Western Range & Wildlands Edition
FALL 2014

TechLine
INVASIVE PLANT NEWS

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

Protecting the Upper Ruby Watershed from Invasive Plants: A Gem of Collaboration and Cooperation Page 12

BECKY KINGDON, MONTANA WEED CONTROL ASSOC.

BRIEFS


CELESTINE DUNCAN

Montana Weed Fighter Inducted into Cowboy Hall of Fame

Charlie Hahnkamp, lifelong rancher from Dillon, Montana, was recently inducted into the Montana Cowboy Hall of Fame. Hahnkamp has been involved in rodeo, ranching, and killing weeds for more than 70 years.

"They say your destiny chooses you at times … so when you're 10 years old and trailing cows from Broadus, Montana to Bell Fourche, South Dakota it's safe to say you're going to be a cowboy. And Charlie has been a real top hand ever since," writes the Hall of Fame.

Not only is he a first rate cowboy, but Charlie has also been a top hand at controlling weeds in Montana. He was instrumental in organizing and leading the Headwaters Resource Conservation and Development Range Weed Committee during the 1980s. Charlie continues to be a strong supporter of weed management, lobbying for stronger weed legislation in Montana and Washington D.C., and still finds time to control weeds on his own property and neighboring ranches. Affectionately known as Charlie 'Knapkamp' for his relentless quest to control spotted knapweed, he even plotted public education stunts at rodeo events arranging for the rodeo queen to fly a knapweed flag during the opening ceremony.

Congratulations on your recent award Charlie, and thanks for your long-term commitment to weed control in Montana and the West!

New training video highlights prevention BMPs

A supplement to the California Invasive Plant Council's prevention Best Management Practices (BMP) manuals for land, transportation, and utility managers (2013) is available. This 42-minute training video covers the basics of cleaning, disturbance, planning and awareness. The video can be used in training settings to start a discussion about weed prevention practices in your organization.

Learn more at: http://bit.ly/dvdpreventionbmp

10th Edition Herbicide Handbook Now Available

The 10th edition of the Weed Science Society of America Herbicide Handbook is completely revised and updated in a new easy-to-use alphabetical format. It contains detailed information on more than 230 herbicides currently in commercial production and includes a handy reference glossary of technical terms and listings of adjuvants. It is a perfect resource for teachers, students, researchers, industry representatives, government officials, and weed control specialists.

Purchase the book at: http://bit.ly/wssahandbook10

Invasives: Plants on the Move Curriculum

This curriculum from the Oregon Natural Resources Education Program (Corvallis) is designed for teachers who want to integrate the topic of invasive weeds in the classroom, develop weed awareness, and provide students in grades K-12 with an understanding of the serious problem of invasive weeds.

Explore the site at: http://weedinvasion.org

READER'S CORNER

READERS Ask Questions AND Suggest Solutions

Is there a list of Milestone®-tolerant grass species available?

"In your TechLine Article dated February 01, 2012 Technical Facts and Answers to Frequently Asked Questions About Milestone Herbicide question 'Will Milestone Herbicide Harm Grasses?' it reads that there was research conducted on 33 grass species that showed tolerance to this herbicide. Can I get a list of these grass species?"

-- CHRIS OVERBAUGH, NATIONAL PARK SERVICE

Information from Dow AgroSciences on grass tolerance to Milestone herbicide is available at: http://bit.ly/milestonegrasslist1

Readers Review the ATV/UTV Herbicide Sprayer Platform Equipment

http://bit.ly/atvutvreview

Readers Recommend Apps for Mapping, Monitoring, and More

http://bit.ly/readerapps1

DID YOU KNOW?

We use email to send exclusive on-line articles on invasive plant management to readers? To avoid missing out on timely control recommendations and management tips SUBSCRIBE TO THE TECHLINE EMAIL LIST. You can expect to receive about one email per month. We will not share your email address. Use this link to update your subscription to include email delivery:
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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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PHOTOS BY BRYAN DAYTON, PMG ENVIRONMENTAL

THE "SMART" SPRAY WAND records GPS location, herbicide flow, application time and other desired data. It can simplify invasive weed management and has provided the necessary data capture for the development of a weed treatment cost model.

"Smart" Spray Wand and Weed Treatment Time Prediction Model

TWO NEW WEED CONTROL TOOLS FOR WILD LAND MANAGERS

By Bryan Dayton [PMG Environmental], Ralph Whitesides [Utah State University] and Scott Pratt [PMG Environmental]

"SMART" SPRAY WAND

Millions of dollars are spent managing invasive weeds on public and private lands each year. Although new weed management tools and technology have advanced for precision agriculture, those for wild land (grazing land or natural areas) have lagged. In 2013, Jardyne Technologies developed the "Smart" spray wand, a precision tool for treating invasive plants on wild land sites.

The "Smart" spray wand technology has a GIS[1]/computer/flow meter and a quick connect for use with any type of spray system including back pack, ATV/UTV, or truck reel. The wand records the GPS[2] location, herbicide flow, application time, and associated data of each treatment spray point. Addition of the "Smart" wand technology adds only 6.5 ounces of weight to a traditional spray wand.

This new technology can simplify invasive weed management by:

- Saving inventory time and money
- Increasing ecological, treatment, and funding accountability
- Justifying funding requests
- Streamlining data flow for cooperative management
- Increasing information for planning and management
- Expanding research possibilities in wildland weed control

TREATMENT TIME MODEL DEVELOPED TO SUPPORT WEED MANAGEMENT PLANNING

Wild land invasive weed treatment bids are based primarily on acreage or hours but can be influenced by variables that increase treatment time and cost. Often neither the land manager contracting the treatment nor the contractor has a clear idea of the amount of time that will be involved in a weed control project. This makes it difficult to develop an accurate budget or bid for invasive weed control projects.

The "Smart" spray wand's ability to collect valuable application information led to a partnership between the Department of Plants, Soils, and Climate at Utah State University, Providia Management Group (PMG) and Jardyne Technologies. The purpose of the partnership was to determine if a treatment cost model could: 1) establish an accurate standard for contractors and land managers, 2) assist in planning and managing limited treatment resources, and 3) justify funding requests and expenditures.

A study was designed to collect and evaluate invasive weed treatment data over multiple locations, weed species, and terrains to develop a treatment time calculation model.

[1] Geographic Information System (GIS); [2] Global Positioning System (GPS)

The model is based on four primary variables: 1) weed density, 2) slope, 3) land cover, and 4) weed visibility. Other variables were also evaluated in the model development.

In 2013, PMG's backpack crews treated invasive weeds on hundreds of acres in Utah and Idaho. Using "Smart" spray wands and backpack equipment, PMG gathered millions of data points including a GPS point each time a weed was sprayed. Each data point included the GPS location, herbicide flow, and application time. Slope, treatment time per area, and weed density were determined to create the model.

Field data were used to develop a treatment time model based on weed density and other variables (slope, land cover, and weed visibility). See examples in the table and figure below. The complete model and findings from the field data are scheduled to be published spring of 2015.

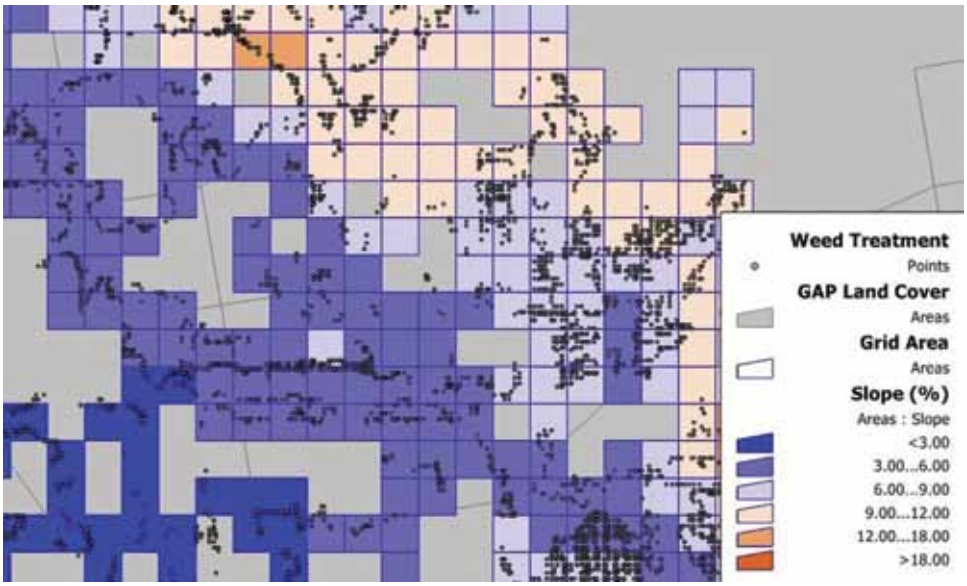
For additional information regarding the treatment time model and the Jardyne "Smart" spray wand go to Jardyne.com. (Website will be available soon).

TREATMENT TIME MODELS IN RESPONSE TO WEED DENSITY. Calculation examples include the average and minimum treatment times (hours) at various weed densities. For example: if weed density is 5% of the area to be treated, the average treatment time in hours per acre can be calculated using the formula y=2.7 (0.05 [density]) + 0.36; where 2.7 and 0.36 are standards. To calculate the minimum treatment time per acre with ideal land cover, slope and weed visibility use the equation listed under minimum treatment time. Treatment times shown below do not include the response to other variables including slope, land cover and weed visibility.

Treatment Time Calculations per Acre Due to Density

	Average Treatment Time (y=hours)	Minimum Treatment Time (y=hours)
Density (x) %	y=2.7(x)+0.36	y=1.6(x)+0.02
1	0.39	0.04
5	0.50	0.10
25	1.04	0.42
50	1.71	0.82
75	2.39	1.22
95	2.93	1.54

GPS DATA POINTS were obtained using a Jardyne "Smart" spray wand. The slope of invasive weed treatment area was obtained from the U.S. Geological Survey.




CELESTINE DUNCAN

Fall is an excellent time to control invasive weeds

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

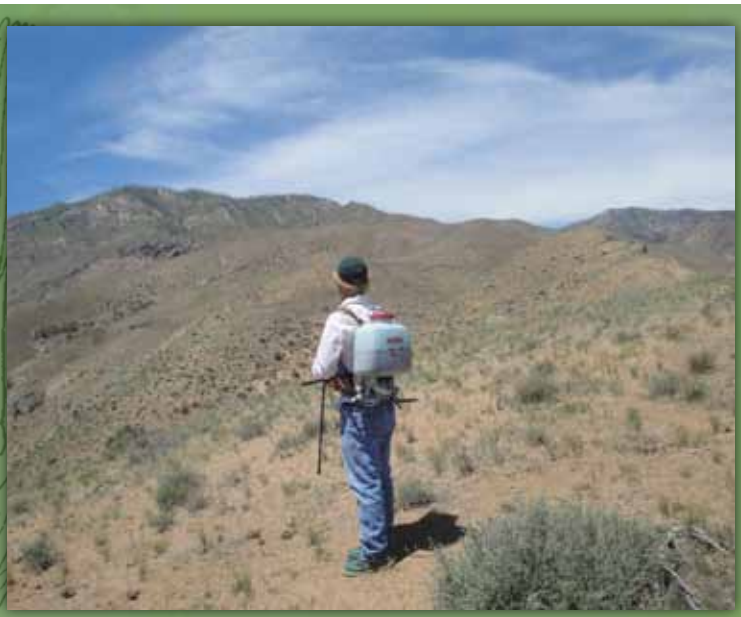
YELLOW STARTHISTLE
http://bit.ly/yellowstarthistle

RUSH SKELETONWEED
see page 5

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*).

Rush Skeletonweed Management:
CHALLENGES AND SOLUTIONS



JEREMEY VARLEY, LEMHI COUNTY WEED DISTRICT

LINE DRAWING COURTESY OF KENTUCKY NATIVE PLANT SOCIETY, USDA PLANTS DATABASE

RUSH SKELETONWEED is often widely dispersed on steep terrain that is difficult to access.

By Celestine Duncan

RUSH SKELETONWEED (*Chondrilla juncea* L.) IS A DEEP ROOTED, PERENNIAL FORB INFESTING MORE THAN 6.2 MILLION ACRES MAINLY IN THE WESTERN UNITED STATES. The weed is listed as "noxious" in nine states (Figure), with dense, widespread infestations on about 3 million acres in Idaho alone.

In spite of aggressive containment and control efforts, landscape-scale spread of rush skeletonweed continues, and the rate of invasion is escalating in eastern Idaho, southwestern Montana, western Wyoming, and northern Utah.

"Rush skeletonweed is one of the most wide-spread noxious weeds in Idaho," explains Tim Prather, weed scientist at University of Idaho. "The plant infests canyon grassland and sage steppe, which provide critical winter range for mule deer and elk. During winter months, rush skeletonweed has minimal feed value, and both wildlife and livestock are challenged to find enough forage on severely infested areas."

Rangeland and natural areas, especially those disturbed by fire, logging, road construction or over-grazing, are susceptible to invasion. Rush skeletonweed can also encroach into cropland. "Once the weed forms dense infestations the ecological progression to desirable perennial grassland seems to be stopped," says Prather.

FIGURE. DISTRIBUTION AND STATUS OF RUSH SKELETONWEED in the United States. Green states indicate presence of rush skeletonweed (http://www.eddmaps.org/) and red dots indicate status as state-listed noxious weed.

SPREAD

Rush skeletonweed is capable of reproducing by seed or lateral roots. Flowers are self-fertile, and a mature plant can produce up to 20,000 seeds. A pappus (tuft of hair on top of the seed) facilitates wind dispersal over long distances. Seeds can also attach to animals, vehicles and other vectors. Germination occurs in fall or spring based primarily on moisture conditions, with few seed remaining viable for more than a year in soil. Rush skeletonweed has a taproot that can reach depths of 7.5 feet, enabling it to thrive under a variety of climatic conditions. Root segments as small as one inch are capable of producing a new plant.

MANAGEMENT

Prevention, early detection and control are important components of an integrated management program on rush skeletonweed. Kim Goodwin with Montana State University coordinates a regional project to safeguard western Montana against rush skeletonweed invasion. "The weed is characterized by landscape-scale spread," she explains, "So we are piloting a regional approach with county-level safeguarding, risk reduction, and control plans in southwestern Montana."

Jeremey Varley, Lemhi County Weed Superintendent in Salmon, Idaho is one cooperator in the regional effort. "The county has been controlling rush skeletonweed since 1999, but wind driven seed complicates our management program," explains Varley. The weed is often widely dispersed on steep terrain that is difficult to access.

Control efforts include monitoring, early detection and treatment of newly

STEVE DEWEY AND UTAH STATE UNIVERSITY ARCHIVES, BUGWOOD.ORG

IDENTIFICATION. Rush skeletonweed plants are typically 1.5 to 3 feet tall with multiple spreading, nearly leafless, light-green stems characterized by stiff, downward pointing hairs located on the lowermost 2 to 3 inches of the plant. Rosettes form from taproot, lateral roots or seeds, and resemble common dandelion. The plant has milky sap and small yellow flowers.

invading plants. "We try to inventory infested areas and spot-treat plants each year," explains Varley. "Our preferred herbicide application is Milestone® at 7 fluid ounces per acre (fl oz/A) either alone or mixed with 2,4-D[1] at 16 fl oz/A. We get good rush skeletonweed control, and treated areas don't have a flush of cheatgrass (*Bromus tectorum*) the year following Milestone or Milestone plus 2,4-D."

Tordon® 22K at 32 fl oz/A is applied on Bureau of Land Management land since Milestone has not yet been approved for use by the agency. Milestone is more selective on desirable broadleaf plants than Tordon 22K. Tolerance of tree and shrubs to herbicide treatments can be found on the product label or within the *Invasive Plant Management Guide for Natural Area Managers* (http://bit.ly/milestoneguide).

Brad Gamett, Weed Superintendent for Butte County, Idaho agrees that either Milestone® or Tordon 22K provide good control. "Most of our herbicide applications on rush skeletonweed are spot treatments to small infestations or individual plants, rather than broadcast applications over large areas. The problem is that we tend to get seedling germination or miss rosettes in non-treated areas with spot applications, so we continually have to monitor sites." A broadcast application around established plants rather than just a spot treatment to individual plants is recommended to control seedlings.

Both Gamett and Varley often wait until grass cures since rush skeletonweed will remain green later in the summer, making plants easier to locate. "Earlier in the season (May) or late fall would be a more optimal time to apply herbicide, but we miss too many rush skeletonweed plants because they are difficult to see," explains Gamett.

Research trials conducted in Washington support results reported by on-ground managers. Studies show that either fall or spring applied herbicides provide good control of rush skeletonweed for a year or more following treatment (see Table). Although Tordon 22K at 32 fl oz/A was more consistent across sites, Milestone at either 5 or 7 fl oz/A provides more

1 2,4-D rate is based on products containing 4 pounds of active ingredients per gallon.

RUSH SKELETONWEED MANAGEMENT CHALLENGES*

RAPID AND DISTANT SPREAD. Long distance dispersal by wind, high annual seed production, long period of seed production, and high seed survival rate contribute to spread.

COMPLEX SPREAD PATTERNS. Wind-dispersed plants have diverse patterns of spread to distant sites that are often difficult to access.

MONITORING CHALLENGES. Distant and complex spread makes early detection difficult, as vast expanses of wildland must be monitored regularly for new populations.

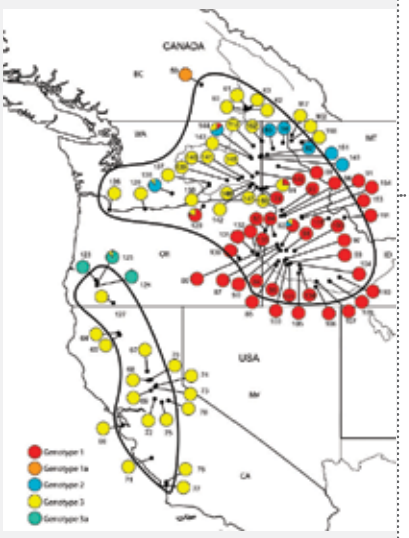
LOW DETECTABILITY. Plants lack leaves and showy, distinct flowers allowing the plant to blend in with surrounding vegetation and making detection and eradication difficult.

HERBICIDE LIMITATIONS. Complete control of the extensive root system is difficult on older, well-established populations. Spot-treatment programs often miss small rosettes and newly germinated seedlings, so continued monitoring and follow-up treatment are required.

WIDE ECOLOGICAL AMPLITUDE. The weed tolerates a variety of climatic and soil conditions allowing for invasion of diverse ecosystems. Although it grows well on disturbed sites, plants also establish on undisturbed open forest habitat types and native shrublands.

**adapted from Goodwin.*

RUSH SKELETONWEED GENOTYPES



John Gaskin and others conducted molecular studies on rush skeletonweed to determine origin and distribution of invasive genotypes. Results showed that 682 unique genotypes were present in the native range for rush skeletonweed (Spain to Uzbekistan), but only seven were present in North America, with two of these being genetically distinct from previously identified genotypes. Two new genotypes have been identified in the eastern United States. Results from these studies will support efforts to develop viable biological control agents on rush skeletonweed.

VIEW MAPS ONLINE
http://bit.ly/rswgenotypemaps

Full Paper Citation:
Gaskin JF, Schwarzlander M, Kinter L, Smith JF, Novak SJ. 2013. Propagule pressure, genetic structure, and geographic origins of *Chondrilla juncea* (Asteraceae): An apomictic invader on three continents. *American Journal of Botany* 100(9): 1871–1882. 2013.

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TABLE. RUSH SKELETONWEED CONTROL about one and two years after fall-applied herbicides (YAT) at two locations in Washington (Gaiser, Cook, and Yenish, unpublished data).

Herbicide	Rate	Percent Control			
	(fl oz/A)	PALOUSE FALLS		LACROSSE	
		1 YAT	2 YAT	1 YAT	2 YAT
Milestone®	5	85	80	92	40
Milestone	7	99	90	96	40
Tordon® 22K	32	99	99	97	90
Transline®	16	-	-	80	15
Non-treated	-	0	0	0	0

selective control with less injury to desirable grasses and forbs.

The level and duration of control achieved from herbicides on rush skeletonweed is dependent in part on presence of biological control agents, skeletonweed biotype, and percent cover of competitive perennial grasses. Prather reported that 18 percent perennial grass cover is the threshold needed to keep rush skeletonweed from dominating a site. Once perennial grass cover drops below 18 percent, the duration and level of rush skeletonweed control achieved with herbicides declines.

OTHER MANAGEMENT OPTIONS

Targeted grazing to suppress rush skeletonweed can be effective; however, cost and other challenges such as managing livestock distribution, increased labor needs, and fencing may limit this approach (Goodwin, personal communication).

Establishing effective biological control agents is a top priority to reduce rush skeletonweed vigor, seed production, and establishment success. Three biocontrol agents of rush skeletonweed are established in the western United States including the rust fungus (*Puccinia chondrillina*), gall mite (*Aceria chondrillae*), and gall midge (*Cystiphora schmidti*). Although these agents are well established, their success has been limited in reducing either rush skeletonweed populations or spread. The root moth (*Bradyrrhoa gilveolella*) is established on a limited number of sites in the West and control efficacy of this agent is unknown.

There are on-going studies to determine suitability of additional biological control agents, such as the root crown moth (*Oporopsamma wertheimsteini*), for control of rush skeletonweed, and recent genetic studies will help support collection, screening, and distribution of agents better adapted to rush skeletonweed genotypes established in the United States.

Integrating various management techniques including prevention, judicious monitoring, biological, cultural (reseeding), and herbicides is critical for managing rush skeletonweed. Maintaining desirable perennial grass, minimizing disturbance, and establishing desirable competitive vegetation on disturbed or degraded sites will help reduce susceptibility of a landscape to rush skeletonweed invasion.

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Effect of Milestone® Herbicide on Medusahead Rye

STEVE DEWEY, UTAH STATE UNIV., BUGWOOD.ORG

Note: Results summarized in this article are based on field research and demonstration sites conducted by Matthew J. Rinella, Guy B. Kyser, Susan E. Bellows, Vanelle F. Peterson, Aaron D. Roth, J. S. Davy, and Joseph M. DiTomaso.

INVASIVE ANNUAL GRASSES, SUCH AS MEDUSAHEAD RYE (*Taeniatherum caput-medusae*) AND DOWNY BROME (*Bromus tectorum* L.), IMPACT MILLIONS OF ACRES OF RANGELAND IN THE WESTERN UNITED STATES. These grasses can reduce native species richness and abundance, decrease livestock carrying capacity, alter nutrient cycling and shorten wildfire return intervals. Historical management of medusahead has concentrated on timed grazing with livestock, burning, mechanical removal of thatch, and use of herbicides.

One of the challenges with using herbicides as a management tool is achieving selective control of the invasive annual grass without causing significant injury to taxonomically similar desirable grasses or other desirable vegetation. Over the past several years, researchers and managers observed that Milestone® herbicide applied for broadleaf weed control also impacts medusahead and downy brome plants. Field and greenhouse research have recently been conducted to measure the effectiveness of Milestone at controlling medusahead. Results of these studies are discussed in this article.

FIELD STUDIES

Kyser GB, VF Peterson, JS Davy, JM DiTomaso. 2012. Preemergent Control of Medusahead on California Annual Rangelands with Aminopyralid. *Rangeland Ecology & Management:* Vol. 65, No. 4, pp. 418-425.

Scientists at University of California at Davis established replicated field research trials at three medusahead-infested sites in northern California. Herbicide treatments included Milestone at 3, 5, 7, and 14 fluid ounces per acre (fl oz/A), Matrix at 1 and 2 ounces product per acre (oz/A), and Plateau at 8 fl oz/A. Applications were made prior to medusahead germination in September and October 2009. Visual cover estimates, biomass, and seedhead samples were collected from treated and non-treated control plots in May 2010.

Results from the three field experiments indicate that medusahead reduction was greatest with Milestone at 14 fl oz/A (Figure 1). There was a significant release of desirable annual grasses including Italian ryegrass (*Lolium multiflorum*), soft chess (*Bromus hordeaceus*) and meadow barley (*Hordeum brachyantherum*) with Milestone at 7 fl oz/A (Figure 2). The increase in desirable annual grass production was significantly greater with Milestone® treatments compared to Matrix or Plateau, and this finding is consistent with findings from other research trials and demonstration sites where these grasses have been present in the understory.

GREENHOUSE TRIALS:

New Research on Annual Grass Seed Viability

Rinella MJ, SE Bellows, AD Roth. 2014. Aminopyralid Constrains Seed Production of the Invasive Annual Grasses Medusahead and Ventenata. *Rangeland Ecology and Management.* 67:406-411.

The purpose of this greenhouse study by Rinella and others was to explore effects of growth regulator herbicides on medusahead seed production. Milestone at 4 and 7 fl oz/A was one of the herbicides applied to greenhouse-grown medusahead plants at the seedling, internode elongation and heading growth stage. A no-herbicide control was included for comparison. Seed heads were clipped from the plants when ripe and stored for four months prior to germination testing. Germinable seeds present in each pot were calculated to determine the effect of the two growth regulator herbicides on seed germination.

Results indicate that Milestone treatments reduced medusahead seed production more than 90 percent across all timings, and 96 to 100 percent when applied at the internode and heading stages (Figure 3). These results contribute to a growing body of evidence suggesting it may be possible to use growth regulator herbicides to control invasive annual grasses by depleting their short-lived seedbanks.

CONCLUSIONS

Invasive forbs such as yellow starthistle (*Centaurea solstitialis*) and other knapweeds (*Centaurea* sp. and *Acroptilon repens*) commonly grow in association with invasive annual grasses on degraded range sites. It may be possible to reduce medusahead dominance on infested sites by applying Milestone at 7 to 14 fl oz/A pre-emergence or at growth stages when broadleaf weeds and medusahead are both susceptible to Milestone.

Growth regulator herbicides pose less risk to established perennial grass plants than grass-specific herbicides. Perennial grass populations have been shown to increase when growth regulators are used to control broadleaf weeds. Combined results from field and greenhouse studies suggest a wide range of Milestone® application timings (i.e., pre-emergence, late seedling, internode, heading) may be effective in reducing or eliminating medusahead seed production.

FIGURE 1. PERFORMANCE OF MILESTONE® HERBICIDE at 3, 5, 7 and 14 fl oz/A compared to Matrix at 1 or 2 oz/A or Plateau at 8 oz/A in replicated trials. Data show medusahead cover at 8 months after treatment. (Kyser et al. 2012)

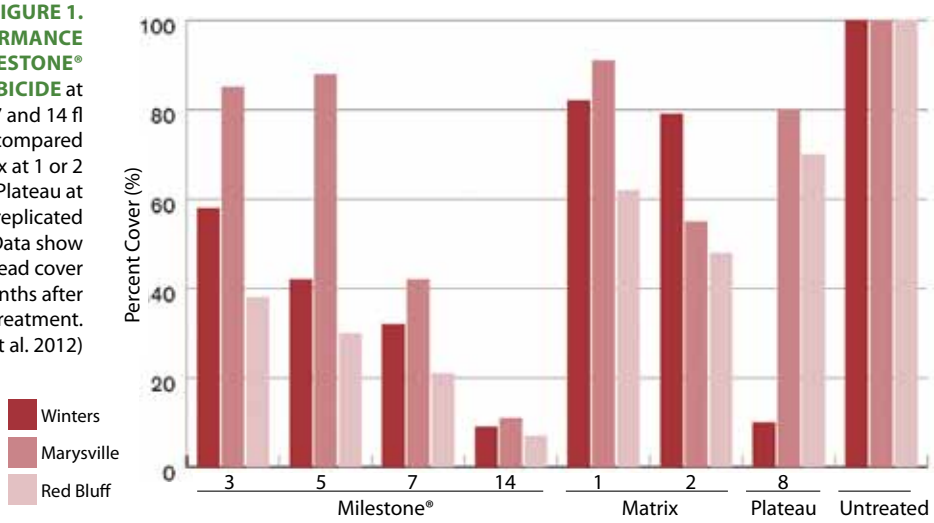


FIGURE 2. DESIRABLE ANNUAL GRASS COVER taken 8 months after the fall 2009 medusahead applications from the Sierra Foothills Research Station and Red Bluff sites. (Kyser et al. 2012)

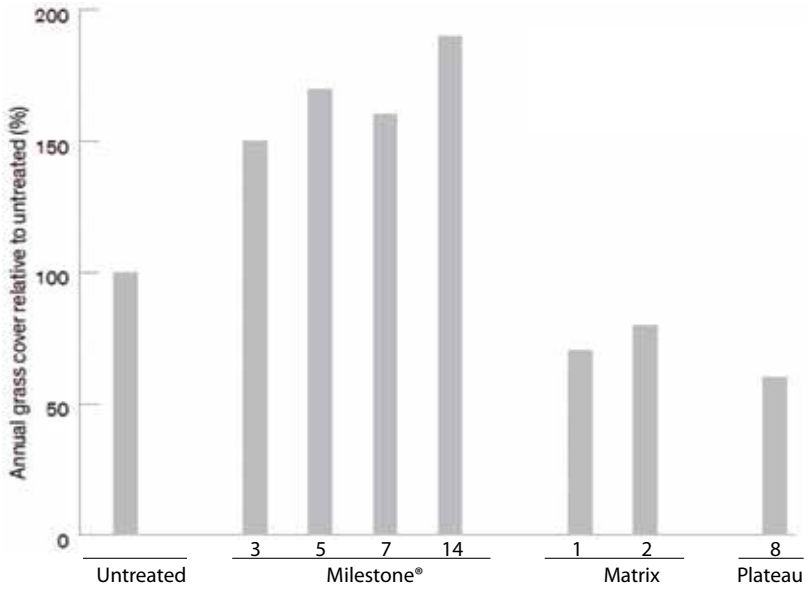
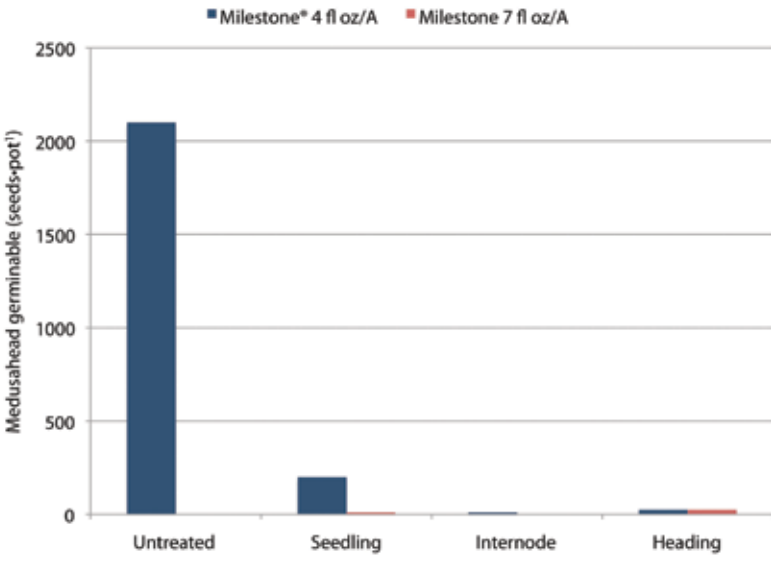


FIGURE 3. EFFECTS OF MILESTONE® HERBICIDE ON MEDUSAHEAD SEED VIABILITY following application to medusahead plants at seedling, internode and heading growth stages. (Rinella et al. 2014)



USE RATES AND TIMING FOR CONTROL OR SUPPRESSION OF WINTER ANNUAL GRASSES

Milestone® applied broadcast at 7 to 14 fluid ounces per acre (fl oz/A) can suppress or control many winter annual grasses including medusahead rye (*Taeniatherum caput-medusae*) and downy brome (*Bromus tectorum*). The key to optimum results is application timing. Applications should be made in late summer prior to rains and seed germination in order to provide the best possibility of suppression or control.

MAXIMUM APPLICATION RATE

Do not broadcast apply more than 7 fl oz/A of Milestone per year. The total amount of Milestone applied broadcast, as a re-treatment, and/or spot treatment cannot exceed 7 fl oz/A per year. Spot treatments may be applied at an equivalent broadcast rate of up to 0.22 pounds acid equivalent (14 fl oz) of Milestone per acre per annual growing season; however, not more than 50 percent of an acre may be treated at that rate. Do not apply more than a total of 0.11 pounds acid equivalent (7 fl oz) of Milestone per acre per annual growing season as a result of broadcast, spot or repeat applications.

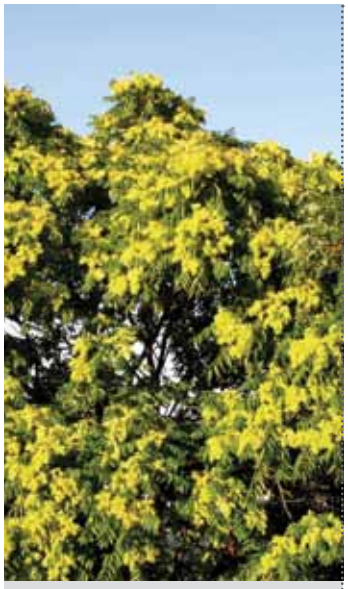
MEDUSAHEAD CONTROL WITH MILESTONE® HERBICIDE

http://techlinenews.com/s/medusahead-white-paper.pdf

TREE OF HEAVEN: A Devil in Disguise

By Celestine Duncan

Tree-of-heaven (*Ailanthus altissima*), also called stinking sumac or Chinese sumac is naturalized throughout much of the United States. The introduced tree is adapted to a wide variety of ecological sites ranging from urban areas, saline soils, surface-mined lands and natural areas. High seed production (325,000 seeds per female tree) and viability, and vegetative sprouting from the roots increase this plant's invasiveness.



JAN SAMANEK, STATE PHYTOSANITARY ADMINISTRATION, BUGWOOD.ORG

TREE OF HEAVEN IN BLOOM. Male and female flowers occur on separate plants.

INTERESTING FACTS ABOUT TREE-OF-HEAVEN

- Clonal stems can grow 100 feet from parent tree.
- Dense thickets exclude other species.
- Roots are shallow and extensive, surviving extended periods of drought.
- Clones attached to parent trees can persist in low light conditions for at least 20 years.

USDA PLANTS DATABASE 2014 HTTP://PLANTS.USDA.GOV

OCCURRENCE IN THE UNITED STATES AND CANADA. Tree of heaven is naturalized throughout much of the United States

MANAGEMENT OPTIONS*

**For a full discussion of management options, go to:* http://bit.ly/tree-of-heaven

HERBICIDE

FOLIAR APPLICATION

Foliar application with Garlon®3A, Garlon 4 Ultra, Capstone®, or glyphosate (Accord®XRT, and others) will provide good control where tree-of-heaven size and distribution allow for effective foliar coverage. Capstone, Garlon 3A and Garlon 4 Ultra are selective for broadleaf and woody plants and will not kill desirable grasses contacted by the spray. Glyphosate is non-selective and will kill or cause injury to herbaceous or woody plants contacted by over-spray during the foliar canopy application. Apply Capstone, Garlon 3A at a 2% solution and Garlon® 4 Ultra at a 1.5% solution from June through early September. Glyphosate can be applied at a 2% solution.

CUT STUMP APPLICATIONS

Research trials conducted at University of California at Davis, looked at effectiveness of glyphosate, Garlon 4 Ultra, and imazapyr applied as cut stump or basal bark applications on tree-of-heaven control compared to mechanical cutting only (DiTomaso and Kyser 2007). Results showed that manual cutting alone did not provide tree-of-heaven control. Garlon 4 Ultra (20% v/v in oil) applied as a cut-stump application resulted in more than 90% reduction in both vigor ratings and re-sprouting of single stems and stem-clusters and provided similar control to imazapyr, but significantly better control than glyphosate (Table 1). Although control was excellent in research trials, some invasive plant managers have reported significant re-sprouting following cut stump herbicide treatment (Law and Evans, personal communication).

BASAL BARK APPLICATION

This treatment method is generally used for trees that are less than six inches in diameter and is preferred by many operational field managers. In the California study, basal bark applications with Garlon 4 Ultra and imazapyr provided excellent tree-of-heaven control (Table 2). Researchers concluded that although both Garlon 4 Ultra and imazapyr provided similar control results, imazapyr is a broad-spectrum herbicide and applications often result in a "dead vegetation zone" around the treated trunk. Garlon® 4 Ultra is a selective herbicide and less phytotoxic to non-target desirable vegetation. Based on research results and field observations, the optimum application timing for basal bark and cut stump treatments is a late summer or fall application timing.

STEM INJECTION [HACK AND SQUIRT] APPLICATION

The stem injection technique can provide effective control of individual tree-of-heaven stems or stem-clusters. Recommended herbicides include undiluted Garlon 3A, Garlon 4 Ultra, imazapyr or glyphosate injected

TABLE 1. PERCENT TREE-OF-HEAVEN WITH SPROUTS two years following CUT STUMP treatments. (DiTomaso and Kyser 2007)

Within each treatment group, values followed by different letters are different at 0.05 level (analysis of variance, Student-Newman-Keuls test).

Herbicide	Rate	% reduction in tree canopy (2 years after treatment)
Triclopyr (Garlon® 4 Ultra)	20% (mixed with oil)	6.7 c
Imazapyr	20% (mixed with oil)	9.8 c
Glyphosate	50% (mixed with water)	40.8 b
Cut; Non-treated		85.7 a

PLANT DETAILS.
Foliage and flowers, left.
Flower detail, top-right.
Seed pods, bottom-right.

LESLIE J MEHRHOFF, UNIV OF CONNECTICUT, BUGWOOD.ORG

JAN SAMANEK, STATE PHYTOSANITARY ADMIN., BUGWOOD.ORG

ANNEMARIE SMITH, ODNR DIV OF FORESTRY, BUGWOOD.ORG

into cuts. Stem cuts should be spaced so that a minimum of 1 to 2 inches of uncut living tissue remains between each cut. Overall, reports from invasive plant managers indicate basal bark treatments provide more effective control than stem injection methods.

KEY POINTS

- Tree size and site conditions dictate the management method selected for tree-of-heaven control.
- An advantage of using stem injection, basal bark, or cut stump application methods, rather than foliar treatment, is the low risk of off-site movement through spray drift.
- A cut stump technique would be most appropriate with very large trees or stem-clusters having well-developed bark. The bark of these plants would be difficult to penetrate with the stem injection method and would not likely absorb herbicide using a basal bark treatment.
- Late summer or fall herbicide application timing for basal bark and cut stump treatments is more effective at reducing sprouting compared to applications made in late spring and summer.
- Early fall herbicide applications followed by periodic evaluations the following spring with follow-up retreatment of sprouts was reported to provide the best long-term control of an infestation.
- Manual removal can be effective on small, newly established populations but all root fragments must be removed to be effective.
- Mechanical cutting or burning without herbicide application will not control tree-of-heaven and may increase density.

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METHOLOGY

CUT STUMP

Cut the stem about six inches above ground level. Apply the herbicide to the sides of the stump, including the root collar area, and outer portion of the cut surface until thoroughly wet but not to the point of runoff. Apply herbicide as soon as possible after cutting, but no later than one hour after cutting. Do not use this method if there is heavy sap flow or if snow covers the cut surface.

BASAL BARK

Apply herbicide in a band around the entire stem. Applications should be made from the base of the woody stem to a height of 12 to 15 inches above the groundline. Ideal for stems less than six inches in diameter. Do not use this method if there is heavy sap flow or if snow or vegetation block the target area.

STEM INJECTION [HACK AND SQUIRT]

Using a hand axe, make cuts every 3 to 4 inches around the trunk at 6 to 18 inches above the ground. Cuts should be at the same level around the trunk, and herbicide applied uniformly to cover the cut area. Do not use this method if there is heavy sap flow.

Herbicide	Rate	Tree diameter at application	% of trees with sprouts (2 years after treatment)
Triclopyr (Garlon® 4 Ultra)	20% (mixed with oil)	<1.6 inches	86.7a
Triclopyr (Garlon 4 Ultra)	20% (mixed with oil)	>1.6 inches	100.0a
Imazapyr	20% (mixed with oil)	<1.6 inches	100.0a
Imazapyr	20% (mixed with oil)	>1.6 inches	100.0a
Non-cut control			27.1b

TABLE 2. PERCENT REDUCTION IN TREE-OF-HEAVEN CANOPY two years following BASAL BARK applications. (DiTomaso and Kyser 2007)

Within each treatment group, values followed by different letters are different at 0.05% level (analysis of variance, Student-Newman-Keuls test).

BECKY KINGTON, MONTANA WEED CONTROL ASSOCIATION.

Protecting the Upper Ruby Watershed from Invasive Plants

A Gem of Collaboration and Cooperation

GRAVELLY RANGE looking toward the Ruby River.

THE RUBY RIVER IN SOUTHWESTERN MONTANA IS NESTELED BETWEEN THE SNOWCREST AND GRAVELLY MOUNTAIN RANGES OF MADISON COUNTY. The river flows northward about 76 miles, sculpting a wide valley before joining the Beaverhead River. Ranching, farming and recreation in the Ruby Valley are cornerstones of the economy of Madison County. With over 2.3 million acres of land and less than 7,600 residents in the county, protecting natural resources from invasive plants is vital to preserving the rural lifestyle and ranching heritage of Ruby Valley landowners.

No one understands that better than Rick Sandru, a third-generation Montana rancher and president of the Ruby Valley Stock Association. "Noxious weeds are a growing problem that threaten private and public land in the upper Ruby Valley," explains Sandru. "I watched weeds spread in parts of western Montana, so when we saw them establishing on our summer grazing allotment we knew something had to be done. In 2011 we were trailing cattle to summer pasture and decided that a planned, organized weed control effort was needed, and it needed to happen soon!"

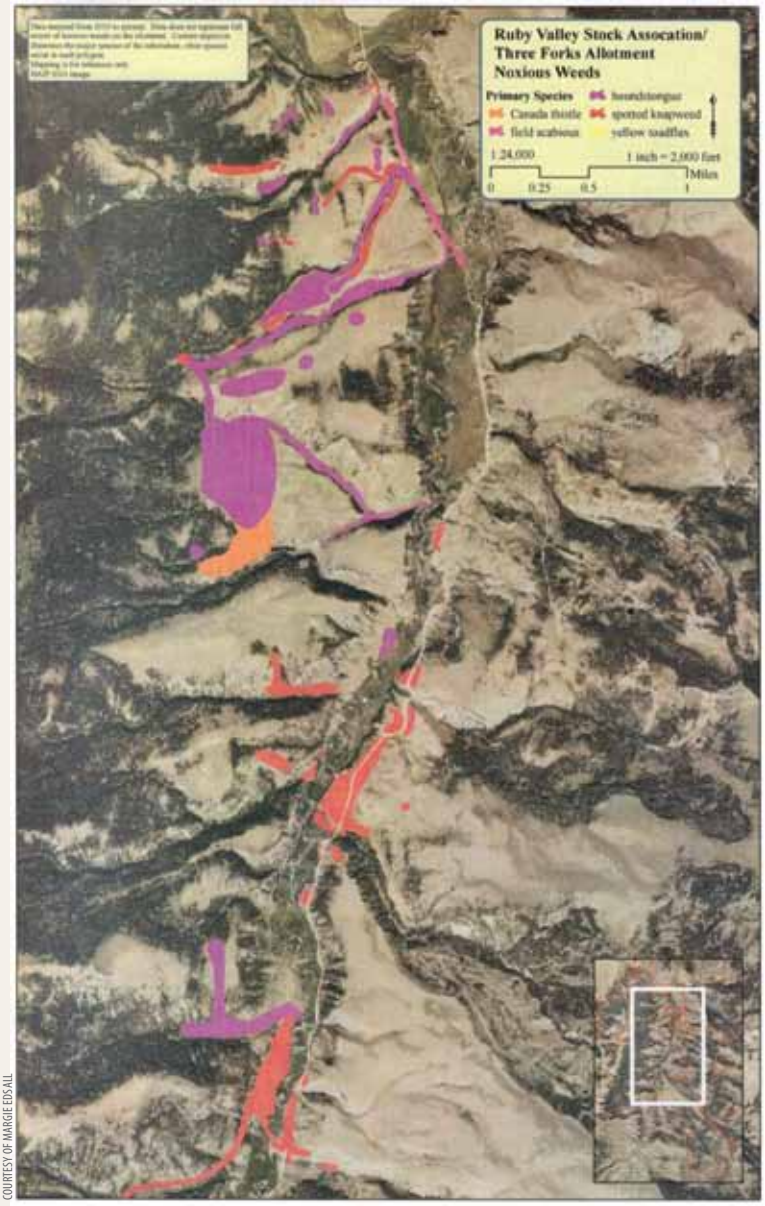
MAKING IT HAPPEN

Sandru and seven other ranching families that compose the Three Forks Grazing Association and their herd riders surveyed and recorded weed infestations within their grazing allotment (see Map). Results of the survey showed that houndstongue, spotted knapweed and field scabious were the most widespread species (Table 1). A total of about 830 acres of noxious weeds are scattered over the 65,000-acre area. Although some weed infestations are difficult to access, many of the weeds are associated with roads, trails and other disturbed sites.

Once the initial survey work was completed, Sandru contacted the Ruby Watershed Council, Ruby Valley Conservation District, Ruby Grazing Association and Madison County Weed District. Together they formalized the Upper Ruby Watershed Cooperative Weed Management Area (CWMA). The group developed a comprehensive plan that focused on:

- Improving the effectiveness of prevention and control efforts on invasive plants within the CWMA.
- More efficiently utilizing resources across political boundaries through coordination and strategic planning.

The partnership has expand since 2011 to include 16 different agencies, groups, and businesses (Table 2).



COURTESY OF MARGIE EDSALL

MAP SHOWING INFESTATIONS of noxious weeds in the Upper Ruby Watershed Cooperative Weed Management Area.

TABLE 1. WEED SPECIES AND ACREAGE INFESTED within the 65,000-acre cooperative weed management area. Weed inventories are still needed on the eastern allotments within the project area.

Acres	Noxious Weed
400	Houndstongue (*Cynoglossum officinale*)
300	Spotted knapweed (*Centaurea stoebe*)
60	Field scabious (*Knautia arvensis*)
40	Canada thistle (*Cirsium arvense*)
30	Hoary alyssum (*Berteroa incana*)
<1	Dalmatian and Yellow toadflax (*Linaria dalmatica* and *L. vulgaris*)
<0.5	Tall buttercup (*Ranunculus acris*)

TABLE 2. PARTNERS IN THE UPPER RUBY VALLEY CWMA

Broken Arrow Outfitters
Commercial Applicators
Madison County
Montana Fish, Wildlife and Parks
Montana Department of Natural Resources and Conservation
Private landowners
Robb Ledford Wildlife Management Area
Ruby Grazing Association
Ruby Valley Conservation District
Ruby Valley Wildlife Group
Ruby Watershed Council
Three Forks Grazing Allotment
Upper Canyon Ranch
USDA Forest Service, Madison Ranger District
USDI Bureau of Land Management
Warm Spring Creek Grazing Allotment

MANAGEMENT GOAL =HEALTHY LANDS

Invasive plant management within the CWMA has concentrated on improving and protecting desirable vegetation, reducing soil disturbance, monitoring, and herbicide treatments. Although weeds are scattered over a large landscape, infestations are at a level that can still be contained and controlled.

The first cooperative noxious weed spray day was organized by Sandru and Madison County Weed District in Fall 2011, and these events have continued annually since that date. "Herbicide treatments have been effective at reducing the size and distribution of invasive plants within the project area," explains Margie Edsall, Madison County Weed Coordinator. "We apply Milestone® at 7 fluid ounces per acre (fl oz/A) to control spotted knapweed, field scabious and Canada thistle, and we are getting more than 90 percent control a year later. On sites where we have houndstongue or hoary alyssum intermingled with knapweed or thistle we add Escort at 1 ounce per acre (oz/A) to Milestone at 7 fl oz/A, and control has been excellent." Monitoring for satellite infestation continues to be an important part of the effort to find and possibly eradicate new infestations.

"Maintaining grass on our summer grazing allotment is a matter of survival for ranchers in the Upper Ruby Valley," explains Sandru. "But managing weeds also has other benefits including protecting wildlife habitat, reducing soil erosion, improving water quality, and enhancing natural resource values that are critical in the Ruby River watershed."

The ranchers that compose the Three Forks and Warm Springs Creek Grazing Allotments recognize that a healthy

STEVE DEWEY, UTAH STATE UNIV., BUGWOOD.ORG

FIELD SCABIOUS

Occurrence of field scabious in the United States and Canada.*

Field scabious (*Knautia arvensis*) is a tall, tap-rooted perennial plant in the teasel family (Dipsacaceae). This native of Europe has naturalized in areas of southwestern Montana, other northern-tier states in the U.S. and in southern Canadian provinces. Plants are up to 4 feet in height with violet-blue to purple flowers on the ends of long, leafless stalks. One plant can produce up to 2,000 seeds, which may remain viable in the soil for many years. Plants establish easily along roadsides, pastures, meadows, rangeland and disturbed sites. Field scabious spreads rapidly and competes with desirable grasses causing declines in hay production and forage for livestock and wildlife.

*USDA Plants Database 2014 (http://plants.usda.gov)

ARCTIC GRAYLING

Arctic grayling (*Thymallus arcticus*) are a unique fish species because remnant populations were native to only two of the lower 48 states, Michigan and Montana. Grayling were apparently isolated in both of these areas by the last period of glaciers, which ended 10,000 to 12,000 years ago. Michigan's grayling were extinct by 1936, but Montana populations continue to persist in a fraction of their historic range. The only remaining native stream dwelling grayling population in the lower 48 states was found in the Big Hole River in southwest Montana prior to reintroduction to the Ruby River. Fluvial Arctic grayling in Montana are designated as a "Species of Concern" by the Montana Natural Heritage Program, a "Species of Special Concern" by the Montana Chapter of the American Fisheries Society, and a fish of "Special Concern" by the Endangered Species Committee of the American Fisheries Society.

MARGIE EDSALL

VOLUNTEERS. More than 15 ranchers, volunteer commercial applicators and partner agencies dedicate time and resources to controlling weeds in the Upper Ruby Watershed Cooperative Weed Management Area.

plant community is critical to protecting natural resource values and minimizing the establishment and spread of invasive plants. Their projects include:

- A successful rest-rotation grazing system that fosters a desirable plant community.
- A water system to disperse cattle away from creeks to improve riparian function, stream bank stabilization, and increased aspen regeneration.
- Hardened stream crossings and corral relocation.

All of these projects help maximize desirable vegetation and minimize soil disturbance. The result is less sediment moving into the Ruby River, and reduced weed establishment and spread.

In addition to controlling weeds, another testament to the ranchers' hard work is the successful reintroduction of the Arctic grayling (*Thymallus arcticus*) to the Ruby River. Sandru explains, "Several years ago we voluntarily agreed to embrace Fish, Wildlife and Parks reintroduction of Arctic grayling to the Ruby River. Grayling need extremely cold and clean water to survive, and this is the only successful reintroduction in Montana. We believe that desirable habitat for the fish is a direct result of our progressive management practices."

FUNDING

A diverse group of supporters help fund weed management efforts within the CWMA including the Rocky Mountain Elk Foundation, Montana Noxious Weed Trust Fund, and the Resource Advisory Council. Combined, these three groups have contributed more than $40,500 since 2011. The majority of these funds (about $35,000) have been spent on public lands for inventory and control of invasive plants. The CWMA submitted a new grant request to the National Public Lands Council for $150,000 to provide long-term support to the effort.

FUTURE

The future goal of the project is to expand from the Upper Ruby Watershed downstream to the Ruby Reservoir, increasing the CWMA to include more than 135,000

COURTESY OF THE SANDRU FAMILY

RICK SANDRU and seven other ranching families that compose the Three Forks Grazing Association initiated the Upper Ruby Cooperative Weed Management Area.

MARGIE EDSALL

RANCHERS MEET in the grazing allotment to discuss weed infestations that need to be treated.

acres. "Even with the success we are having with our current efforts, larger areas still need management," says Edsall. "The cooperation we have from land owners and agencies is the most effective and efficient way to control invasive plants and prevent their introduction."

Partners believe that the survival of family ranches and preservation of vast undeveloped landscapes is dependent on long-term management of invasive plants to maintain healthy lands.

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BULL THISTLE

MUSK THISTLE

PLUMELESS THISTLE

SCOTCH THISTLE

NATIVE AND EXOTIC THISTLES: Who's Jeckyl, who's Hyde?

Adapted from Jane Mangold and Hilary Parkinson, August Weed Post, Montana State University

There are five common exotic thistles (excluding *Centaurea* spp., both the starthistles and knapweeds) in the western US that are problematic to some degree across a variety of habitats. In addition to exotic thistles, there about 160 native thistle species in North America, some of which can be difficult to distinguish from the troublesome exotics! Why is it important to distinguish exotic from native thistles? Exotic thistles can spread quickly, especially with disturbance, they have poor forage value, and their sharp spines can injure livestock and limit recreational activities. In contrast to exotics, native thistles are rarely or ever reported as invasive and play an important role in the ecosystem. For example, birds feed on thistle seed, and some birds time their nesting around thistle flowering because they use the downy seeds to line their nests. Bees, wasps, flies and beetles feed on thistle pollen and become food sources for other wildlife, and some native thistles are forage for deer and elk. Answer the following questions to distinguish five common exotic thistles from many native thistles.

1. **Does the thistle have rhizomes?**

   Yes? It's the exotic Canada thistle (*Cirsium arvense*). Heads are small and clustered, and there are no spiny wings on stem. Note: native Flodman's thistle, *Cirsium flodmanii*, is a taprooted perennial, spreading by horizonal roots, which may appear rhizomatous. Heads are not densely clustered, but grow as one to two heads at stem tips.

   No? Continue to question 2.

2. **Does the thistle have spiny wings the entire length of the stem?**
   Yes? It's one of four common exotic thistles. Review the key diagnostic features and photos below.

- Bull Thistle (*Cirsium vulgare*). Narrow, needle-like bracts, leaves green on upper and lower surface.
- Musk Thistle (*Carduus nutans*). Broad triangular bracts point outward or down, heads are often nodding. There may be an expanse immediately below the flower head without spiny wings, but you will see them lower on the stem.
- Plumeless Thistle (*Carduus acanthoides*). Flower heads in clusters so each flower stalk is ≤0.75 inches, each head measures ≤1 inch in diameter.
- Scotch Thistle (*Onopordum acanthium*). Foliage silver gray in appearance, plants may grow up to 12 feet tall, spiny wings especially prominent.

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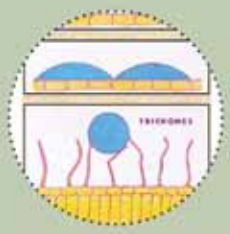

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