed as they can transport oxygen for some species. In most cases, several months to a year of flooding is needed, depending on the species present.

Heavy mulches of five to eight inches can be effective for weed control in upland buffer areas. Shredded hardwood mulch is the most common material used. As with flooding, graze or mow vegetation as low as possible beforehand. Applying a layer of newsprint or Craft paper before mulching can help prevent weed growth.

Additional mulch may need to be added periodically in areas where weeds growth through the mulch. The use of heavy mulches is most practical in smaller areas where trees and shrubs will be planted. Prairie and wetland seed will not germinate well in a mulch substrate.

Heavy grazing or repeated mowing at a low height can be used to set back perennial vegetation. These methods are done in combination with tilling or other methods to control perennial weeds but can be effective at decreasing plant energy reserves, particularly when plants are flowering. Similar to grazing and mowing, prescribed burning is used for the control of undesirable vegetation in preparation of planting. Prescribed burning is used to remove dense aboveground biomass of species such as reed canary grass,

phragmites, and cattails in preparation for conducting other control methods. In the case of cool-season grasses, late spring burns in uplands may set back undesirable species and promote warm season prairie plants.

Scraping or scarifying the soil surface is a site preparation technique that does not involve herbicide application. Scraping with bulldozers can remove entire root mats of invasive species such as reed canary grass and giant reed grass. Shallow scraping with bulldozers to remove reed canary grass or cattail aboveground biomass is an effective aid to additional control methods. Other types of equipment such as mechanical brushes on front end loaders can be used to scarify the surface to remove biomass and promote native vegetation establishment where a native seedbank is present.

OTHER CONSIDERATIONS

Crop production may require additional soil treatment such as harrowing to prepare the seedbed for planting. If there is a period of a month or longer after harvest before a fall seeding is conducted, additional control methods may be needed to remove weeds. Herbicide use may also be restricted near organic farming operations or sensitive waters.

A combination of mowing, herbicide application, and tilling is recommended for the removal of weeds in situations such as old fields dominated with smooth brome grass and for seedbed preparation of wetland areas in preparation for broadcast seeding.

Tilling may allow weeds to germinate, requiring additional site preparation strategies to control weeds. Heavy grazing or mowing is often recommended as a first step when flooding or heavy mulches will be used for weed control.

COSTS

Costs for vegetation removal vary depending on previous landuses, project size, and the vegetation present. Project that are transitioning from agriculture often have the lowest costs while fields in perennial weeds may have high weed removal costs due to the need for multiple treatments. It is common that practices such as plowing, tilling and harrowing have costs between \$15 and \$30 dollars an acre while herbicide application can cost from \$30 to over \$100 an acre depending on site conditions, the species to be treated, and the acres of treatment. When heavy equipment is used to scrape invasive species, costs are typically between \$150 and \$175 an hour. An experienced operator is a worthwhile investment when scraping as it can be difficult to get the correct depth on a variable landscape.

ADDITIONAL REFERENCES

Best Management Practices for the Invasive *Phalaris arundinacea* L. (Reed canary grass) in Wetland Restorations, Reinhart, C.H., Galatowitsch, S.M.

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