



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

IN THIS ISSUE:

A Collaborative Approach to Riparian Restoration Along the Dolores River, 4

Forbs Tolerant to Milestone® Specialty Herbicide, 7

Managing Sulfur Cinquefoil in Natural Areas, 8

Are Drones in Your Future?, 11

ESSENTIAL RESOURCES FOR INVASIVE PLANT MANAGERS, 7

MANAGEMENT GUIDES AND SPECIAL PUBLICATIONS FROM TECHLINE, 3

TECHLINE WELCOMES NEW TEAM MEMBER, 2

PHOTO CONTEST WINNERS, 2

ABOUT TECHLINE

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.

This and past issues can be downloaded from [www.techlinenews.com](http://www.techlinenews.com).

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# TechLine

## INVASIVE PLANT NEWS

### SEE INSIDE FOR IMPORTANT CHANGES WITH TECHLINE IN 2017



MARK TABER



BRIAN RISKAS, RMD SYSTEMS



THEODORE WEBSTER, BUGWOOD.ORG



### Spring Brings Transformation

Spring is a season that brings transformation, change, and a chance for new growth in our professional and personal lives. This spring also brings changes to TechLine Invasive Plant News. Melissa Munson, Copy Editor and Website Manager since 2009, is stepping down from her position to spend more time with her family. She leaves us with an incredible legacy of expanding TechLine from a hard-copy only publication, to an expansive web-based and social media platform.

Her foresight and dedication to TechLine will be missed, but we wish her the best in her future. Kaaren Robbins will assume Melissa's position and we welcome her inspiration and enthusiasm!

Our goal with TechLine Invasive Plant News is to continue to provide you and your program with new ideas and resources for managing invasive plants. Our website allows us to share more information with a greater audience than we can reach with hard-copy mailing. After this spring issue, all future TechLine materials will be published only on the website and through bi-monthly email TechNotes. Be sure to go online to [techlinenews.com](http://techlinenews.com) and subscribe to receive email updates.

We appreciate your dedication and perseverance in protecting lands from invasive plants, and look forward to helping you meet your management goals and objectives. Thank you for supporting and sharing TechLine Invasive Plant News.

-- Celestine Duncan, Editor

### Welcome Kaaren



**Hello! I am Kaaren Robbins,** a marketing and communications professional specializing in social media, database and systems management. I earned my Bachelor of Science degree in Business Administration with an emphasis in Marketing from Concordia University with studies at Michigan State University.

I have worked with various corporations and associations, and in 2003 opened KC Consulting Group, Inc., a company specializing in technology and graphic arts.

My husband and I moved to Montana in 2007 and built our home in front of the Beartooth Mountains near Belfry, Montana. We have two children, a son living near Phoenix, and a daughter and two grandchildren that live in the Birmingham area. When I'm not working, I enjoy horseback riding, hunting, climbing and other outdoor activities. I look forward to the opportunity to make a difference with TechLine.



## 2016 PHOTO CONTEST WINNERS



INVASIVE PLANTS CATEGORY  
*"Orange Hawkweed Flower"*  
BY LAUREL BALDWIN

Laurel has been the coordinator for the Whatcom County's (Washington) Noxious Weed Program since 1989 and has seen many beautiful and beastly weeds in her career. She hopes that compelling images of invasive plants in outreach materials may help the public better remember and identify invasive plant species.



MANAGEMENT IN ACTION CATEGORY  
*"Spraying Teasel"*  
BY JAKE VANCIL

Jake grew up taking photos and videos of his outdoor activities in central Illinois. Since working with the Illinois Recreational Access Program, he has been taking invasive plant photos and videos to help the public understand problems associated with invasive plants and how to treat them.

#### WHAT'S WRONG WITH THIS PICTURE?

*If you guessed "The applicator is not wearing adequate personal protective equipment (PPE)," you are correct! Herbicide applicators and other handlers should wear appropriate PPE for the products they are applying.*

### Thank you, TechLine!



During the past 8 years, I've witnessed a level of engagement and commitment to continued learning among our readers that truly inspires me. I am honored to have had the opportunity to nurture TechLine from print newsletter to a major online resource for invasive plant managers across the country. Thank you for your input and support of the TechLine effort, and your continued commitment to protecting natural areas from the impacts of invasive plant populations.



# THIS IS YOUR LAST PRINT ISSUE!

Update your **EMAIL SUBSCRIPTION** to join invasive plant professionals and private land managers as part of the online TechLine Invasive Plant News Community.

Dear Reader,

Since 1989, TechLine has supported invasive plant managers and professionals with information on innovative invasive plant management techniques, proven science-based methods, and success stories from around the country.

In 2010, editors at TechLine established a successful online presence with the launch of [www.techlinenews.com](http://www.techlinenews.com), email newsletter delivery, and social media networks.

With this issue, TechLine Invasive Plant News is ending its print edition and transitioning to an online-only format. While this is the final print issue of the magazine, we hope it's not the last you'll hear from us.

TechLine Invasive Plant News will continue to deliver materials, in electronic format, that promote sustainable management practices and support invasive plant professionals and private land managers.

## CONTINUE YOUR RELATIONSHIP WITH THE TECHLINE COMMUNITY

### 1. ONLINE, ANYTIME

Get full access to [www.techlinenews.com](http://www.techlinenews.com) including full articles and an online archive dating back to 1989.

### 2. SOCIAL NETWORKS, DAILY/WEEKLY

Access new and updated articles as they are published by joining TechLine's social media networks. Comment on articles and share your experiences with other readers. Like (Facebook) or Follow (Twitter).



### 3. EMAIL NEWSLETTER, BI-MONTHLY

Timely articles specific to your geographic region are delivered to your email inbox about twice a month. Subscribe at [www.techlinenews.com/e-news](http://www.techlinenews.com/e-news)

## MANAGEMENT GUIDES AND SPECIAL PUBLICATIONS FROM TECHLINE

Explore the "PUBLICATIONS" tab at [www.techlinenews.com](http://www.techlinenews.com) for back issues of this magazine, monthly e-newsletter, and other TechLine publications.



### PRAIRIE AND GRASSLAND MANAGEMENT

Provides a suite of resources to natural area managers so they can better understand how and when to integrate herbicides into prairie and grassland management programs. The guide includes information on herbicide use rates, herbicide selectivity on desirable forbs and grasses, seeding options and guidelines, invasive woody and herbaceous plant control, and other useful tips. [www.techlinenews.com/prairieguide/](http://www.techlinenews.com/prairieguide/)



### PLANT AND ANIMAL COMMUNITY RESPONSE TO LONG-TERM VEGETATION MANAGEMENT PRACTICES ON RIGHTS-OF-WAY

Results of 60 years of ecological research on Pennsylvania electric transmission rights-of-way demonstrate that plant communities can be selectively managed to support reliable electric service and a diverse plant community for wildlife. <http://bit.ly/bramblebyrnes>



### INVASIVE PLANT MANAGEMENT GUIDE

Provides information on selective herbicides as one tool for invasive plant management on rangeland, pastures, and natural areas. Information on herbicide use rates, herbicide selectivity on non-target plants, sprayer calibration, seeding guidelines, environmental considerations, and other useful tips are provided in this document. [www.techlinenews.com/management-guide/](http://www.techlinenews.com/management-guide/)



### SALT CEDAR (TAMARISK) AND RUSSIAN OLIVE MANAGEMENT

A four-page guide outlining management with herbicides via foliar treatments alone or combined with mowing or cutting, cut stump, and low volume basal bark applications. <http://bit.ly/scromanagement>

# Dolores River Restoration Partnership

## A Collaborative Approach to Riparian Restoration

**MARK TABER AND GARY RUSHING** discuss basal bark treatments on tamarisk resprouts along the Dolores River.

Flowing north from its headwaters in the San Juan Mountains of western Colorado, the Dolores River meanders through iconic canyons and broad valleys as it descends to its confluence with the Colorado River more than 200 miles downstream. Like many rivers that have been dammed in the West, a combination of altered flows and introduction of invasive plants such as tamarisk (*Tamarix* spp.) has reduced biodiversity and impacted the health of the Dolores River.

In 2009 a coalition of concerned individuals and agencies (Box 1) took action to restore about 175 miles of riparian habitat along the Dolores River between McPhee Reservoir and its confluence with the Colorado River just north of Moab, Utah. Mark ‘Sparky’ Taber, natural resource specialist for the Bureau of Land Management in Grand Junction, Colorado, is a key player in the partnership. “Our goal is to erase boundaries and implement the restoration work where it’s needed, regardless of whether it’s public or private lands,” explains Taber.

Trust is a large part of making the public-private partnership work. “Building relationships and following through with a plan of work is critical, especially if you want private landowners to come on board. They have to see results to know that the project is effective and

that other partners are committed,” says Taber. “What is so great about being part of this project is that we develop plans through consensus that include both public and private lands. This helps secure funding and provides a network of individuals that can help with project direction, oversight and long-term maintenance.”

### PROJECT IMPLEMENTATION

The first large scale project on the river started just below McPhee dam in the fall of 2010. Since that time, the partnership delineated 94 work units that span the entire length of the river, and designed management prescriptions for each unit. Restoration on many of those work units is complete or in the process of being completed (Box 2 and Figure 1).

BY CELESTINE DUNCAN  
PHOTOS BY MARK TABER

### BOX 1. DOLORES RIVER RESTORATION PARTNERSHIP

#### Participating Agencies in Cooperation with Private Landowners

Bureau of Land Management  
(Dolores, Montrose, Grand Junction,  
and Moab Offices)

State of Colorado

Colorado Division of Parks and Wildlife

Colorado counties of Dolores, Montrose, San  
Miguel, Mesa & Grand (in Utah)

The Nature Conservancy

[Tamarisk Coalition](#)

Walton Family Foundation

Rocky Mountain Bird Observatory

Southwest Conservation Corps

Canyon Country Youth Corps

Western Colorado Conservation Corps

Natural Resources Conservation Service and  
Conservation Districts

Colorado Division of Wildlife

Utah Division of Wildlife Resources

Colorado Department of Highways

Unaweep Tabeguache Scenic Byway

Department of Energy

Partners for Fish and Wildlife-Colorado and Utah

**FIGURE 1.**

An infestation of tamarisk along the Dolores River prior to removal (left) and following removal and regeneration of desirable native vegetation (right).



**FIGURE 2. (LEFT)**

Conservation Corp crews remove tamarisk from the Dolores River riparian area.



**FIGURE 3. (RIGHT)**

Excavators with a grapple are used to remove tamarisk and other woody invasive plants, and pile debris for burning.



**FIGURE 4.**

Work unit H-7 showing tamarisk density pre-removal (left) compared to post removal with mechanical equipment (right).



Management includes integrating biological control agents with manual and mechanical removal of tamarisk, herbicide treatment of tamarisk regrowth and herbaceous weeds such as Russian knapweed, and restoring desirable native riparian species. Site conditions, tamarisk density, presence of other native or non-native vegetation, and physical access determine what method is prescribed on each of the work units.

“The Conservation Corp crews are a key part of our success,” explains Taber. “Crews are employed to cut tamarisk or other woody invasive trees in areas where the trees are scattered, or where access for machinery is difficult (Figure 2). In areas with dense tamarisk and very little desirable understory,

excavators with a grapple are used to pull and stockpile trees which are burned after drying (Figure 3). This method leaves less woody debris on the ground, minimizes opportunity for regrowth, and is faster than mulching an entire tree (Figure 4). It’s an aggressive approach, but you can selectively remove invasive woody plants from desirable native plants such as New Mexico privet (*Forestiera neomexicana*), which helps restoration efforts,” says Taber.

Tamarisk leaf beetles (*Diorhabda* sp.) have been present on the Dolores River since 2005, and have weakened or killed tamarisk in some areas (Figure 5). Combining mechanical treatments in areas where beetle density is high reduces the amount

Continued on page 6...

## BOX 2.

DOLORES RIVER RESTORATION PARTNERSHIP

# Restoration by the Numbers 2009-2015

### ON-GROUND RESTORATION/ MANAGEMENT

- 1,430 acres of tamarisk removed
- 3,615 acres of tamarisk re-sprouts and secondary (herbaceous) weeds treated
- 497 acres of re-vegetation
- 15 structures and facilities where fuel loads were reduced
- 27 miles of scenic vistas and sight lines improved along Highway 141 (Scenic Byway)
- 23 riverside campsites improved for recreationists

### JOBS CREATED AND HOURS OF SERVICE

- 41 jobs created for local contractors
- 276 jobs for youth and young adults through Conservation Corps
- 95,380 hours of work contributed by Corps crews, interns, and strike teams
- 130 hours (on average) of training for each Corps member

### ECONOMIC IMPACT

- \$6,586,453-- expenditures and in-kind resources invested in the region's economies



### LEARN MORE ABOUT RUSSIAN KNAPWEED MANAGEMENT

<http://bit.ly/russianknapweed>

... Continued from page 5



**FIGURE 5.** Tamarisk leaf beetles (*Diorhabda* sp.) (inset) have weakened or killed tamarisk in some roadside and riparian areas.



**FIGURE 6.** Tamarisk regrowth is treated with Garlon® 4 Ultra in oil applied as a basal bark treatment in late fall and winter.

of regrowth following cutting. Tamarisk that does regrow is treated with Garlon® 4 Ultra specialty herbicide in oil applied as a basal bark treatment in late fall and winter (Figure 6).

Mechanical removal of tamarisk and other invasive woody plants is conducted during the fall and early winter. Herbaceous weeds such as Russian knapweed are treated the following summer or fall. “On BLM lands we were using Transline® specialty herbicide on Russian knapweed, but we just received approval to use Milestone® specialty herbicide so we will be applying that on Russian knapweed in 2017,” explains Taber.

The gall nematode (*Subanguina picridis*) is also established on some Russian knapweed infestations in the project area resulting in stunted plants. Once invasive plants are removed or reduced in abundance, the site is restored by seeding desirable vegetation and/or planting cottonwood and willows.

### LESSONS LEARNED

The Dolores River Partnership has completed more than 70 percent of prioritized restoration along 175 miles river. The commitment and energy leveraged through the partnership has allowed for landscape-scale

restoration with financial, technical, and human resources shared across jurisdictional boundaries. The partnership also created an effective career path in natural resource management for young adults that are part of the Conservation Corps.

“The scope of the project and acres of riparian habitat restored on the Dolores River could never have been done without the benefit of the Partnership,” says Taber. “Our collective efforts have knocked back tamarisk and other invasive plants for a long time, maybe decades—but without continued monitoring and maintenance these plants can reinvade. It is so critical that we continue to build on existing relationships, and establish long-term funding levels so we can protect what we’ve accomplished. Meeting this goal is likely our biggest challenge for the future.”

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Milestone is not registered for sale or use in all states. Contact your state pesticide regulatory agency to determine if a product is registered for sale or use in your state. State restrictions on the sale and use of Transline and Garlon 4 Ultra apply. Consult the label before purchase or use for full details. **Always read and follow label directions.**

**Active ingredients for herbicide products mentioned in this article:** Milestone (aminopyralid), Transline (clopyralid), Garlon 4 Ultra (triclopyr).

## FOR MORE INFORMATION ON THE DOLORES RIVER PARTNERSHIP

### A collaborative model for large-scale riparian restoration in the western United States

Oppenheimer JD, SK Beaugh, JA Knudson, P Mueller, N Grant-Hoffman, A Clements, and M

Wight. 2014. *Restoration Ecology*.

<http://onlinelibrary.wiley.com/doi/10.1111/rec.12166/abstract>

### Leaving a Legacy on Southwest Rivers

Mike Wight. 2015. *River Management Society Journal*.

<http://www.river-management.org/assets/Journals-Newsletters/fall2015web.pdf>



## FORBS TOLERANT TO MILESTONE® SPECIALTY HERBICIDE Recommended for Seeding into Sites Infested with Canada Thistle or Other Invasive Weeds

Use this table to develop a seed mix tolerant to Milestone that meets the goal of structural diversity (height) and varied flowering times. \*Susceptible to fall herbicide treatment. See Section 4 of the publication, **Integrating Herbicides in Prairie and Grassland Management** (below) for symptoms and injury levels associated with these rankings.

Common Name	Scientific Name	Flower Color	Height (feet)	Flower Time					
				Apr	May	Jun	Jul	Aug	Sep
Blanket flower	<i>Gaillardia aristata</i>	Red, Yellow	1 to 2			✓	✓		
Blue vervain	<i>Verbena hastata</i>	Blue	5				✓	✓	✓
Butterfly milkweed	<i>Asclepias tuberosa</i>	Orange	2 to 3			✓	✓	✓	
Button (or rough) blazingstar	<i>Liatris aspera</i>	Purple, Pink	3 to 5					✓	✓
Common milkweed	<i>Asclepias syriaca</i>	Lavender	2 to 4			✓	✓	✓	
Cup plant	<i>Silphium perfoliatum</i>	Yellow	3 to 10				✓	✓	✓
Golden alexanders	<i>Zizia aurea</i>	Yellow	3	✓	✓	✓			
Heart-leaved alexanders	<i>Zizia aptera</i>	Yellow	2	✓	✓				
Heath aster	<i>Aster ericoides</i>	White	2					✓	✓
Hoary vervain	<i>Verbena stricta</i>	Blue	2			✓	✓	✓	✓
Large flowered penstemon	<i>Penstemon gradiflorus</i>	Lavender	2 to 4		✓	✓			
Leadplant	<i>Amorpha canescens</i>	Purple	2 to 3			✓	✓		
Lupine	<i>Lupinus sericeus</i>	Blue	1 to 2		✓	✓			
Meadow blazingstar	<i>Liatris ligulistylis</i>	Purple, Pink	3 to 5					✓	✓
New England aster	<i>Aster novae-angliae</i>	Purple, Pink, Blue	3 to 6					✓	✓
Ox Eye sunflower	<i>Heliopsis helianthoides</i>	Yellow	3 to 6			✓	✓	✓	✓
Prairie blazingstar	<i>Liatris aspera</i>	Purple	3				✓	✓	✓
Prairie onion	<i>Allium stellatum</i>	Purple	1				✓	✓	
Purple meadow-rue	<i>Thalictrum dasycarpum</i>	Purple	6			✓	✓		
*Purple prairie clover	<i>Dalea purpurea</i>	Purple, Yellow	1 to 2				✓	✓	
Round-headed bush clover	<i>Lespedeza capitata</i>	White	3 to 5					✓	✓
Showy tickfoil	<i>Desmodium canadense</i>	Purple	5				✓	✓	
Smooth blue aster	<i>Aster laevis</i>	Blue	4					✓	✓
*Stiff goldenrod	<i>Solidago rigida</i>	Yellow	3 to 4					✓	✓
*Stiff sunflower	<i>Helianthus pauciflorus</i>	Yellow	5				✓	✓	✓
*White prairie aster	<i>Aster ericoides</i>	White	2 to 3					✓	✓
Swamp milkweed	<i>Asclepias incarnata</i>	Red, Pink	3 to 5			✓	✓		
White wild indigo	<i>Baptisia alba</i>	White	4			✓	✓		
Wild bergamot	<i>Monarda fistulosa</i>	Purple	4				✓	✓	✓



**PRAIRIE AND GRASSLAND MANAGEMENT** provides a suite of resources to natural area managers so they can better understand how and when to integrate herbicides into prairie and grassland management programs. The guide includes information on herbicide use rates, herbicide selectivity on desirable forbs and grasses, seeding options and guidelines, invasive woody and herbaceous plant control, and other useful tips. Available online at: [www.techlinenews.com/prairieguide](http://www.techlinenews.com/prairieguide)

ESSENTIAL ONLINE  
RESOURCES FOR INVASIVE  
PLANT MANAGERS



## UNDERSTANDING HERBICIDES

With spring just around the corner, now is the time to improve your skills and expand your understanding of the science behind selecting, applying, and assessing the effects of herbicides.

Explore these and more articles with technical and practical information about using herbicides at: <http://techlinenews.com/herbicides>

### HERBICIDE EDUCATION SERIES

- [Effective Herbicide Use Starts With the Label](#)
- [Introduction to Herbicide Formulations](#)
- [Factors Affecting Herbicide Performance](#)
- [Surfactants and Adjuvants](#)

### TOLERANCE OF NON-TARGET SPECIES TO HERBICIDE

- [Native Forb and Shrub Tolerance to Milestone® Herbicide](#)
- [Tolerance of Warm and Cool Season Grasses to Milestone Herbicide](#)
- [Possible Effects of Herbicides to Honeybees](#)

### PRODUCT INFORMATION

- [Answers to FAQs about Control of Saltcedar and Russian Olive with Vastlan™ vs Garlon® 4 Ultra](#)
- [Answers to FAQs about Milestone Herbicide](#)
- [Labels, MSDS, and Additional Information](#)

## PROPER APPLICATION TIMING MAXIMIZES INVASIVE PLANT CONTROL

### SPRING AND EARLY SUMMER CAN BE EXCELLENT TIMES TO CONTROL ACTIVELY GROWING INVASIVE PLANTS WITH HERBICIDES.

Applying herbicides to the target plant at the optimum growth stage is important to maximize control. The following guidelines provide information on the best application timing and rate to control key invasive plants.

#### CANADA THISTLE

(*Cirsium arvense*)

Late spring and early summer applications of Milestone® specialty herbicide on Canada thistle should be made after all plants have emerged and basal leaves are expanded. It is better to wait until some of the plants are at the bud growth stage to be sure that all plants are emerged before applying Milestone at 5 to 7 fluid ounces per acre (fl oz/A). Use the 7 fl oz/A rate at later growth stages. <http://bit.ly/canadathistle>

#### BIENNIAL THISTLES:

BULL (*Cirsium vulgare*), MUSK (*Carduus nutans*), PLUMELESS (*Carduus acanthoides*)

Milestone at 3 to 5 fl oz/A can be applied in spring and early summer from rosette to early flower growth stage. Use the 5 fluid ounce rate at the late bolt to early flower growth stage.

<http://bit.ly/biennialthistle>

#### SPOTTED and DIFFUSE Knapweed

(*Centaurea stoebe* and *C. diffusa*)

Milestone at 5 to 7 fl oz/A may be applied any time during the growing season when plants are actively growing. Applications made during the late bud to bloom stage will not stop seed production the year of treatment.

<http://bit.ly/spottedknapweed>

# MANAGING SULFUR CINQUOIL IN NATURAL AREAS

BY CELESTINE DUNCAN

THEODORE WEBSTER, BUGWOOD.ORG



Sulfur cinquefoil (*Potentilla recta* L.) is a perennial forb native to Eurasia. It first appeared in North America before 1900 in Ontario, Canada. By the 1950s it was widely established in eastern Canada, the Pacific Northwest, northeastern United States and the Great Lakes region. In 2017 sulfur cinquefoil was reported in the 48 contiguous states in the United States (Figure 1), and southern Canadian provinces.

## BIOLOGY

Sulfur cinquefoil is a long-lived perennial (30 years or more) with a woody taproot. New shoots grow from the root perimeter; however, plants do not have rhizomes. Each plant has one to several erect stems about 1 to 2 feet in height. Leaves have 5 to 7 leaflets arranged in a palmate pattern (Figure 2) and are basal until the plant sends up flowering stalks in spring. Numerous leaves are attached along the length of the stem with fewer leaves near the base. Stems and leafstalks are covered with hairs that are ¼ inch in length and project outward at right angles (Figure 3).

Flowering begins in late May (Figure 4) and may continue throughout the summer if growing conditions are favorable. Sulfur cinquefoil reproduces only by seed with a single plant capable of producing up to 1,650 seeds per year.

## SPREAD AND IMPACTS

Sulfur cinquefoil is adapted to a wide range of environmental conditions. The plant is found in grasslands, shrub and open forest habitat types, and disturbed areas. Seeds are likely spread by humans, vehicles, and animals including wildlife and domestic livestock. Movement of contaminated equipment



**FIGURE 1.** Sulfur cinquefoil distribution in the United States and Canada. (USDA PLANTS DATABASE AND EDMAPS)

for agricultural purposes, construction, and fire suppression activities hasten seed spread. Seeds that fall directly from the parent plant disperse only a short distance unless aided by an external vector as described above.

Sulfur cinquefoil has a high tannin content limiting its palatability to most livestock and wildlife. Studies conducted in Montana indicated utilization by livestock and wildlife was less than 1 percent on 98 percent of sites sampled. Selection of plants other than sulfur cinquefoil by grazing animals may have a long-term impact by reducing bio-diversity. Sulfur cinquefoil reduces grass production by about 60 percent as a result of direct plant competition.



**FIGURE 2.** Sulfur cinquefoil leaves are compound with 5 to 7 leaflets arranged in a palmate pattern.



**FIGURE 3.** Sulfur cinquefoil stems and leafstalks are covered with hairs that are ¼ inch in length and project outward at right angles.



**FIGURE 4.** Sulfur cinquefoil has pale yellow flowers with five petals.

## MANAGEMENT

### HERBICIDES

Field studies conducted on sulfur cinquefoil in the United States and Canada show that Milestone® specialty herbicide at 4 to 7 fluid ounces per acre (fl oz/A) provided good to excellent control (90 to 100%) one year following application. The addition of 2,4-D to Milestone did not improve control over Milestone applied alone (Figure 5).

The optimum time to apply Milestone to control sulfur cinquefoil and stop seed production is at rosette to early bolt stage in spring. Sulfur cinquefoil is often difficult to locate until the plant blooms; thus, the higher application rate will be more effective on mature plants treated later in the summer.

### PHYSICAL REMOVAL

Hand pulling, grubbing, or hoeing may be used to control small populations of sulfur cinquefoil. These methods can cause significant disturbance and sites should be seeded with desirable species to reduce reinvasion by sulfur cinquefoil germinating from seed. The caudex (basal stem structure) must be removed to effectively control the plant. Follow-up treatment will be needed if plants have produced seed.

### MECHANICAL METHODS

Mowing prior to bloom will reduce flowering and seed production but will not reduce plant populations. Sulfur cinquefoil is not usually a problem in cultivated cropland; however, tillage will control sulfur cinquefoil

on cropland. Follow-up management using herbicides may be needed to control regenerating plants. Mowing and tillage equipment must be cleaned of soil that may contain seed or plant root crowns to prevent spread to non-infested sites.

### PRESCRIBED BURNING

Prescribed fire alone will not control sulfur cinquefoil and may increase cinquefoil populations unless control measures such as herbicide treatments are applied post-burn. Field studies in Montana indicate spring and fall prescribed fires did not change sulfur cinquefoil population densities five years post-burn compared to infestations that were not burned. Fires on infested sites that do not have competitive plants may increase the invasiveness of sulfur cinquefoil.

### LIVESTOCK GRAZING

Most livestock avoid grazing sulfur cinquefoil due to the high tannin content. Confining sheep or goats on an infestation may reduce seed production. Proper grazing management is essential to maintain the health and competitiveness of desirable pasture and rangeland plant communities. This will help slow invasion and increase effectiveness of other control treatments.

### BIOLOGICAL CONTROL

There are no biological control agents currently available for management of sulfur cinquefoil. The probability of agents becoming available in the near future is not likely because of the many native and agricultural

*Proper timing, continued...*

### RUSSIAN KNAPWEED

*(Acroptilon repens)*

Applications of Milestone® specialty herbicide at 5 to 7 fl oz/A should be delayed until Russian knapweed has bolted and is in the early bud to flower growth stage; applications can be made through the fall. It is important to remember that herbicide efficacy symptoms do not always show on Russian knapweed the season the treatment is made.

<http://bit.ly/russianknapweed>

### LEAFY SPURGE

*(Euphorbia esula)*

The optimum time to treat leafy spurge with most herbicides is at the true flower growth stage, which is after the yellow bract is formed (late spring to early summer). Apply Tordon® 22K specialty herbicide alone at 1 to 2 quarts of product per acre (qt/A) at true flower. When applying Tordon 22K at rates less than 1 qt/A add 2,4-D at 1 qt/A (1 lb ae/A). The addition of OverDrive herbicide at 4 oz/A may improve leafy spurge control by up to 20%. For suppression of leafy spurge on sensitive sites apply a tank mix of 7 fl oz/A Milestone plus 1 qt/A 2,4-D plus 4 oz/A of OverDrive.

<http://bit.ly/leafyspurge>

### EXPLORE MORE CONTROL RECOMMENDATIONS AT

<http://techlinenews.com>

### KNOTWEEDS

<http://bit.ly/knotweeds>

### WOODY PLANTS

<http://bit.ly/woodyplantcontrol>

### HAWKWEEDS

<http://bit.ly/hawkweeds>

### COMMON TEASEL

<http://bit.ly/teasel2014>

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## SELECTING, MAINTAINING & CALIBRATING EQUIPMENT

### TIPS FOR SELECTING, MAINTAINING, AND CALIBRATING BACKPACK SPRAYERS

Learn key features to consider before purchasing a backpack sprayer, maintenance guidelines, and TechLine reader-reviews of backpack sprayer equipment. <http://bit.ly/sprayerselection>

### SELECTING ATV OR UTV HERBICIDE SPRAYER PLATFORMS FOR WILDLAND AND NATURAL AREA MANAGEMENT

We asked 10 public and private invasive plant management professionals which ATV and UTV herbicide application platforms they recommend and why. Learn about the equipment they endorse based on experience. <http://bit.ly/atvutvplatform>

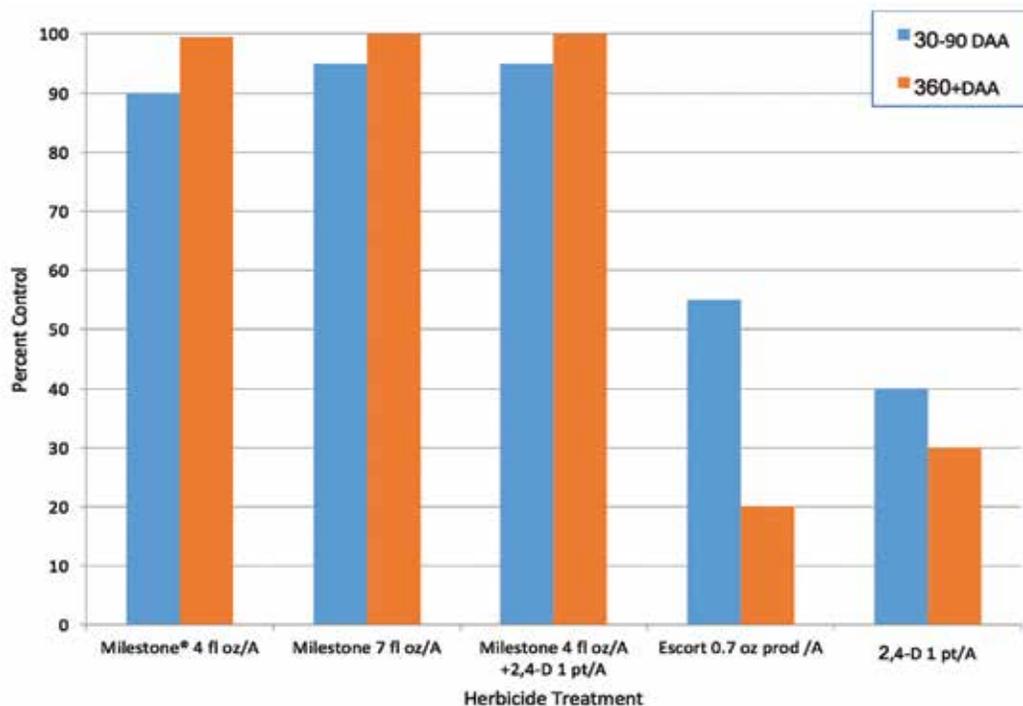
### CALIBRATION GUIDELINES FOR SMALL (BACKPACK) AND LARGE VOLUME (ATV-, TRUCK-MOUNTED BOOM AND BOOMLESS) HERBICIDE SPRAYERS

How do I make the most of my herbicide spot treatments? How much herbicide do I put in my tank? The answers to these questions plus step-by-step procedures for calibrating your large and small volume sprayers are included in this article. <http://bit.ly/techlinecalibration>

### MOBILE APPS AIDING IN HERBICIDE APPLICATION

Explore smart phone apps that calculate tank mixes and log application records. <http://bit.ly/applicationapps>

... Continued from page 9



**FIGURE 5.** Percent sulfur cinquefoil control with various herbicides and combinations the season of treatment and one year after treatment. (DAA=Days After Application). \* Milestone and 2,4-D data are summarized across six field trials in the US and Canada; only one study included Escort.

plants that are close taxonomic relatives. A rust fungus (*Phragmidium ivesiae*) infects sulfur cinquefoil in the northern Rocky Mountain region; however, its effectiveness is limited.

### REVEGETATION

Long-term effective management of sulfur cinquefoil is unlikely in areas where desirable plant species are absent, such as disturbed areas or those dominated by annual grasses. Restoring desirable plant species and communities that resist weed invasion should be considered an integral component of the management program. Recommendations for desirable species adapted to a specific area can be obtained from state universities, cooperative extension service, Natural Resource Conservation Service, and private conservation organizations such as Pheasants Forever.

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**Active ingredients for herbicide products mentioned in this article:**  
Milestone (aminopyralid); Escort (metsulfuron methyl)



BRIAN RISKAS, RMD SYSTEMS

# ARE DRONES IN YOUR FUTURE?

BY CELESTINE DUNCAN

## *New Technology for Treating Invasive Plants in Inaccessible Areas*

**E**ngineering firms specializing in mobile robotic systems have developed multirotor drones (Unmanned Aerial Vehicle- UAV) complete with a lightweight spray system that can be used for a variety of agricultural applications. Most of the agricultural drones available on the market today were designed specifically to improve precision agriculture in row crops. However, some of these systems may have application for managing invasive plants in natural areas. An example is the Vector R30, a carbon fiber and aluminum constructed drone capable of autonomous flight in adverse condition. Flight time can be as long as 45 minutes with a small stabilized camera payload, and up to 35 minutes with a 1 gallon sprayer payload.

Spray systems vary depending on the manufacturer, but the Vector R30 uses pressurized gas to propel the liquid out of the tank. A small solenoid valve controls the release of liquid product from the tank. The valve is controlled by a switch on the operator's hand held controller, or automatically by the autopilot system (such as flying GPS waypoints). Advantages of this system are lighter weight and increased reliability. With only one moving part (the solenoid spool) the tank system can be maintained in the field with simple hand tools.

The tank system can be fitted with a variety of nozzles, depending on the application. For example, when using the tank to spray specific targets, a pencil nozzle can be fitted that allows for a cohesive stream

of liquid to be delivered to the target plant. A small real time camera system fitted to the nozzle allows for exact placement of the product on the intended target. Because the nozzle is placed in the center of the drone vehicle, the rotor wash does not affect the liquid stream, thus minimizing drift. A boom spray system is also available and is capable of dispensing small metered amounts of liquid over a wide area.

Drones and sprayer systems must be fully compliant with the regulations laid out under the Federal Aviation Administration Part 107, and allow operation by anyone possessing a small Unmanned Aircraft System (UAS) operator certificate (similar to a driver's license). Agricultural drones are available for purchase from the manufacturer, and most come with training sessions as well as phone and email support. Some companies will contract the drone and spray system, along with an operator, to land managers that want to measure the utility and effectiveness of the system on their lands.

### LEARN MORE

#### Vector R30 system

[www.RMD-Systems.com](http://www.RMD-Systems.com) <http://www.rmd-systems.com/vector-r30/>

#### Agricultural Drones: An extensive Overview

<http://www.droneguru.net/agricultural-drones-an-extensive-overview/>

**NOTE:** Reference to the Vector R30 does not imply the endorsement by Techline, but it is used as an example of technology that is available to invasive plant managers.



## HERBICIDE SPRAYER NOZZLES

### NOZZLES: SMALL IN SIZE —BIG IN IMPORTANCE.

Spray nozzles are an important part of your herbicide application program. There are many different types of nozzles available from manufacturers, and each nozzle can perform differently. Review some guidelines for selecting the proper spray nozzles and operating them effectively.

<http://bit.ly/nozzletips>

### PROFESSIONAL INSIGHTS ON SPRAYER NOZZLE SELECTION, MAINTENANCE, AND OPERATION

We asked 13 invasive plant management professionals to provide insight and tips on nozzle selection and maintenance based on their field experience. See what the professionals suggest for type and size of nozzles for backpack and ATV/UTV or truck-mounted sprayers, supplemental equipment, and best practices for calibrating, maintaining, and replacing nozzles.

<http://bit.ly/nozzlereview>

### UNDERSTANDING PERFORMANCE OF YOUR ATV-MOUNTED BOOMLESS SPRAY NOZZLES

A summary of field studies by Robert Woolf and others at Kansas State University to evaluate the effectiveness of spray nozzles on all-terrain vehicles (ATVs).

<http://bit.ly/boomless>



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## TRAINING OPPORTUNITIES & RESOURCES

### TURN AROUND, LOOK AROUND

A presentation to use for spring training programs for private, commercial, and government herbicide applicators and staff. The downloadable PDF includes over 40 slides highlighting important guidelines applicators should follow before, during and after herbicide application.  
<http://bit.ly/turnaroundlookaround>

FIND MORE RESOURCES  
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