TechLine
INVASIVE PLANT NEWS

INNOVATIVE RESEARCH, SUCCESS STORIES, AND TIPS FOR INVASIVE PLANT MANAGERS

Prairie & Grasslands Edition
FALL 2015

BELWIN CONSERVANCY

Belwin Conservancy Tackles Grecian Foxglove Page 04

ABOUT TECHLINE

Invasive Plant News aims to provide an objective communication tool for on-the-ground natural resource managers who face common management challenges so they may share the successes of their programs and learn from one another.

Print newsletters are published twice per year and delivered free of charge. This and past issues can be downloaded from www.techlinenews.com.

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UAF COOPERATIVE EXTENSION ARCHIVE, UNIVERSITY OF ALASKA - FAIRBANKS, BUGWOOD.ORG

Long-term Control of Crown Vetch at a Wisconsin Wildlife Refuge

By Celestine Duncan

CROWN VETCH (*Securigera varia*) IS A NON-NATIVE PERENNIAL PLANT IN THE LEGUME FAMILY. It was introduced into the United States in the 1950s primarily for erosion control along roads and waterways. Crown vetch is currently found in all US states except North Dakota (USDA Plants Database 2015, Klein 2011).

The invasion of crown vetch into natural areas in Midwestern states is having a significant impact on plant diversity and wildlife habitat. The plant is a prolific seed producer, spreading by seed and rhizomes.

Field trials were conducted in 2007 on a crown vetch infestation located on Boomerang Island in the Upper Mississippi River National Wildlife and Fish Refuge in Wisconsin. Lee Shambeau with 4 Control Inc. applied Milestone® specialty herbicide at 5 fluid ounces per acre (fl oz/A) in August with a backpack sprayer to mature crown vetch plants. Visual evaluations taken three weeks after treatment showed greater than 95 percent control of crown vetch with no damage to desirable trees and shrubs.

In 2015, refuge Biological Science Technician Calvin Gehri evaluated the site to determine if crown vetch had reinvaded. The site had not been treated since 2007 and Gehri reported that control remained good to excellent. Crown vetch cover was about 10 to 15 percent (85 to 90% control) eight years after application compared to greater than 90 percent cover prior to treatment in 2007.

Reed canary grass (*Phalaris arundinacea*) and nettles (*Urtica dioica* L.) currently occupy niches once dominated by crown vetch. Although neither plant is considered to be desirable, nettles allow other native plants to establish and are used by some native butterflies. Both reed canary grass and nettles provide competition that minimized crown vetch re-invasion. Depending on habitat objectives, establishing desirable plants may be a consideration with future control efforts.

BOX 1. CROWN VETCH IDENTIFICATION

CROWN VETCH HAS DIFFUSE STEMS THAT SPREAD TO ABOUT SIX FEET IN LENGTH AND THREE FEET TALL. Leaves are dark green and odd-pinnately-compound, with 9 to 25 leaflets per leaf. Roots are multi-branched with fleshy rhizomes.

Flowering occurs from late spring through summer; individual flowers are pea-like and vary from pinkish-white to deep pink in color.

Seeds are produced in slender, linear, jointed pods (loments) that may reach two inches in length. The length of time seed remain viable in soil is unknown, but high soil seed banks have been reported.

RELATED ARTICLES

Managing Crown Vetch
http://bit.ly/crownvetch

Management of invasive plants in Wisconsin: Crown-vetch (A3924-21)
http://bit.ly/1FRWokG

LEE SHAMBEAU, 4 CONTROL INC.

PRIOR TO APPLICATION (2007) CROWN VETCH COVER was greater than 90 percent on much of the treatment area.

LEE SHAMBEAU, 4 CONTROL INC.

THREE WEEKS AFTER TREATMENT, VISUAL EVALUATIONS showed more than 95 percent control of crown vetch and no injury to associated trees.

CALVIN GEHRI, UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE

EIGHT YEARS AFTER TREATMENT (2015) CROWN VETCH CONTROL was 85 to 90 percent based on visual evaluation.

OTHER FIELD STUDIES

Dr. Mark Renz of the University of Wisconsin conducted field trials near Barneveld, Wisconsin to study efficacy of Milestone® specialty herbicide applied to crown vetch at three growth stages. Milestone was applied to crown vetch at the bud (June), flower (July), and fall (October) growth stages in 2012. Evaluations included visual percent control and cover of crown vetch, and percent visual injury to grasses one to two years following treatment.

Results of the study showed that Milestone applied at either bud or fall growth stage provided excellent control one year after treatment (Figure). However, only the fall herbicide application continued to provide good crown vetch control two growing seasons following treatment. There was no grass injury noted in plots resulting from the herbicide treatment.

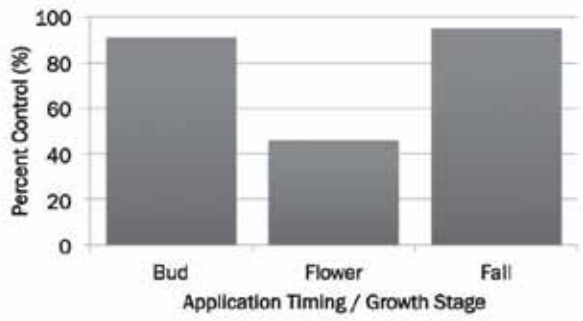

FIGURE. PERCENT CONTROL OF CROWN VETCH one year after treatment with Milestone® specialty herbicide applied at bud, flower and fall growth stages.

These results indicate that Milestone applied at either 5 or 7 fl oz/A will provide good to excellent control when applied late summer or fall. Establishing a competitive plant community is critical to maintain long-term control of the weed. Follow-up herbicide applications may be necessary to control seedlings emerging from the soil seed bank or mature plants that survive treatment. Disturbed sites or areas without desirable understory vegetation may require restoration. In areas with residual desirable vegetation, post-treatment restoration efforts may not be necessary.

Klein, Helen. 2011. Crownvetch *Coronilla varia* L. Alaska Natural Heritage Program. Univ. of Alaska, Anchorage. http://aknhp.uaa.alaska.edu/wp-content/uploads/2013/01/Coronilla_varia_BIO_COVA2.pdf

Belwin Conservancy Tackles GRECIAN FOXGLOVE

A New Invader in Minnesota

By Celestine Duncan

BELWIN CONSERVANCY

INFESTATION OF GRECIAN FOXGLOVE on Belwin Conservancy prior to treatment.

BELWIN CONSERVANCY
Inspiring through Nature

BOX 1. HISTORY

The Belwin Conservancy is a non-profit organization dedicated to inspiring human connection to the natural world. The Conservancy was founded in 1970 when Charlie and Lucy Bell donated 200 acres of land to the newly created Belwin Foundation to develop an outdoor education facility in cooperation with the St. Paul Public Schools. Today the 1,400-acre Belwin Conservancy is one of the largest privately owned nature preserves in the region. The Conservancy maintains miles of public trails and an observation area to give visitors an opportunity to experience the preserve for themselves. Scientists are also allowed a rare opportunity to conduct long-term ecological research in an area that is permanently protected. This research will help further the understanding of natural processes and develop methods for restoring lands in a manner that is economically sustainable.
More information on the Belwin Conservancy is available at http://www.belwin.org

BELWIN CONSERVANCY, A PRIVATE NATURE PRESERVE LOCATED EAST OF MINNEAPOLIS, MINNESOTA, IS DEDICATED TO THE PRESERVATION, RESTORATION AND APPRECIATION OF NATURAL AREAS. Each year more than 10,000 public school students visit the Conservancy to gain an understanding and working knowledge of nature.

The restored prairies and woodlands within Belwin Conservancy also serve as models for ecological restoration in the St. Croix Valley. Non-native invasive plants such as Canada thistle (*Cirsium arvense* L.) have historically been problematic in prairie restorations. However, a new invader, Grecian foxglove (*Digitalis lanata*) is impacting desirable plant communities especially on prairie sites.

"We first noticed small populations and began pulling Grecian foxglove on Belwin Conservancy in 2000," explains Lynette Anderson, Restoration Assistant and Naturalist for the Conservancy. "Starting in 2007, we hired crews each summer to hand-pull and mow the weed, and thought we were holding it in check. Then in 2011, we started finding Grecian foxglove in areas we had never seen it before."

Today, Grecian foxglove is scattered over all of Conservancy lands with the largest infestation at the organization's Stagecoach Prairies Natural Area. "Our conundrum is that we don't know how or why it's spreading so rapidly in this area—it's mind boggling," exclaims Anderson.

Minnesota's only known infestations of Grecian foxglove are in the St. Croix Valley—some in the heart of Belwin Conservancy. The weed is also on the Minnesota Department of Agriculture's Eradicate List, increasing the urgency and importance to contain and control infestations.

In 2011, herbicide treatments were integrated into the hand-pulling and mowing

LEE SHAMBEAU, 4 CONTROL INC.

LYNETTE ANDERSON, BELWIN CONSERVANCY

LYNETTE ANDERSON WITH A TRUCK-LOAD OF GRECIAN FOXGLOVE that was pulled from an infestation on Belwin Conservancy, left. Anderson has worked for the Conservancy since 2008 and spends about 75 percent of her time on invasive plant management. **VOLUNTEERS** display their foxglove bouquets, right.

program to reduce spread and improve Grecian foxglove control. Lee Shambeau, a commercial applicator working with the Conservancy to manage invasive plants, established field trials to determine the optimum herbicide and rate to control Grecian foxglove.

"There are several different invasive plants growing in association with each other on Belwin, so we wanted a herbicide treatment that would not only control Grecian foxglove, but would also control plants such as Canada thistle and spotted knapweed," Shambeau explains. "We recommended Opensight® at 3.3 ounces per acre (oz/A) in 2012. Based on results the last two years, we added an additional 0.5 oz/A of metsulfuron methyl to Opensight this year to further improve control on Grecian foxglove. Applying Opensight has given us good control of multiple invasive weed species including the foxglove."

Grecian foxglove is shallow rooted and relatively easy to pull; however, gloves need to be worn because of the toxic properties of the plant (See Box 3). Volunteers with Belwin Conservancy pull and clip the plant, and crews from Conservation Corp Minnesota crews are hired to hand pull and treat infestations with Opensight® specialty herbicide.

"Our hand pulling program has evolved over the years to reduce the possibility of seed spread," explains Anderson. "After pulling, plants that are going to seed are hauled from the site to our burn pit, covered with black plastic and burned when conditions allow."

Field studies are currently being conducted to see if Grecian foxglove plants that are clipped just prior to seed maturation can regrow the following year. There is concern that clipping could encourage perennial growth characteristics in the plant.

Continued on page 6 > > >

BOX 2. OPENSIGHT® SPECIALTY HERBICIDE BROADENS WEED CONTROL SPECTRUM

Noxious weeds often occur as a complex or mixed stand of species that may include knapweeds (*Centaurea* sp.) or thistles (*Cirsium* sp. and others), growing with Grecian foxglove, wild parsnip (*Pastinaca sativa*), or common tansy (*Tanacetum vulgare*). Growth regulator herbicides such as Milestone® specialty herbicide (aminopyralid) provide excellent control of knapweeds and thistle but have less activity on weeds such as Grecian foxglove, wild parsnip and common tansy. In contrast metsulfuron methyl provides good control of Grecian foxglove, wild parsnip, and common tansy but poor control of knapweeds and thistle. Opensight® specialty herbicide combines both aminopyralid and metsulfuron-methyl in a dry flowable formulation (soluble in water). The combination of these two active herbicide ingredients broadens the weed control spectrum and allows applicators to control invasive weed complexes with one application.

The maximum label use rate for Opensight specialty herbicide is 3.3 ounces of product per acre (oz/A), which includes 1.7 ounces acid equivalent (a.e.) of aminopyralid (equal to 7 fluid oz/A of Milestone® specialty herbicide) and 0.36 oz a.e. of metsulfuron methyl (about 0.5 oz of a 60% metsulfuron product).

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Belwin Conservancy provides the bulk of funding for control and containment of invasive plants. The Minnesota Department of Agriculture and the Valley Branch Watershed District provided small grants in 2014. Both funding sources were used to hire the Conservation Corp crews to control Grecian foxglove.

"We hope to work with the Washington Conservation District and the Minnesota Department of Agriculture to see if we can get some additional funding for control in the future," Anderson explains.

According to the National Park Service which was involved in early control efforts on Grecian foxglove in the St. Croix Valley, the long-term control plan was to allow infested sites to succeed to forest communities and shade out the pest. It didn't work.

"The threat from Grecian foxglove is similar to other non-native plants with aggressive growth characteristics and high seed production. If natural area managers find Grecian foxglove they need to remove the entire plant as soon as possible and destroy it. This plant spreads so rapidly by seed that you need to have an aggressive program, use herbicides early on in a control effort, and be vigilant for new plants and eradicate them as soon as possible," concludes Anderson.

For more information, contact Lynette Anderson, Belwin Conservancy: (651) 436-5189.

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http://www.belwin.org/news/2011/12/08/grecian-foxglove/

Minnesota Department of Agriculture
http://www.mda.state.mn.us/plants/pestmanagement/weedcontrol/noxiouslist/foxglove.aspx

Minnesota Wildflowers
https://www.minnesotawildflowers.info/flower/grecian-foxglove

National Park Service
http://www.nps.gov/sacn/learn/nature/exotic-plants.htm

U.S.D.A. Plants Database
http://plants.usda.gov/core/profile?symbol=DILA3

LEE SHAMBEAU, 4 CONTROL INC.

BOX 3:

GRECIAN FOXGLOVE

Grecian foxglove (*Digitalis lanata*) is an invasive ornamental introduced to the United States from Europe. Unlike many other garden foxgloves, this species escaped cultivation and infests grasslands, forest edges, and disturbed areas such as roadsides and fields. It is now established throughout much of the northeastern United States and is spreading into midwestern states.

IDENTIFICATION

Grecian foxglove is a biennial or short-lived perennial plant in the Plantaginaceae (Plantain) family. The plant germinates from seed and spends the first year as a rosette; flowering in the second year. Flower stalks are two to five feet tall with creamy white, tubular flowers with brownish venation on the inside.

Leaves are simple, alternate, oblong-shaped, and about six inches long with a pointed tip. Grecian foxglove stems, sepals, and undersides of leaves have wooly hairs that distinguish the plant from common or garden foxglove. Garden foxglove also has a wide range of flower color and leaves that are more rounded. Grecian foxglove produces large amounts of seed that can be spread by wind, water, vehicles, and by moving seed-contaminated soil. Seed pods have barbs that can easily attach to fur or clothing facilitating movement by wildlife and humans.

TOXIC PROPERTIES

Grecian foxglove and other *Digitalis* species produce cardiac glycosides that have medicinal uses, but can irritate skin and be highly poisonous when ingested by humans and wildlife. Digoxin is a glycoside used to treat heart problems including atrial fibrillation. The drug has been used as a heart stimulant since 1785.

USDA PLANTS DATABASE

REPORTED LOCATION of Grecian foxglove in the United States and southern Canada, left.

FOXGLOVE rosette, bottom left; and flowers, bottom right.

PHOTOS COURTESY OF BELWIN CONSERVANCY

Partnerships Expand Invasive Plant Management in Dakota Prairie Grasslands

Story and Photos By Celestine Duncan

THE RUGGED LANDSCAPE OF THE DAKOTA PRAIRIE NATIONAL GRASSLAND stretches over 1.2 million acres in two states. These grasslands support a diversity of uses including livestock grazing, wildlife habitat, paleontological and archeological digs, oil and gas production, and recreation.

"The federal grassland boundaries you see on a map can be misleading," explains Chad Prosser, Range & Weeds Program Manager for Dakota Prairie Grasslands. "Within our borders are significant portions of state and privately owned land that are permitted to ranchers for livestock grazing. That's why developing and fostering partnerships is so critical to the success of our invasive plant management effort."

The majority of weed management on the grasslands is conducted through agreements with either county weed control boards or grazing associations. "This allows us to leverage dollars with the partnerships and stretch our budget to get more work done on the ground," says Prosser.

INVASIVE PLANT MANAGEMENT

The invasive plant program is based on prevention, early detection, control, restoration and public education. Canada thistle (*Cirsum arvense* L.), leafy spurge (*Euphorbia esula*), absinth wormwood (*Artemisia absinthium*), black henbane (*Hyoscyamus niger* L.), and houndstongue (*Cynoglossum officinale*) are priority noxious weeds in the grasslands. Infestations are managed on a watershed scale across ownership boundaries starting at upper reaches of watershed and working downstream.

In 2014, about 22,000 acres of noxious weeds were treated; more than half of those acres were on leafy spurge in the Sheyenne Grasslands in eastern North Dakota. Although leafy spurge biological control agents are working well on some sites, infestations of spurge are expanding on sites where insect populations have declined. "The flea beetle (*Aphthona* spp.) populations cycle, and when their numbers are down we use herbicide applications to contain and control the weed," explains Prosser.

Canada thistle and absinth wormwood are located throughout the Dakota Grasslands. Populations are controlled based on management goals and objectives. Milestone® specialty herbicide applied at 5 to 7 fluid ounces per acre effectively controls both weeds.

Continued on page 8 > > >

BOX 1.

HISTORY OF THE DAKOTA PRAIRIE NATIONAL GRASSLANDS

The grasslands of the Great Plains Region were considered North America's last frontier. The Homestead Act of 1862 brought almost six million settlers to the area by 1890 who tried to replace grass with crops. Land that should never have been plowed yielded tons of topsoil to incessant dry winds during the 1920s. By the early 1930s depressed crop prices and drought ruined marginal farms. The National Industrial Recovery Act of 1933 and the Emergency Relief Appropriations Act of 1935 allowed the federal government to purchase and restore damaged lands and resettle destitute families. Today, these restored lands have become the National Grasslands, dedicated to the principles of land conservation and use. The Dakota Prairie Grasslands are part of 20 publically owned National Grasslands administered by the Forest Service.

DAKOTA PRAIRIE NATIONAL GRASSLAND stretches over 1.2 million acres in two states.

LEARN MORE @

http://www.fs.fed.us/grasslands/aboutus/

BOX 2.

PROGRAM PARTNERS

Partners in the program include U.S. Forest Service, county weed control boards, Theodore Roosevelt National Park, oil and gas companies, and livestock grazing associations.

ROCKY MOUNTAIN JUNIPER AND SPREADING JUNIPER are encroaching on grasslands in the absence of fire. Little Missouri River National Grassland.

Rocky mountain juniper (*Juniperus scopulorum*) and creeping juniper (*J. horizontalis*) are native plants that have been increasing on the grasslands the last 50 years.

"The mixed prairie grassland evolved with fire and grazing, but fire has been mostly removed from the equation," says Jack Dahl, botanist with the Medora Ranger District. "This allowed the junipers to increase exponentially, especially on north facing slopes, on sites that should be dominated by grasses and forbs. Encroachment of junipers may be one of the biggest natural resource challenges we face in the grasslands without the use of prescribed fire."

"The historical fire cycle was about every 15 to 25 years in the badlands," Dahl explains. "Without fire, the junipers spread onto upland sites shading desirable grasses and reducing livestock carrying capacity." In addition, to juniper encroachment, an increasing concern about the unchecked spread of exotic cool-season grasses such as Kentucky bluegrass, smooth brome grass and crested wheatgrass into native grasslands is becoming a focus of researchers and land managers.

OIL AND GAS DEVELOPMENT AND INVASIVE PLANTS

Bakken Oil Field activity has increased disturbance and the risk of introducing new weeds to the Little Missouri River Grassland. Billings County Weed Control Board works with the oil companies and their private contractors to manage weeds on roadsides, drill pads and pipelines.

"One of our focus areas in public education is with the oil and gas companies," says Katie Clyde, Supervisor for the Billing County Weed Control Board. "We are at the south end of the Bakken Oil Field, so any new roads, pipelines, or drill pads have to be inspected and approved by county zoning board."

The weed district conducts a pre-inspection survey prior to any pipeline construction and monitors roadsides for newly

Continued on page 10 > > >

KATIE CLYDE, Billings County Weed Control Board Supervisor, top left.

CHAD PROSSER, Range & Weeds Program Manager for Dakota Prairie Grasslands, bottom left.

JACK DAHL, LES SIMNIONOW, KATIE CLYDE AND CHAD PROSSER DISCUSS INVASIVE PLANT DATA COLLECTION (left to right). Field crews record location of weed infestations and control areas on GPS units and provide reports to the U.S. Forest Service.

BOX 3. BLACK HENBANE

BLACK HENBANE is a problematic weed on roadsides and other disturbed areas. The photograph at left shows black henbane treated with Milestone® specialty herbicide at 5 fl oz/A one week after application.

Shown below, **MATURE PLANT**, black henbane.

BLACK HENBANE (*HYOSCYAMUS NIGER* L.) IS A TAP-ROOTED ANNUAL OR BIENNIAL OF THE NIGHTSHADE FAMILY (Solanaceae) that reproduces by seed. Plants grow 1 to 6 feet tall with erect, coarse, hairy stems. Leaves are alternate with coarsely toothed to shallowly lobed margins, and are grayish-green in color. Foliage is covered with fine, sticky hairs. Flowers are arranged in a long spike-like inflorescence in the upper leaves with the youngest flower at the tip. Black henbane produces 10,000 to 500,000 small black seeds per plant. The plant has an unpleasant odor at all growth stages, especially when it is crushed.

Black henbane is an invasive weed in pastures, grasslands, and roadsides throughout the United States. The weed is native to Europe and northern Africa, and was likely introduced to the United States as a medicinal plant by early colonists in the late 17th century. The name "henbane" is literally translated "hen killer" because when fowl eat its seeds they become paralyzed and die.

Black henbane is poisonous to both livestock and humans. Livestock usually avoid the weed because of its foul odor and bitter taste. All parts of black henbane including leaves, seeds and roots contain alkaloids. Although used as an herbal medicine for centuries, accidental or intentional poisoning in humans may result in hypertension, coma and convulsions.

THE JOHN DEER GATOR carries a 1,000-pound payload and has both hand wands and boom buster nozzles for herbicide application on roadsides and back-country areas.

RELATED ARTICLE

Selecting ATV or UTV Herbicide Spray Platforms for Wildland and Natural Area Weed Management
http://bit.ly/atvutvplatform

< < < Continued from page 8

RELATED ARTICLE

Biology and management of absinth wormwood

http://bit.ly/absinth

SUCCESS STORIES FROM THE WESTERN RANGE & WILDLANDS EDITION

Partnership Protects Greater Sage-Grouse Habitat from Invasive Plants

http://bit.ly/wysagegrouse

invading weeds. If weeds are present the oil company has to control the infestation and continue monitoring.

Black henbane and absinth wormwood are big problems on disturbed areas, especially roadsides. Although gravel pits in Billings County are currently kept weed-seed free, some stockpiles were historically contaminated with these weeds and viable seeds are still present. "We hope within the next several years that all gravel pits in a three-county area will be certified weed-seed free," says Clyde. "Until we have stockpiles that are free of noxious weed seed, our job will be more difficult."

The Dakota Prairie Grasslands have a long history of restoration and that continues today. Disturbed sites are seeded as soon as possible to reduce weed invasion and erosion. Since the 1990s, managers have seeded a native mix that includes western wheatgrass (*Pascopyrum smithii*), green needlegrass (*Nassella viridula*), prairie sandreed (*Calamovilfa longifolia*) and Great Basin wildrye (*Leymus cinereusis*).

MOVING FORWARD

Partners agree that the most important asset to the invasive plant program is the ability to work together toward a common goal.

"You have to have a team approach—not only within an agency but also with outside partners. Sometimes you hit a bump in the road, but you have to keep moving forward as a team," says Dahl.

Prosser agrees, "Partnerships allow us to have more eyes looking for invasive plants and that local on-ground knowledge is instrumental in the success of any management effort. Our weed crews and those of our partners are doing a great job, and we are extremely appreciative of the work they do."

Now is a great time to capture photographs of invasive plants and weed managers in action!

Start shooting now and submit your favorite photo of an invasive plant and/or photos of weed management in action as part of our Invasive Plant Photo Contest. The top photograph will receive a $100 value prize along with your photo published on the cover of TechLine Invasive Plant News.

WHEN TO ENTER: August 14, 2015 to October 15, 2015

WHAT TO ENTER: Your original photographs of invasive plants or invasive plant management in action.

WHY TO ENTER: You'll win a prize! The overall winner will receive a gift card to Forestry Suppliers or REI ($100 value).

VISIT http://techlinenews.com/photo-contest for contest rules and details on how to submit your entry

What happens to herbicides after they are applied? This two-part series discusses environmental factors and herbicide properties that influence the fate of several herbicides used on range, pasture and natural areas.
http://bit.ly/herbicidesintheenvironment

Explore the "Articles>Herbicide Information" tab to learn more about reading and understanding herbicide labels, herbicide formulations, factors affecting herbicide performance, the influence of adjuvants, and more.
http://techlinenews.com/herbicides

Ask THE Experts

Are Fall Herbicide Applications Effective on Perennial Invasive Plants?

EACH YEAR TECHLINE RECEIVES QUESTIONS FROM READERS ABOUT TREATING BROADLEAF PERENNIAL WEEDS IN THE FALL—including whether it is an effective application timing, what weeds are most susceptible to fall herbicide treatments and WHY? We interviewed seven weed scientists who work in natural areas about their research results and thoughts regarding fall application timing for perennial invasive plant control.

Weed Scientists Interviewed for "Ask the Experts"

ROGER BECKER, PhD
Extension Agronomist,
Univ. of Minnesota.

JOE DITOMASO, PhD
Extension Specialist,
Univ. of California at Davis.

STEPHEN ENLOE, PhD
Associate Professor,
Univ. of Florida.

RODNEY LYM, PhD
Associate Dept. Head and Professor, North Dakota State Univ.

SCOTT NISSEN, PhD
Professor and Extension Specialist, Colorado State Univ.

TIMOTHY PRATHER, PhD
Professor,
Univ. of Idaho.

MARK RENZ, PhD
Associate Professor and Extension Weed Specialist, Univ. of Wisconsin-Madison.

Do you agree or disagree that fall is a good time to apply herbicides for perennial invasive plant control?

BECKER, DITOMASO, ENLOE, LYM, NISSEN, PRATHER, RENZ: Fall applications can often provide equal or better weed control compared to spring or summer herbicide applications; however, success or failure will depend on: 1) the target weed species, 2) herbicide being applied, 3) growing conditions, and 4) soil residual properties of the herbicide.

ENLOE: "It is important to define fall application timing. In the Southeast, early fall applications are often from two to six weeks prior to a frost when plants are still green and photosynthesizing. Herbicide application made immediately prior to or following a light frost on many cold-sensitive herbaceous plants may not be effective. This is different in the West where fall application timing is effective on many perennial plants following a light frost (26 to 30° F)."

DITOMASO: "For most perennial plants, particularly woody species, fall is an effective time for control. We found that for some species and herbicides (e.g. perennial pepperweed [*Lepidium latifolium*] treated with chlorsulfuron) both spring and fall applications give the same level of control."

LYM: "You cannot make a general yes or no statement. For instance, glyphosate will not control leafy spurge (*Euphorbia esula*) when applied in June or July in our region (north central U.S.), but will give about 9 to 12 months of control when applied in September. Milestone[1] provides best control of Canada thistle (*Cirsium arvense*) at bud stage, but can work on rosettes in the fall. Absinth wormwood (*Artemisia absinthium*) is best controlled with either Milestone or Transline[2] in spring (May), or in fall if you mow ahead of time."

PRATHER: "Idaho has a number of perennial weeds where fall application timing is effective, such as rush skeletonweed (*Chondrilla juncea*) with Milestone; however, fall herbicide treatments do not provide optimum control of hawkweeds (*Hieracium* spp)."

RENZ: "Research has shown that applications following the first light frost of the season (temperature drops below 32° F, but leaf tissue is not damaged) will provide a significant

Continued on page 12 > > >

[1]Milestone® specialty herbicide
[2]Transline® specialty herbicide

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increase in control with several perennials. A hard frost with temperatures in the mid- to lower 20s (° F) may cause injury to some herbaceous perennials reducing control. Frost damage can take a day or more to show visually on plants. To assess potential damage to plants the morning after a suspected frost, gently squeeze the leaf with your thumb and forefinger, and release. If you see your fingerprint, this indicates the epidermis has separated and the plants likely have suffered frost damage to the point where we would not recommend spraying that fall."

In your opinion, why does fall application timing work or not work?

DITOMASO AND ENLOE: Data are available on movement of total non-structural carbohydrates that demonstrates carbohydrate movement to roots in early to late fall, and depletion of reserves in early spring. The hypothesis is that systemic phloem-mobile herbicides[3] should move with carbohydrates and effectively control the root system of perennial plants. The question is…when are carbohydrates moving to important growing points? In herbaceous plants there is likely some variability, but in woody plants movement of carbohydrates in fall is more predictable.

BECKER AND RENZ: Deposition of the herbicide close to plant crowns and root system appears to be important. Research suggests that the distance between the source (above ground leaves) and sink (crown buds and root) is a major factor in movement of photosynthates and presumably systemic herbicides. Buds on lateral roots or rhizomes are also very active metabolically in fall building up carbohydrate reserves to over-winter. In the upper Midwest, fall herbicide applications on herbaceous perennials (e.g. Canada thistle) that have been mowed and have fall regrowth are very effective. In unmanaged systems such as pastures or prairies that have not been mowed or grazed heavily, much of the plant material may be the shoots that originally emerged last spring with minimal new regrowth. As long as the lower portions of these original stems and leaves have green tissue, fall applications can be effective.

NISSEN: "Residual activity of the herbicide in soil is very important[4]. Root and/or root bud herbicide absorption from soil is a significant factor in fall and early winter, especially for weeds like Canada thistle and Russian knapweed. In Colorado, studies have shown that soil-residual herbicides (for example, Milestone) are absorbed by Canada thistle and Russian knapweed roots and/or root buds even when no top growth is present. In areas with high soil organic matter content (>3%), herbicide absorption by roots may be reduced. Although results from the upper Midwest indicate that above-ground green growth must be present to achieve good control, this is not the case in Colorado. Higher soil organic matter present in the upper Midwest may bind herbicides reducing root and bud uptake from soil in the fall."

PRATHER: "With fall applications you may get enhanced herbicide translocation in perennial weeds because of slower metabolic processes that detoxify the herbicide. Microbial degradation of soil-active herbicides would also be slower in fall allowing for a longer period of time for root uptake of the herbicide."

BECKER, LYM AND RENZ discuss how dry conditions in late summer and fall can reduce effectiveness of fall herbicide applications.

BECKER: "In Minnesota and Iowa, the exception to better, more consistent control with fall applications has been in drought cycles where spring moisture was adequate, but by fall, the target weeds were severely moisture stressed and did not appear to translocate herbicides effectively. Rainfall totals and distribution start to transition rapidly moving from western Iowa and Minnesota into Nebraska and the Dakotas, increasing the likelihood of fall moisture stress and reduced control with fall vs. spring/early summer applications. The take home message – in the upper Midwest, assess the stress level of target weeds in the fall following abnormally dry periods. If plants are showing obvious moisture stress, you might be better off leaving a foliar herbicide in the jug."

LYM: "This is not an easy question to answer. Herbicide efficacy in fall can be influenced by plant growth stage (e.g. Canada thistle mature stems vs rosettes), soil moisture, and canopy cover. If conditions are dry in fall, herbicide application may be ineffective."

RENZ: "It appears that soil active herbicides such as Milestone may improve perennial weed control in fall. Even a small percentage of the herbicide absorbed by roots in the fall, winter and early spring can improve perennial weed control. Moisture may also influence control. If summers are very dry and regrowth is limited (e.g. Canada thistle rosettes), then control may go from good to poor. A major reason for weed control failure in fall is no fall moisture."

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[3] Systemic herbicides are those that are absorbed by the roots or foliage and translocated (moved) throughout the plant. This includes herbicides Milestone®, Transline®, Tordon® 22K, Garlon® 4 Ultra, glyphosate, and many more.

[4] The length of time an herbicide remains active in soil is called soil persistence, or soil residual life. Herbicides such as Milestone, Tordon 22K and Transline have soil residual properties that allow for root and or bud absorption (uptake). Garlon 4 Ultra is not readily absorbed by roots.

Which perennial invasive plants are good targets for fall herbicide application?

Following is a summary of some invasive plants that can be controlled with fall applications (listed by scientists in this interview). Herbicide options and rates are available at http://techlinenews.com/management-guide and in other online references.

WEED SPECIES	COMMENTS
Most large-statured perennial weeds that rely strongly on asexual spread by roots	In the Midwest, the presence of basal regrowth is important to success of fall applications.
Absinth wormwood (*Artemisia absinthium*)	Spring or Fall regrowth following mowing in mid-summer.
Canada thistle (*Cirsium arvense*)	Bud stage and fall.
Dalmatian toadflax (*Linaria dalmatica*)	Flower or fall.
Dandelion (*Taraxacum officinalis*)	Fall (best) or spring.
Field bindweed (*Convolvulus arvensis*)	Flower or fall.
Hemp dogbane (*Apocynum cannabinum*)	Flower or fall.
Russian knapweed (*Acroptilon repens*)	Bud stage to late fall.
Knapweeds-taprooted (*Centaurea* spp.)	Rosette to fall.
Kudzu (*Pueraria montana*)	Late June to October.
Leafy spurge (*Euphorbia esula*)	True flower (best) or fall.
Perennial pepperweed (*Lepidium latifolium*)	Fall basal regrowth.
Purple loosestrife (*Lythrum salicaria*)	Bloom or fall.
Rush skeletonweed (*Chondrilla juncea*)	Spring (rosette to early bolt) or fall.
Smooth brome (*Bromus inermis*) and Reed canarygrass (*Phalaris arundinacea*)	Fall in Wisconsin Iowa, Minnesota, and Illinois.

RESEARCH ON HERBICIDE APPLICATION TIMING

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Mapping invasive plants using a helmet based video system

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PHOTO COURTESY COREY RANSOM, UTAH STATE UNIVERSITY

INFESTED ACREAGE AND THE TIME REQUIRED TO ESTIMATE IT WERE COMPARED FOR TWO INVENTORY METHODS: a traditional method of mapping on foot with handheld GPS units versus an experimental method of recording video of infestations while riding a mountain bike. Helmet-mounted cameras were placed facing forward and focused approximately 70 degrees apart to give wide perspective to the right and left of the rider.

INTRODUCTION

Conducting invasive plant inventories is a critical component of an integrated approach to invasive plant management. Inventory data often provides the information necessary to evaluate the extent of weed invasion allowing land managers to prioritize management efforts; however, this data is often expensive to collect. Aerial approaches to invasive plant mapping can be more efficient for highly visible species, but are limited to plants visible from the air. Recent advances in video technology allow collection of high definition video with compact, relatively inexpensive cameras.

OBJECTIVES

Research was conducted at Utah State University to compare a traditional ground-based approach to invasive plant mapping, to one using helmet mounted video cameras. The two ground-based inventory methods were compared for: 1) total estimated infested acreage, and 2) time required to conduct the inventories.

METHODS

The first inventory method involved mappers on foot inputting infestation data into a handheld GPS (traditional method). The second approach utilized a person riding a mountain bike wearing two helmet mounted video cameras (GoPro Hero2, GoPro Inc.) and later using the video to generate inventory polygons on a desktop computer in the office. A GPS or smart phone was used to collect tracklog data to accompany the video footage.

The helmet-mounted cameras were placed facing forward and focused approximately 70 degrees apart to give wide perspective to the right and left of the rider. Five trails were mapped using both approaches in mid May 2014 while the target plant was in full bloom. Dyer's woad (*Isatis tinctoria* L.) was selected as the target since its bright yellow flowers are easily distinguishable from surrounding green vegetation. The videos from both cameras were blended into a single video (Premiere CS6, Adobe) and then imported along with the corresponding tracklog into software (VIRB Edit,

NOTE:

This information was presented at the Western Society of Weed Science meeting March 9-12, 2015, Portland, OR.

Garmin Ltd.) that allows the video and the tracklog to play simultaneously. Using a second computer monitor, infestation shapes were drawn onto a GIS map (ArcPad 10, ESRI) as they were observed in the video and the location was identified on the corresponding map. The time spent mapping on the computer was recorded and was added to the time required to ride each trail section to determine total time required for mapping. Time required to stitch videos together or to sync tracklogs with the video was not included in calculations as the process could likely be automated in the future. Comparison of the two mapping methods included total time, total number of points, polygons, and lines, as well as total infested acres.

RESULTS

Time efficiency as well as estimates of total infested acreage varied widely between the two techniques.

TIME SAVINGS WITH VIDEO APPROACH

Time savings using the helmet mounted video approach ranged from 17 to 25% for a very steep trail and a small parcel respectively; and 60 to 73% for trails that were relatively flat to mostly downhill.

INFESTATION ESTIMATES WITH VIDEO APPROACH

The video mapping approach had lower estimates (70 to 83%) than the on-foot approach for two of the trails, but infestation estimate was almost 35% higher for another trail. Unfortunately there was no way to determine which method is more accurate since there was no actual infestation measurement for comparison. Future studies will need to include such a comparison. In some instances, both mapping methods identified small patches or single plants in the exact same location. While infestation polygons differed in size, in most cases the location of plants and patches were similar between the methods. Many discrepancies were due to the method each mapper selected to represent any given infestation (individual patches vs. large polygons or line features).

CONCLUSIONS

The video approach did allow fairly clear differentiation between dyer's woad and other yellow-flowered species in bloom. Newer video cameras offer even higher resolutions and video frame capture rates that could increase the ease of identifying specific species. Approaches to stabilize the camera during data collection are currently being investigated and have potential to improve video clarity. This research shows that helmet mounted video cameras can be used to map easily detected weed patches, with potential time savings compared to mapping on foot.

READ ABSTRACT > http://bit.ly/helmetvideomapping

Fall rain and cooler temperatures provide good conditions for extending the herbicide application season. The following species and many others can be effectively controlled in the fall. Follow the links for control recommendations for each species.

SPOTTED & DIFFUSE KNAPWEED
http://bit.ly/spottedknapweed

CANADA THISTLE
http://bit.ly/canadathistle

LEAFY SPURGE
http://bit.ly/leafyspurge

BIENNIAL THISTLES
http://bit.ly/biennialthistle

CROWN VETCH
http://bit.ly/crownvetch
(and see page 2)

BIRDSFOOT TREFOIL
http://bit.ly/birdsfoottrefoil

SWEETCLOVER
http://bit.ly/sweetclover

TEASEL
http://bit.ly/teasel2014

WOODY PLANTS
Foliar herbicide application to woody plants can be made in fall until the first sign of color change in the leaves.
http://bit.ly/woodyplantcontrol

SOME SPECIES ARE NOT EFFECTIVELY CONTROLLED IN FALL. For example: Hawkweeds (*Hieracium* spp.), and annual weeds such as pigweeds (*Amaranthus* spp.), buffalobur (*Solanum rostratum*), and kochia (*Kochia scoparia*).

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R12-000-135 010-58510 (WMS, 8/2015)