FALL 2016

TechLine

INVASIVE PLANT NEWS

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

WESTERN RANGE & WILDLANDS EDITION

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TIM HARRINGTON

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MEET THE TECHLINE TEAM

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

WHY ENTER: You'll win a prize! The winner of each category will receive a gift card to Forestry Suppliers or REI ($200 value).

FIND DETAILS AT
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Vastlan™ Specialty Herbicide Replaces Garlon® 3A

Vastlan™ is a herbicide developed by Dow AgroSciences for the control of woody plant species and annual and perennial broadleaf weeds on industrial vegetation management, aquatic, Conservation Reserve Program (CRP), range and permanent grass pastures sites and grasses grown for hay. Vastlan herbicide is formulated as a soluble liquid (SL) and contains 4 pounds acid equivalent per gallon (lbs ae/ gallon) of triclopyr choline. The choline formulation of triclopyr reduced the signal from "Danger" on Garlon® 3A to "Warning". This reduced toxicity and higher concentration sets Vastlan herbicide apart from its predecessor Garlon 3A. Grass tolerance and weed control spectrum of Vastlan herbicide is the same as Garlon 3A. Vastlan is registered for use in 47 states, excluding California, New York, and Florida.

APPLICATION RATE CONVERSION FOR GARLON® 3A TO VASTLAN™ SPECIALTY HERBICIDE

Garlon 3A has 3 lb acid equivalent per gallon (ae/gallon) and Vastlan has 4 lb ae/gallon.

GARLON® 3A (3 lb ae/gal)		VASTLAN™ (4 lb ae/gal)
2 pints/Acre	=	1.5 pints/Acre
3 pints/Acre	=	2.25 pints/Acre
4 pints/Acre	=	3 pints/Acre
6 pints/Acre	=	4.5 pints/Acre
8 pints/Acre (4 quarts)	=	6 pints/Acre (3 quarts)

TWENTY YEARS OF SUCCESS:
Managing Tansy Ragwort in Northwestern Montana


DAN WILLIAMS


UTAH STATE UNIVERSITY, BUGWOOD.ORG

TANSY RAGWORT ESTABLISHES EASILY IN DISTURBED SITES SUCH AS SLASH PILES AND AREAS THAT HAVE BEEN LOGGED (LEFT).

TANSY RAGWORT FLOWERS (ABOVE)

By Celestine Duncan

High temperatures, windy conditions and lack of precipitation created extreme wildfire conditions in northwest Montana during the summer of 1994. The Little Wolf Fire began in August of that year, burning over 15,000 acres of national forest and private timber lands.

"Tansy ragwort was probably already present as scattered plants when the wildfire burned," explains Dan Williams, weed coordinator in Lincoln County. "But, two years after the fire, the ragwort infestation exploded within the burned area."

Open sites created by the burn and disturbance from fire-fighting activities provided ideal habitat for tansy ragwort. Initial estimates suggested that about 1,000 acres were infested by the weed; but subsequent surveys recorded 15,000 acres of tansy ragwort scattered within a 500,000-acre perimeter.

The County Weed District and other partners organized a cooperative weed management area (CWMA) and developed management plans to contain tansy ragwort. The goal of the Tansy Ragwort CWMA is to restrict populations of tansy ragwort to existing areas and prevent further expansion through an integrated approach.

Management components include:

1) inventory/mapping and monitoring
2) control and containment
3) use of biological control agents and related research
4) road closures and grazing restrictions
5) public education
6) a plan for cross jurisdictional cooperation

"The project has always been a cooperative effort between the Forest Service, county weed districts, state Departments of Agriculture and Natural Resources, a large private timber company, local landowners and other partners," Williams explains. "We were fortunate that several biological control specialists with the Forest Service and Montana State University were able to secure insects from Oregon and establish release sites in the area early in the project."

Three insects including the cinnabar moth, tansy ragwort seed fly and tansy ragwort flea beetle were collected and tested for survival and suitability for tansy ragwort

PROJECT FUNDING

A key funding partner in the project is the **Montana Noxious Weed Trust Fund** (NWTF), which provided more than $1.9 million to control tansy ragwort since 1994. Approximately 12 percent of the budget has gone directly toward rearing, screening, and distribution of biological control agents on tansy ragwort and invasive hawkweeds.

The Montana NWTF grant program was established by the 1985 Montana Legislature to provide funding for the development and implementation of weed management programs in the state. Since its inception, more than $58.2 million dollars in grants has been awarded to support integrated management of noxious weeds in the state (includes research, public education, and on-ground management). The program is administered by Montana Department of Agriculture.

Continued on page 4...

... Continued from page 3

control in northwestern Montana (*See on this page, Controlling Tansy Ragwort*). The cinnabar moth was established on the site by 1999 followed by the other two insects. The cinnabar moth has proved to be the most successful of the three insects in reducing tansy ragwort density in Montana.

Biological control agents were integrated with the herbicide treatment program to reduce larger core populations of tansy ragwort. Milestone® or Transline® specialty herbicides are applied to tansy ragwort along roadsides, small newly established infestations, and on the perimeter of some of the larger tansy ragwort infestations where insects were released.

"We apply Milestone at 6 fluid ounces per acre (fl oz/A) on the majority of infestations and have had good results," says Williams. "Transline at 1 pint per acre (pt/A) is used under sensitive trees and shrubs." Both herbicides are applied to tansy ragwort from rosette through bloom stage, and in the fall.

Williams explains they are getting complete control of tansy ragwort with Milestone regardless of plant growth stage. "Plants in the mid to late bloom stage will likely produce viable seed if flower heads aren't clipped. But, we do an excellent job of controlling rosettes and seedling germination with late summer and fall applications of Milestone," Williams explains.

The CWMA achieved dramatic reductions in tansy ragwort populations by integrating effective biological control agents with herbicides treatments. Their success has led to creation of other cooperative weed management areas in northwestern Montana.

"Consistent surveys, monitoring, and public education are key components for meeting our goal," says Williams. "By mapping the infestation we can track the spread or decline of the infestation and adjust management methods to maximize control. Monitoring previously treated areas and surveying the outer edge of the infestation for new plants also let us know if our containment efforts are working. Establishing biological control agents in core ragwort populations, and using herbicides on the perimeters of infestations, along roadsides and on newly invading plants reduces the occurrence of new infestations outside of the infestation perimeter."

Counties in northwestern Montana rely heavily on proceeds from timber production, livestock and wildlife forage production, recreational access, and agriculture—all of which are at risk from tansy ragwort invasion. The success of this project is critical to safeguard the social and economic base of communities in this region.

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Active ingredients for herbicide products mentioned in this article: Milestone (aminopyralid), Transline (clopyralid).

ERIK COOMBS, OREGON DEPT OF AGRICULTURE, BUGWOOD.ORG

Controlling Tansy Ragwort in Natural Areas

By Celestine Duncan

Tansy ragwort (*Senecio jacobaea*) is a winter annual, biennial, or short-lived perennial plant in the sunflower family. The plant was unintentionally introduced into Canada about 1850, occurred in the state of Washington by 1901 (Rice 2015), and is currently reported in 14 states and four Canadian provinces (Figure 1). The plant is classified as a noxious weed in seven western states (AZ, OR, WA, CA, MT, CO and ID), two eastern states (CT and MA), and Canadian provinces. Tansy ragwort spreads mainly in hay, or on contami-

USDA PLANTS DATABASE 2016

Tansy ragwort is a prohibited noxious weed in Arizona but is not currently established in the state (McGrew pers. comm.).

FIGURE 1. CURRENT DISTRIBUTION OF TANSY RAGWORT IN THE UNITED STATES AND CANADA


DAN WILLIAMS

FIGURE 2. TANSY RAGWORT HAS YELLOW DAISY-LIKE FLOWER HEADS WITH GOLDEN TO LIGHT BROWN CENTERS LOCATED ON THE END OF STEMS.


DAN WILLIAMS

FIGURE 3. TANSY RAGWORT USUALLY GROWS AS A BIENNIAL, FORMING A ROSETTE THE FIRST YEAR AND FLOWERING AND PRODUCING SEED IN THE SECOND YEAR. LEAVES ARE DEEPLY PINNATELY DISSECTED INTO IRREGULAR SEGMENTS, GIVING THE PLANT A RAGGED APPEARANCE.

nated equipment and vehicles. The invasive plant is well suited to disturbed sites such as roadsides, open forests, logged areas, burned sites, and overgrazed meadows and pastures.

Identification and Spread

Tansy ragwort can reach more than four feet in height. The plant usually grows as a biennial, but can remain in a rosette stage for several years before bolting and producing seed. Mechanical damage to tansy ragwort such as mowing can also cause the plant to persist more than two years. The plant has a basal rosette of leaves, and the upper parts are branched. Leaves are deeply pinnately dissected into irregular segments giving the plant a ragged appearance. Yellow daisy-like flower heads with golden to light brown centers form at the tip of each branch from mid-summer to fall. Tansy ragwort spreads primarily by seed, which are dispersed within about 30 feet of the parent plant. Seed can remain viable for more than 10 years. Tansy ragwort can also reproduce from crown buds under environmental or mechanical stress (Figures 2 and 3).

Impacts

Tansy ragwort can reduce desirable forage production by as much as 50 percent in meadows and pastures. The invasive plant is poisonous to some types of livestock and wildlife including cattle, deer, horses and goats. Sheep are able to consume the plant without harmful effects. Tansy ragwort contains pyrrolizidine alkaloids, which primarily affect the liver. In susceptible animals, liver cells are slowly killed and prevented from regenerating. The poisonous pyrrolizidine alkaloids are present in actively growing plants, and in plants that are cut, dry and in hay or silage. Reduced weight gain, liver degradation, lower butterfat content in milk and sudden death of an animal can be caused by ingesting tansy ragwort. When symptoms of tansy ragwort poisoning appear, it is too late to save the animal; thus, the best prevention measure is to removal the plant from pastures. Alkaloids in tansy ragwort pollen also taint honey, making it bitter, off-color and unmarketable.

Management

HERBICIDES

Tansy ragwort can be effectively controlled using selective broadleaf herbicides. Field studies conducted on tansy ragwort show that Milestone® specialty herbicide at 4 to 7 fluid ounces per acre (fl oz/A) or Transline® specialty herbicide at 1 pint per acre (pt/A) provided good to excellent control one year following application (Figure 4). Results from operational control programs in northwestern Montana and northeastern Idaho support the application of Milestone at 5 or 7 fl oz/A for tansy ragwort control (Williams and Martinson personal communication).

The optimum time to apply herbicides to control tansy ragwort plants and stop seed production is at rosette to early bolt stage in spring, or to fall rosettes.

In northwestern Montana, spot treatment of plants occurs from rosette through early bloom stage with Milestone at 6 fl oz/A. Tansy ragwort is often difficult to locate until the plant blooms; thus, treatments continue through the summer months into fall in some operational programs. Clipping, bagging and removing flower heads from the infested site may be necessary to stop seed production at mid- to late-flower growth stage. Tansy ragwort rosettes and seedlings that are growing in association with mature plants will be controlled, and residual properties of Milestone will stop seedling establishment during the fall.

GRAZING

Managing grazing livestock to support a vigorous desirable plant com-

Continued on page 6...

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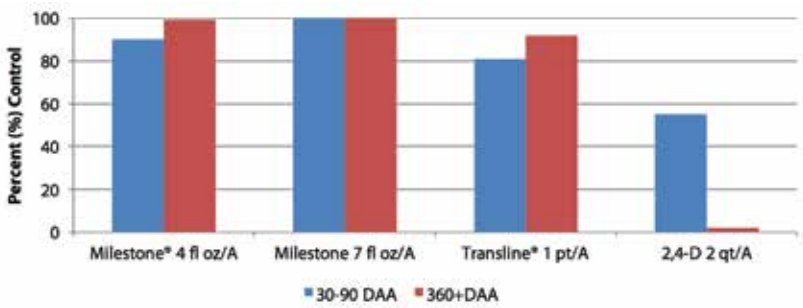
munity is recommended to prevent tansy ragwort invasion into new pastures or re-invasion in previously infested pastures. Sheep are immune to the plant's toxic alkaloids and willingly graze young plants. In New Zealand, intensive sheep grazing is utilized to manage tansy ragwort. Tansy ragwort is poisonous to cattle, horses and goats. To prevent death of susceptible livestock, tansy ragwort density must be less than one plant per square yard and occupy not more than 25 percent of a pasture.

FIGURE 4. PERCENT TANSY RAGWORT CONTROL WITH VARIOUS HERBICIDES THE SEASON OF TREATMENT AND ONE YEAR AFTER TREATMENT. (DAA=DAYS AFTER APPLICATION)



BIOLOGICAL CONTROL

Three insects, including the cinnabar moth (*Tyria jacobaeae*), tansy ragwort seed fly (*Botanophila seneciella*) and the tansy ragwort flea beetle (*Longitarsus jacobaeae*) were introduced from 1960 to1971 in western Oregon and California to control tansy ragwort. Since that time insects have also established on tansy ragwort infested sites in Oregon, Washington, northern Idaho and northwestern Montana.

The ragwort flea beetles introduced to the United States before 2002 were collected in Italy and are credited with control and suppression of tansy ragwort infestations west of the Cascades. A Swiss strain of this agent with a different phenology than the Italian strain is believed to be better adapted to higher elevations, colder winters and shorter growing seasons typical of tansy ragwort infested areas east of the Cascades.

The insects have successfully reduced tansy ragwort populations throughout the Pacific Northwest. In Oregon, cattle deaths were reduced by more than 90 percent as a result of wide-spread insect establishment. Fluctuations in tansy ragwort populations can occur over time based on environmental conditions that favor either the insect or tansy ragwort growth.

OTHER CONTROL METHODS

Hand digging that removes the entire root crown and upper portion of roots will effectively control individual plants and very small infestations. Wearing protective gloves when handling tansy ragwort is recommended as a precautionary measure. Mowing is not effective and may cause the plant to develop perennial characteristics.

Maintaining a desirable competitive plant community is critical to stop reinvasion of tansy ragwort. Shading and competition for light, moisture, and nutrients will make survival difficult for tansy ragwort seedlings.

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SYNTHETIC AUXIN HERBICIDES CONTROL GERMINATING SCOTCH BROOM


TIM HARRINGTON, USDA FOREST SERVICE


TIM HARRINGTON, USDA FOREST SERVICE

SCOTCH BROOM IN BLOOM (LEFT).
A GROWTH CHAMBER WAS USED TO CONDUCT THE SEEDLING GERMINATION STUDY (RIGHT).

EDITOR'S NOTE

The following information was summarized by Celestine Duncan from research conducted by Timothy B. Harrington and published in Weed Technology 2014 28: pp 435–442. Abstract at: http://wssajournals.org/doi/abs/10.1614/WT-D-13-00170.1

SCOTCH BROOM (*CYTISUS SCOPARIUS*) IS A LARGE, NONNATIVE SHRUB THAT HAS INVADED FORESTS AND GRASSLANDS IN 27 U.S. STATES (Figure 1). The plant was introduced as an ornamental in the 1850s and is a prolific seeder with individual shrubs producing from 100 to 14,000 seeds per year. Once the seeds are buried, their germination can be delayed for at least five years, resulting in soil seedbanks of 200 to 27,000 seeds per square meter. Without treatment, Scotch broom's persistent seedbank ensures a continuing source of regeneration after soil disturbance.

A variety of fire, herbicide, and mechanical treatments are effective for controlling established Scotch broom. However, observations regarding effectiveness of soil-active herbicides in controlling germinating seedlings of Scotch broom are limited.

FIGURE 1. CURRENT DISTRIBUTION OF SCOTCH BROOM IN THE UNITED STATES


EDDMAPS 2016

Researchers conducted a series of studies in growth chambers beginning in 2010 to compare the effectiveness of three soil-active auxin herbicides: aminopyralid (Milestone® specialty herbicide), clopyralid (Transline® specialty herbicide) and aminocyclopyrachlor for controlling Scotch broom seedling germination. Herbicide application rates were 0, 50 and 100 percent of the maximum label broadcast use rate, or Milestone at 0, 3.5 and 7 fluid ounces per acre (fl oz/A) and Transline at 0, 10.5 and 21 fl oz/A.

Results of the study showed that Scotch broom seedling emergence, mortality, and biomass did not vary among herbicide treatments 90 days after application. Low herbicide application rates (50 percent of the maximum label use rate) provided 60 to 80 percent control, whereas 100 percent maximum label use rate provided 69 to 89 percent control.

These findings have three important implications to vegetation management in the western United States.

FIRST, Transline is commonly used for herbaceous weed control in forestry because it is safe to apply over seedlings of Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*) and other western conifer species. Findings from this research confirm field observations that operational treatments of Transline reduced regeneration of Scotch broom from existing seedbanks.

SECONDLY, Milestone has been used successfully in restoration of native plant communities, because it controls many nonnative broadleaf species, yet it is tolerated by a wide variety of native grass, forb, and shrub species especially when applied at low rates. Results of this research indicate that low rates of Milestone will provide the added benefit of controlling germinating Scotch broom.

THIRDLY, depending on application rate and time since treatment, the herbicides varied in cost per unit of seedling mortality, with a general ranking of Milestone the least expensive, followed by Transline, and aminocyclopyrachlor (most expensive). Both Milestone and Transline are currently labeled for forestry and other use sites including grazed areas.

NOTE: While Milestone is not registered for use in forestry in western states, Opensight® specialty herbicide (as Special Local Needs (SLN) label in OR, ID, and WA) and Capstone® specialty herbicide (federal label) are registered for use on forest sites.

Active ingredients for herbicide products mentioned in this article: Milestone (aminopyralid), Transline (clopyralid), Opensight (aminopyralid plus metsulfuron, and Capstone (aminopyralid plus triclopyr).

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TIM HARRINGTON, USDA FOREST SERVICE

FIGURE 1 (ABOVE). PHOTOGRAPHS SHOWING HEAVY DEBRIS ON STUDY SITE (TOP), LIGHT DEBRIS (MIDDLE), AND MACHINE TRAILS (BOTTOM).

EDITOR'S NOTE

The following information was summarized by Celestine Duncan from research conducted by T.B. Harrington, RA Slesak, and DH Peter and published in the 2013 Proceedings, Western Society of Weed Science. Page 52.
http://www.wsweedscience.org//wp-content/uploads/proceedings-archive/2013.pdf

Logging Debris and Herbicide Treatments for Controlling Scotch Broom

Researchers conducted a study near Matlock, Washington investigating the potential of logging debris and herbicide combinations to inhibit germination and development of Scotch broom (*Cytisus scoparius*) seedlings. The study site was a mature Douglas-fir forest that was scheduled for harvest. The forest understory included occasional Scotch broom plants that invaded from a previous disturbance, indicating the likely presence of soil-stored seed.

Timber was harvested from the study area in November and December 2011, and debris plots established. Study plots were arranged as a randomized complete block, split-plot design with six replications. Main plots included three soil surface treatments (light debris, heavy debris, and machine trails), with debris depths averaging about 6.5, 12.5, and 6 inches respectively (Figure 1).

Herbicide treatments were applied in August 2012 with backpack sprayers. Treatments included Garlon® 4 Ultra specialty herbicide at 2 pounds (lbs) acid equivalent per acre (ae/A) and Milestone® specialty herbicide at about 7 fluid ounces per acre (fl oz/A) applied either alone or in combination. Douglas-fir seedlings were planted in February 2013. Scotch broom regeneration was measured within 0.1 m^2 frames.

Results of the debris study showed that density of current-year seedlings of Scotch broom doubled from June to July, 2012 (1,800 seedlings per hectare (ha) to 3,800 seedlings/ha respectively). In July, broom density was lower in heavy debris than on machine trails, but it did not differ significantly from that in light debris (Figure 2A).

Results of the herbicide treatments showed that the combination of Garlon 4 Ultra and Milestone reduced broom density by about 90 percent

ESTIMATING LOGGING DEBRIS MASS

HERBICIDE TREATMENTS WERE APPLIED WITH BACKPACK SPRAYERS ON AUGUST 13, 2012.

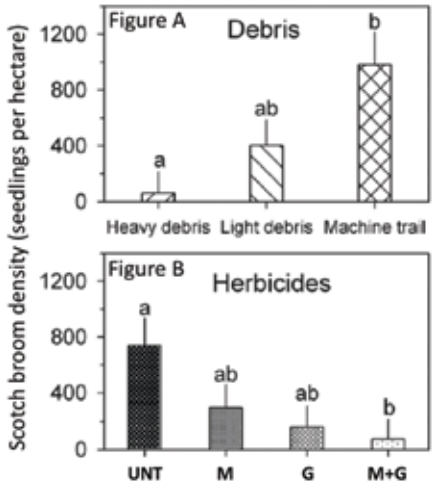


FIGURE 2 A&B. SCOTCH BROOM SEEDLING DENSITY PER HECTARE WITH VARIOUS TREATMENTS: A. DEBRIS STUDY (TOP) AND B. HERBICIDE STUDY (BOTTOM). DATA NOTED BY THE SAME LETTER ARE NOT STATISTICALLY DIFFERENT FROM EACH OTHER.

UNT = UNTREATED
M = MILESTONE® SPECIALTY HERBICIDE
G = GARLON® 4 ULTRA SPECIALTY HERBICIDE
M+G = MILESTONE AND GARLON 4 ULTRA COMBINED

seven weeks after treatment (Figure 2B) compared to non-treated plots. Although the herbicide combination provided the best control of Scotch broom, this treatment did not differ significantly from plots treated with either Garlon 4 Ultra or Milestone alone.

In summary, these results suggest that either heavy debris (12 inches or greater) or application of Garlon 4 Ultra and Milestone combined was the most effective at reducing broom seedling density. Both of these treatments reduced density of first-year seedlings by about 90 percent. Debris treatments inhibited broom germination by altering soil and light environments.

NOTE: While Milestone is not registered for use in forestry in western states, Opensight® specialty herbicide (as Special Local Needs (SLN) label in OR, ID, and WA) and Capstone® specialty herbicide (federal label) are registered for use on forest sites.

Active ingredients for herbicide products mentioned in this article: Milestone (aminopyralid), Garlon 4 Ultra (triclopyr), Opensight (aminopyralid plus metsulfuron), and Capstone (aminopyralid plus triclopyr).

CONTROLLING INVASIVE WEEDS IN THE FALL

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.

RUSSIAN KNAPWEED
http://bit.ly/russianknapweed

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

ABSINTH WORMWOOD
http://bit.ly/absinth

BLACKBERRY
http://bit.ly/blackberrycontrol

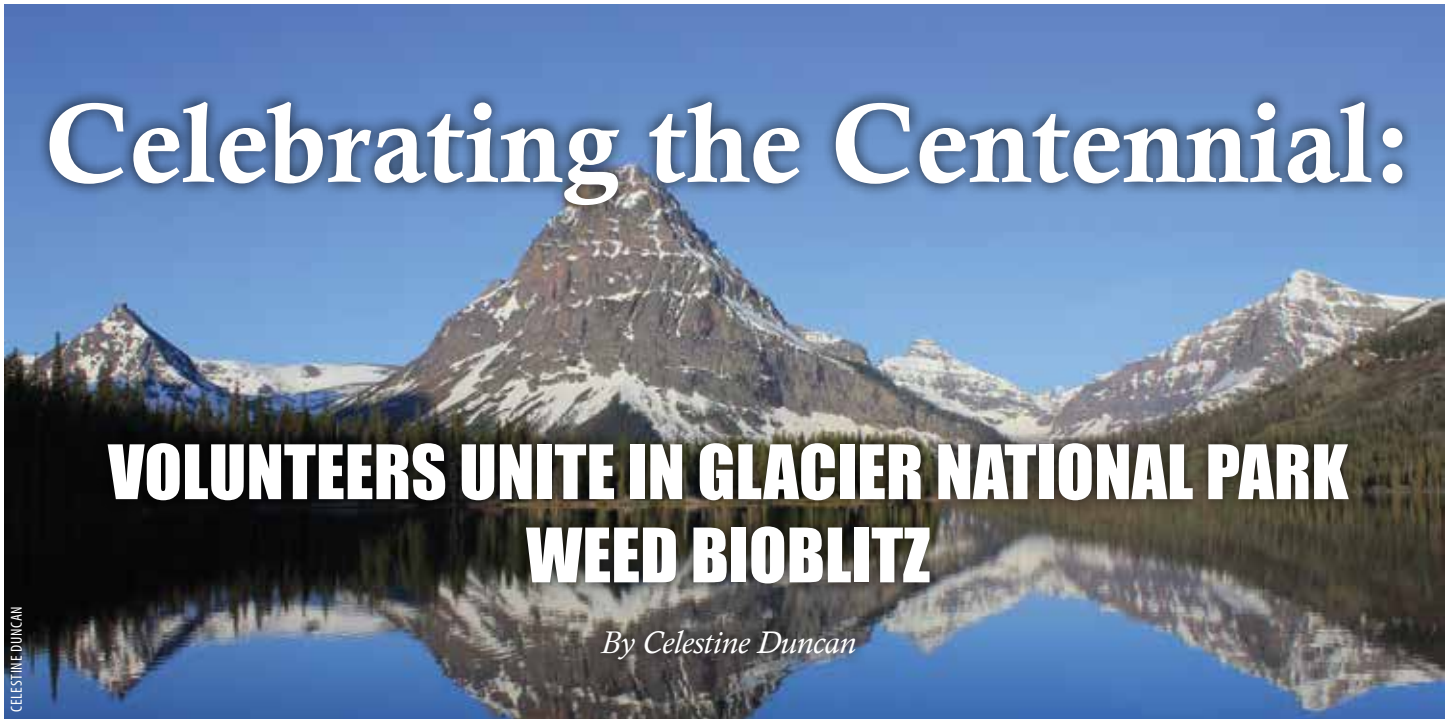
YELLOW STARTHISTLE
http://bit.ly/yellowstarthistle

RUSH SKELETONWEED
http://bit.ly/rushskeletonweed

COMMON TANSY
http:/bit.ly/commontansy

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*).

Celebrating the Centennial:



CELESTINE DUNCAN

VOLUNTEERS UNITE IN GLACIER NATIONAL PARK WEED BIOBLITZ

By Celestine Duncan

More than 90 volunteers gathered in July to be trained on noxious weed identification, monitoring and control in Glacier National Park as part of the Weed BioBlitz. Participants included volunteer youth and adults from Montana, Wyoming and Idaho. *See Box 1.*

The Weed BioBlitz is part of a larger effort coordinated by the National Park Service (NPS) to celebrate the NPS Centennial. "This is a great opportunity to learn more about the biodiversity of a park, and engage youth and adults in hands-on resource stewardship," says Terry Peterson, Citizen Science Coordinator for the Crown of the Continent Research Learning Center.

Glacier National Park hosts over 1,000 different species of plants including 126 non-native species, about 20 of which are noxious or invasive weeds. Although most invasive plants in the park are closely associated with disturbed areas such as recreational, roadside and construction sites, the 700 miles of backcountry trails also provide a corridor for invasive plants to spread into natural areas.

"Monitoring these backcountry trails is often difficult and time consuming, and we have limited field staff," explains Dawn LaFleur, restoration biologist and lead for the invasive plant management program in Glacier National Park. "Our goal is to keep noxious weeds out of backcountry areas, so it's important to find and control these plants as early as possible to minimize their impact on native vegetation and other natural resource values. With only four invasive plant managers on the summer work crew we need all the help we can get."

The Weed Blitz is a day-long event with volunteers attending an indoor training program on weed identification, impacts and monitoring presented by LaFleur. In the afternoon, volunteers separate into groups to search for and pull priority invasive plants in high public use areas.

"Our main objective in the afternoon is to get people familiar with five key target weeds, and hand pulling is a good way to do that," explains Tyler Jack, a group leader and member of the NPS Exotic Plant Management Team. Volunteers also pulled a lot of weeds, with a total of 48 bags containing about 630 pounds of weeds removed from high public use areas.

The training approach seems to be working! Mac McPherson, scout master with Troup 104 from Westmond, Idaho said that service projects are great for scouts, and hands-on is the best way for them to learn. "These scouts will always be able to identify oxeye daisy and the other weeds they are pulling during the BioBlitz."

BOX 1. PARTICIPANTS IN WEED BIOBLITZ

AmeriCorps

Montana Youth Conservation Corp

Boy Scouts of America leaders and members

Boys and Girls Club leaders and members

Xanterra employees

Citizen volunteers

National Geographic representative

Glacier National Park employees and volunteers

BOX 2. HISTORY OF GLACIER NATIONAL PARK

1895
Waterton Lakes National Park established.

MAY 11, 1910
Glacer National Park established.

1932
Established as Waterton-Glacier International Peace Park. Going- to- the-Sun Road completed.

1974
Established as an International Biosphere Reserve.

1995
Established as Waterton-Glacier International Peace Park World Heritage Site

CELESTINE DUNCAN


MELISSA SLADEK


CELESTINE DUNCAN

CLOCKWISE FROM TOP, LEFT:

DAWN LAFLEUR, RESTORATION BIOLOGIST IN GLACIER NATIONAL PARK AND TWO VOLUNTEER SCOUTS SHOW **HOW FAR LEAFY SPURGE ROOTS CAN SPREAD** AS PART OF THE BIOBLITZ TRAINING (TOP, LEFT).

TYLER JACK, MEMBER OF THE NPS EXOTIC PLANT MANAGEMENT TEAM PULLS OXEYE DAISY WITH A VOLUNTEER DURING THE WEED BIOBLITZ TRAINING (TOP, RIGHT).

MORE THAN 90 VOLUNTEERS GATHERED FOR THE WEED BIOBLITZ IN GLACIER NATIONAL PARK (BOTTOM, LEFT).

Once volunteers complete the training they can be part of the Invasive Plant Citizen Scientist Project in the park. "The citizen scientists find and report the location of high priority invasive plants in the backcountry," says LaFleur. "This way we can send crews directly to the site to control the weeds, saving us a lot of time and allowing us to expand what we can accomplish."

Species targeted by the program are spotted knapweed (*Centaurea stoebe*), oxeye daisy (*Leucanthemum vulgare*), houndstongue, (*Cynoglossum officinale*), St. Johnswort (*Hypericum perforatum*) and yellow toadflax (*Linaria vulgaris*). "These noxious weeds are well established in Glacier National Park high public use areas and are transported into backcountry areas by recreationists, wildlife, wind and water," explains LaFleur. There are also four new invaders on the high priority list for monitoring since they are recently established within the park or occur just outside park boundaries. *See Box 3.*

Each year more than two million visitors come to Glacier National Park from all over the world for the scenic mountain vistas, glaciers, and unique biodiversity. As visitation increases, the risk of introduction and spread of non-native species also escalates, making management a critical priority in the park.

Although the National Park Service recognizes the spread of invasive plants as a major factor contributing to ecosystem change and instability, funding for the program in Glacier National Park has declined over the last several years. According to LaFleur, adequate funding is always a struggle and managers at the national level needs to recognize and adequately fund invasive plant management programs.

"We try to be as efficient as we can and our volunteer program really helps, but there is no way we can adequately protect the park from invasive plants with only four employees spread over one million acres," LaFleur explains.

The volunteer Invasive Plant Citizen Science Program is one way that concerned public can help support Glacier National Park's invasive plant program. Strengthening these partnerships and increasing financial resources to control invasive plants is critical to protecting the unique biodiversity of Glacier National Park. For citizen scientists, the rewards are a sense of stewardship, a greater awareness of the park's resource issues, and an expanded insight in ecological research and management methods.

BOX 3. NEW INVADERS

THREATENING GLACIER NATIONAL PARK ARE A PRIORITY FOR CONTROL IN BOTH HIGH PUBLIC USE SITES AND BACKCOUNTRY AREAS

Orange hawkweed
(Hieracium aurantiacum/ Pilosella aurantiaca)

Meadow hawkweed complex
(*Hieracium caespitosum, H. praealturm, H. floridundum,* and *Pilosella caespitosa*)

Blueweed
(Echium vulgare)

Yellow starthistle
(*Centaurea solstitialis*)

MTWEED.ORG PHOTOS

BOX 4. CITIZEN SCIENCE PROGRAM

The Glacier National Park Citizen Science Program engages park visitors, students, and staff in collection of scientific information that would otherwise be unavailable to resource managers and researchers. Since 2005, the Citizen Science Program has invited members of the public to assist in biological research while recreating in the park. The program is coordinated by the Crown of the Continent Research Learning Center (CCRLC), based in Glacier National Park. For more information go to https://www.nps.gov/glac/learn/ccrlc.htm

Managing Scotch Thistle on Rangeland and Natural Areas

By Celestine Duncan

STEVE DEWEY, RETIRED, UTAH STATE UNIVERSITY, BUGWOOD.ORG

Scotch thistle (*Onopordum acanthium*) is a robust non-native plant well established throughout much of the United States and Canada (Figure 1). The plant was introduced into the United States during the 1880s possibly as an ornamental and/or as a medicinal plant. It subsequently escaped from cultivation and is now abundant and problematic in the western U.S. Severe infestations can form tall, dense stands that impede livestock and wildlife access to desirable forage plants, impacting wildlife habitat and limiting carrying capacity of infested rangeland and natural areas.

Scotch thistle is generally considered a biennial weed, but can also grow as an annual or short-lived perennial. The plant reproduces exclusively by seed that can germinate throughout the year depending on moisture and temperature. Large Scotch thistle can produce from 20,000 to 40,000 seeds that can remain viable in soil for at least seven years. Seeds are 4 to 5 mm (0.2 in.) in length, smooth, slender, and plumed. A water soluble germination inhibitor contained in seeds suggests that germination will not occur without optimum soil moisture.

USDA NRCS 2016

FIGURE 1. DISTRIBUTION OF SCOTCH THISTLE IN THE UNITED STATES AND CANADA

The first year, Scotch thistle forms a rosette of large, spiny leaves that can be 12 inches or more in width. Flowering stems are normally produced during the second growing season and can grow from 6 to 12 feet tall. Stems have vertical rows of spiny ribbon-like "wings" that extend to flower bases. The plant is highly branched and gray-green in appearance. Leaves are oblong and prickly, and toothed or slightly lobed along the margins. Upper and lower leaf surfaces are covered with a thick mat of cotton-like or woolly hairs, giving the foliage a gray-green color. The dark pink to lavender flower heads measure 1 to 2 inches in diameter. The whorl of bracts beneath the flower is tipped with flat, pale, orange-colored spines. Flowers stand alone on branch tips and bloom July-October. Stout taproots anchor the plant. Scotch thistle is distinguished from other invasive thistles by the very dense, white woolly covering on stems and leaves.

Scotch thistle favors habitats with high soil moisture and is often associated with waterways (swales, gullies, roadsides, and other moist sites) in the western United States. Disturbed areas and plant communities dominated by annual grasses are susceptible to invasion.

Management

Improving the desirable plant community by seeding competitive grasses or implementing grazing management practices that favor desirable vegetation may be necessary to provide long-term control of Scotch thistle. On disturbed sites, integrating the use of herbicides with reseeding is likely to decrease Scotch thistle populations more effectively than either control method used alone. Buried seed may persist for more than seven years, and re-infestation is likely without follow-up management.

HERBICIDES

Several herbicides are recommended for managing Scotch thistle on grazed rangeland and natural areas including Milestone® (aminopyralid), Opensight® (aminopyralid + metsulfuron methyl), and Transline® (clopyralid) specialty herbicides, and 2,4-D and dicamba (Banvel and others). A field study conducted in Nebraska compared the effectiveness of various herbicides applied post-emergence in the spring for Scotch thistle control. Herbicide treatments were applied in May to Scotch thistle plants at the rosette growth stage. Visual evaluations of Scotch thistle were made following application. In late May and early July, Scotch thistle control with all herbicides was excellent. By late August, Scotch thistle seedlings were emerging in some of the herbicide treated plots (Table 1).

The best time to apply herbicides is from rosette to early bolt growth stages when Scotch thistle is actively growing. Field studies conducted in California showed that Transline at 2/3 pints per acre provided 100 percent control when

TABLE 1. SCOTCH THISTLE CONTROL WITH VARIOUS HERBICIDES AT MELBETA, NE EVALUATED MAY 30, JULY 1, AND AUGUST 25 (25, 55, AND 111 DAYS AFTER APPLICATION).

Herbicide Treatment	Application Rate/Acre	Visual Percent Control		
		5/30	7/1	8/25
Milestone®	4 fl oz	97	98	99
Milestone	6 fl oz	97	96	88
Milestone	7 fl oz	97	99	99
GrazonNext® HL	1.5 pints	93	99	98
Transline®	0.5 pint	96	97	94
Dicamba+2,4-D	1.0 pint+1.0 pint	94	89	66
Non-treated	-	0	0	0
LSD 5%	-	3	9	53

SCOTCH THISTLE FACTS AND FABLES

Scotch or 'Scottish' thistle has been the national emblem of Scotland since the 15th century. One of the best-known legends surrounding the thistle takes place during a surprise invasion by Viking soldiers at Largs, a coastal town in western Scotland. After coming ashore, the Vikings planned to sneak up on Scottish Clansmen and Highlanders and overcome them while they slept. This amount of stealth required that they go barefoot - which proved to be their undoing. While creeping up on the town, one of the Vikings bare feet came down hard on a Scottish thistle and his cries of shock and pain were enough to wake the sleeping Scots. Leaping to their feet, the fiery Scots charged into battle and the rest is history!

applied at the rosette growth stage and only 65 percent control when applied at late bolt growth stage.

Optimum herbicide rates to control Scotch thistle include:

- Milestone (aminopyralid): 5 to 7 fluid ounces of product per acre (fl oz/A).
- Other premix herbicide formulations of aminopyralid include Opensight at 2.5 to 3.3 ounces/A, and GrazonNext HL at 1.5 to 2.1 pints/A. Herbicides containing aminopyralid applied to rosettes in fall will control Scotch thistle seeding germination through the following spring.
- Transline (clopyralid): 2/3 to 1 pint/A.
- 2,4-D at 2 quarts (2 lbs ai/A) does not control large bolting plants and has minimal soil activity to control Scotch thistle seedlings that germinate from seed.
- Dicamba (Banvel) at 1 pint to 1 quart per acre should be mixed with 2,4-D to improve Scotch thistle control.

MECHANICAL

Small infestations of Scotch thistle can be controlled by digging/cutting the crown of the plant a few inches below the soil surface. Cutting in late bud to flowering stage will reduce seed production, but may require repeated treatment because populations typically exhibit a wide range of developmental stages among individual plants. Plants should not be cut following seed set, as this increases chances for dispersal. Plants that are cut by hand should be bagged, removed from the site and destroyed if they are flowering.

BIOLOGICAL CONTROL

No classical biological control agents directly targeting Scotch thistle have been released in the United States. Biocontrol agents (e.g. *Rhinocyllus conicus* and *Trichosirocalus horridus*) released against other exotic thistles that also utilize *Onopordum* spp. appear to have little or no impact on Scotch thistle. Native and adventive insects and pathogens that may feed on Scotch thistle are not causing any appreciable damage. Thus, biological control is not currently an option for Scotch thistle management in the United States.

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Saint Johnswort
Biology, Impact and Management

By Celestine Duncan


STEVE DEWEY, RETIRED, UTAH STATE UNIVERSITY, BUGWOOD.ORG

Saint (St.) Johnswort (*Hypericum perforatum* L.), also known as Klamath weed or goatweed, was introduced to the United States as an ornamental and for medicinal purposes. The weed readily escapes cultivation, and has spread to infest natural areas, pastures and rangeland throughout most of the United States (Figure 1). St. Johnswort is listed as a noxious weed in eight western states (CA, CO, MT, OR, NV, SD, WA and WY) (USDA, NRCS 2016) and is on the noxious weed list for the North American Weed Free Forage Program (NAISMA 2016).

Impact

St. Johnswort contains the pigment hypericin, which causes photosensitization when ingested by grazing animals. Livestock will consume the weed when more desirable forage is scarce. Weakly pigmented parts of the grazing animal's body such as the mouth, nose, ears and udders become light sensitive. Sheep, cattle, horses and goats are susceptible, but goats are more resistant than other animals. Symptoms include blistering skin, hair loss, high body temperature, rapid pulse and respiration rates, salivation and diarrhea. Affected animals may die of dehydration or starvation because of swelling and soreness of the mouth following an episode of hypericism. St. Johnswort also forms monocultures, reducing native plant diversity and impacting wildlife habitat and livestock carrying capacity on rangeland and natural areas.

Identification

St. Johnswort is a taprooted perennial weed that reproduces from seed and lateral roots. Plants grow from one to five feet tall with numerous stems that are woody at the base. In autumn, infestations are easily visible because of the upright, rust-colored stems.

Leaves are opposite, sessile, entire, elliptic to oblong, and generally not more than one inch long. A diagnostic characteristic of St. Johnswort is the presence of tiny, transparent perforations on the leaves that are visible when the leaf is held up to a light source (Figure 2). A mature plant may produce up to 30 flowering stems annually.

Flowers are clustered in terminal cymes and each flower has five sepals and five petals (Figure 3). Petals are typically twice as long as sepals with black glands along the margins. The seed capsule bursts at maturity (Figure 4). A single plant can produce about 30,000 seeds that are easily transported by animals, wind, humans, and water. Seeds can remain dormant in soil for ten years.

Management

Early detection and treatment of newly invading plants, minimizing disturbance, and establishing desirable competitive vegetation will reduce the ability of St. Johnswort to establish and spread.

On small, isolated infestations, hand pulling or digging young plants may be effective. Repeated pulling or digging is necessary because lateral roots of older plants can give rise to new plants. Extracted plants should be removed from the area and burned to prevent vegetative regrowth and/or seed dissemination.

Mowing is ineffective as a management tool but may reduce spread of the plant if done before seeds form. Mowing may also negatively impact desirable vegetation that can compete with St. Johnswort. Burning may increase the density and vigor of St. Johnswort infestations.

HERBICIDE

Field trials conducted in Washington and Montana show that Milestone® specialty herbicide at 5 to 7 fluid ounces per acre (fl oz/A) provides excellent control (>95%) of St. Johnswort one year after treatment (Table 1). Applications should


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FIGURE 1. CURRENT DISTRIBUTION OF COMMON ST. JOHNSWORT IN THE UNITED STATES

TABLE 1. ST. JOHNSWORT CONTROL WITH VARIOUS HERBICIDES ONE YEAR AFTER TREATMENT (YAT) WITH SPRING APPLICATIONS IN THE WESTERN UNITED STATES.

Herbicide	Rate (product/A)	% control 1 YAT
Milestone® specialty herbicide	5 -7 fluid ounces	97 to 99
Milestone + metsulfuron	5 fluid ounces + 1 ounce	99
GrazonNext® HL herbicide	1.5 pints	98
2,4-D	1 qt	15


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FIGURE 2. ST. JOHNSWORT LEAVES WITH TRANSPARENT PERFORATIONS.


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FIGURE 3. FLOWERS ARE CLUSTERED IN TERMINAL CYMES AND EACH FLOWER HAS FIVE SEPALS AND FIVE PETALS. PETALS ARE TYPICALLY TWICE AS LONG AS SEPALS WITH BLACK GLANDS ALONG THE MARGINS.


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FIGURE 4. THE SEED CAPSULE BURSTS AT MATURITY. A SINGLE PLANT CAN PRODUCE ABOUT 30,000 SEEDS THAT ARE EASILY TRANSPORTED BY ANIMALS, WIND, HUMANS, AND WATER. SEEDS CAN REMAIN DORMANT IN SOIL FOR TEN YEARS.

be made when the weed is actively growing in late spring, early summer, and in fall when basal regrowth occurs. Opensight® specialty herbicide at 2.5 to 3.3 ounces of product per acre provides similar control as Milestone. In Washington, late fall (November) application of Milestone at either 5 or 7 fl oz/A provided greater than 95 percent control 27 months following treatment (Figure 5). Neither metsulfuron (Escort) at 1 ounce of product per acre, nor 2,4-D provide acceptable control of St. Johnswort.

Control of large infestations should integrate herbicide application with biological control agents. Herbicides can be used on the perimeter of large infestations and on satellite patches, and biocontrol agents can be used in the core of the infestation. Efforts should be focused on management techniques that stop seed production and maintain a healthy plant community that reduces establishment of St. Johnswort.

BIOLOGICAL CONTROL

The flea beetle *Chrysolina quadrigemina* was introduced into California in 1945 to control St. Johnswort. The insect effectively reduced St. Johnswort to about one percent of its former acreage in that state. The flea beetle and three additional agents are currently impacting St. Johnswort: *Chrysolina hyperici*, a foliage feeding beetle; *Aplocera plagiata*, a foliage and flower feeding moth; *Agrilus hyperici*, a root-boring beetle. *Chrysolina hyperici* is better suited for wet sites than *C. quadrigemina*. The success and population stability of biological control agents depends on the fluctuations of St. Johnswort populations and site conditions including cold temperature.

Medicinal Properties

St. Johnswort has been promoted as a natural anti-depression compound and is sometimes used to treat other conditions that accompany depression such as anxiety, tiredness, loss of appetite and trouble sleeping. In some areas of the country, the plant is cultivated and harvested for use in multiple health products. St. Johnswort extracts can cause serious sensitivity to sunlight in humans. Products containing the plant will describe warnings to stay out of direct sunlight, and extracts may also have negative interaction with other drugs.


VANELLE PETERSON, DOW AGROSCIENCES

FIGURE 5. ST. JOHNSWORT CONTROL WITH MILESTONE® SPECIALTY HERBICIDE AT 7 FLUID OUNCES PER ACRE 27 MONTHS AFTER TREATMENT NOTE THE NONTREATED BUFFERS OF UNCONTROLLED ST. JOHNSWORT (FALL = BROWN STEMS).

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