TechLine

Information About Invasive/Exotic Plant Management December, 2000

Post-fire Opportunities Key Invasive Plant Management Progress and Success

It was a severe wildfire season in the Western United States this year. The debate over preventing similar future seasons is multi-faceted. One facet involves invasive species and their cause and effect relationship with fire. Used as prescribed burns, fire can be a useful setup tool for integrated weed management. In the aftermath of wild burns, fire aggressively multiplies weed infestations, but presents unique control options. Dozens of researchers are studying the intricate relationships between fire, invasive species, management techniques, and post-fire ecosystem rehabilitation.

This special issue of *TechLine* summarizes several of these studies and several successful post-fire management programs. Our goal is to lay a foundation of knowledge so that land managers do not waste time on techniques that may not be effective. Instead, with proper planning and preparation, managers can capitalize on the invasive species control opportunities that occur after a fire, whether wild or prescribed.

As always, our goal is to present information that is practical and translates into techniques you can use on an ongoing ***operational basis***. We realize you operate under limited budgets and labor availability. You must also meet the demands of a public that does not always understand the constraints they place on your ability to do the job they ask of you. Effective and successful invasive species management can be only those techniques that manage unwanted vegetation under the operational constraints that you work under each day.

"We have tried on a large scale the experiment of preferring ourselves to the exclusion of all other creatures and plants, with results that are manifestly disastrous. To answer to the perpetual crisis of our presence in the abounding and dangerous world, we have only the perpetual obligation of care."

Wendell Berry,
Another Turn of the Crank

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Protecting Relatively Uninfested Lands: Reducing Weed Spread Following Fire

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Wildland fire is a natural process that often helps to maintain or improve the health and productivity of native plant communities. However, when invasive exotic plants are involved, fires burn in an unnatural situation. There are two purposes to this presentation. The first is to show how weeds often proliferate following wildland fire. The second is to discuss how reducing post-fire weed spread is one of the best ways to keep relatively uninfested land from becoming seriously infested. It is common knowledge that various plants respond differently to fire. However, all too often weeds rapidly infest burned areas frequently causing vast and permanent damage. Therefore the intent of this presentation is to increase the awareness about this problem along with providing some recommendations - with every intention to support appropriate prescribed fire efforts.

How vulnerable are typical wildland sites following fire?

Factors like an ideal seed bed, reduced competition from native plants and increased nutrients released by the fire all combine to make conditions ideal for weed seed to germinate and flourish following fire. With conditions ideal, how much weed seed is likely to be available on any burned site?

There are about 70 million acres of noxious weeds, primarily on wildlands, in the 11 western states (outside of Alaska). Consequently there are roughly 70 million acres of weed seed produced every year! Much of that seed is making its way to relatively uninfested land by wind, water, wildlife, livestock, people and equipment. Therefore, after wildland fire in a previously uninfested area, there is a high likelihood for both ideal conditions for weed establishment, and the presence of weed seed. Furthermore, biennial and perennial weeds, already present in the fire area, commonly sprout from buds or crowns. Squarrose knapweed, diffuse knapweed and rush skeletonweed for example often re-sprout, flower and set seed within six weeks of a fire - while most other vegetation is dormant waiting another season to produce seed. This almost immediate seed production following fire gives the weeds yet another advantage.

Examples of weed spread following fire

Every year we learn more about the challenge of reducing the spread of invasive wildland weeds. A multitude of post-fire photographs in many western states make it clear that weeds frequently invade and dominate plant communities following fire, sometimes on a large scale. For example, in the Bureau of Land Management Sand Butte and adjoining Wilderness Study Areas in Idaho, considerable weed surveillance and successful control of leafy spurge had been underway for many years. A 200,000-acre wildfire burned over the area in 1992. Rush skeletonweed was not known to exist there until 1995, when a few rush skeletonweed plants were found and controlled. In 1996 another wildfire, also about 200,000 acres, burned the entire area again. A preliminary detection survey in 1997 found serious rush skeletonweed infestations widely scattered within a 60, 000 acre area of the burn.

In a research example from northern Utah, wildfire increased squarrose knapweed abundance by 50% to 120% within just two years. Control of squarrose knapweed from herbicide applied in the first fall after a summer burn was 98% to 100% effective, while the same herbicide treatment achieved only 20% control or less in adjacent non-burned areas. Not only did this study show that invasive weeds can increase dramatically after a fire, but it also shows that post-fire

herbicide application is a unique window of opportunity for effective control.

Recommendations

With weeds spreading at about 4,600 acres per day on western federal lands alone (outside of Alaska), the overarching goal becomes keeping relatively uninfested land from becoming seriously infested. Capitalizing on the opportunity to prevent weed spread after fires is cost effective and efficient.

Readiness and post-fire vigilance:

1. At the earliest possible time, hopefully before the fire season, ensure that the NEPA process is adequate to cover timely application of herbicides - if needed *anywhere on the landscape*. The proper process needs to be in place so an environmental analysis update or amendment or whatever documentation is needed does not unduly delay the application of herbicides in order to avoid weed seed set after a fire.

2. Establish procedures that minimize the transport of weeds into or within a proposed fire or burned area.
3. Include existing, or consider involving new cooperators. Weed management efforts have a higher probability of success when adjacent landowners, public land users, agencies, universities, or other interested people are participating.
4. After fires, when weeds begin to "show life" either starting from seed or sprouting from crowns or roots of existing plants, there frequently are outstanding opportunities to control the weeds. Weeds are usually easier to find for hand control or other mechanical techniques, and herbicide application is more effective because weeds are no longer protected by non-target vegetation or debris. Capitalize on this rare opportunity before the weeds have a chance to produce seed.
5. Build the cost of weed management caused or encouraged by the disturbance of the fire into fire rehabilitation plans. In 1998 the Bureau of Land Management, Forest Service, Fish and Wildlife Service and the Park Service were given new authority to use fire rehabilitation funds to control weeds following wildfire, including weed detection and control in subsequent years. Where rehabilitation plans are not intended, use creativity and perseverance to ensure that invasive weeds get the priority they deserve.
6. Approximately one month after any fire, survey the entire fire area for signs of new or sprouting weeds. Repeated surveys will be needed, with the frequency and intensity guided by local conditions.
7. Develop and implement a strategy to control the weeds including follow-up detection and treatments for a few years until the populations are completely controlled or eradicated.

Prescribed fire planning:

Before burning evaluate the potential for increased weed populations and consider the following:

1. Check existing weed maps and visit with local weed experts. Then survey the entire proposed burn area for weeds. If a few weeds have been on the site for a year or more it is likely that thousands of unseen seeds are in the ground ready to germinate.
2. Check adjacent land for weeds that may become a seed source following the burn. These areas may provide weed seed to the burn area via transport by people, livestock, wildlife, wind, water, vehicles or other equipment.
3. Enlist the advice of agency weed coordinators, extension agents, Department of Agriculture or county weed supervisors regarding plans to minimize the increase in weeds. Where possible, time the burn to reduce seed production of existing weeds. Make sure that equipment, vehicles and personnel do not bring weed seed in with them from other areas.
4. Ensure that the appropriate NEPA process/ requirements for weed control are addressed before the fire to avoid any delays in timely application of herbicides in the event they are needed.
5. Keep a log of weed management activities so you can share your experiences with others.

Level of urgency:

Nature often helps put out fires; nature does not help "put out" weeds. Fires are often very beneficial, but weeds are not beneficial. If and when there are negative impacts from fire, they are usually short-term, whereas impacts from weeds are long term and often permanent.

Therefore, new infestations or small burned infestations poised to proliferate out-of-control, truly constitute a state of biological emergency! When preparing NEPA documents, keep that concept in mind regarding the emergency nature of controlling weeds following fire before they have a chance to set seed.

In conclusion, we must keep relatively uninfested land from becoming seriously infested. Future generations deserve to inherit healthy, productive wildlands, not vast landscapes infested with noxious weeds that are unfit for people or wildlife.

Pre-fire Planning Insured That The Railroad Fire Turned Into An Invasive Species Management Opportunity

By Charles Henry
TechLine Editor

By the time it was contained on July 8, 1999, the Railroad Fire in the Great Basin of Utah had consumed 63,000 acres. Sixty percent of this fire was on BLM land that contained infestations of squarrose knapweed and other invasive, non-native vegetation. However, BLM land managers were ready once the fire was out. Pre-fire planning insured that the Railroad Fire turned into an invasive species management opportunity.

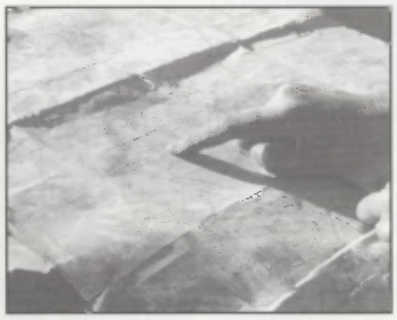
"Your window of opportunity for effective post-fire weed management is the fall and spring following the fire. This window is relatively short, but it is critical. Once cheatgrass, knapweed, or other invasives take over that site, the site's capability threshold lowers. This renders site rehabilitation almost operationally impossible. Once a site's natural capability is lost, only a massive infusion of management inputs can bring it back and most of the time we simply don't have the money or manpower for those inputs," Pat Fosse explains. Fosse is BLM's assistant field manager in the Fillmore Field Office.

"Research shows that invasive species like knapweed really explode after a fire," Fosse says. However, weeds are also easier to spot for mapping and treatment and easier to kill after a fire. We view fires as an opportunity to get ahead of noxious weeds, but it requires planning and pre-fire prep work."

After the fire, Fosse spent 15 days mapping the burned area. From Sept. 1 through freeze-out on Nov. 1, 1999, BLM seasonal ATV spray crews already hired for the spring through fall season were spot spraying roads, washes, and draws with Grazon* P+D at a rate of 3 qt./acre in 25 gallons of water per acre. The ATVs were equipped with Boom Buster nozzles capable of 15 to 20-ft. widths and handguns.

Fosse mapped out 5,600 acres that were aerially treated with Grazon P+D at 3 qt./acre in five gallons of water with fixed-wing aircraft on September 28 through October 3, 1999. On April 28, 2000, an additional 3,960 acres were aerially treated. In November 1999, grass seeding with drills and aerial seeding were completed on the burn. In December, the aerially seeded areas were chained to incorporate the seed and break up burned brush, pinyon, and juniper trees.

Pat Fosse, BLM's assistant field manager in the Fillmore, Utah office, examines weed maps (below) prepared before the Railroad Fire burned. To begin mapping, she puts the perimeter of the fire(s) over their weed inventory in GIS and prints the maps. This gives them a good idea where to start.



In the spring of 2000, Fosse, along with the seasonal spray crew, checked all the roads again and in the fall the seasonal ATV crews work back through the burned area to spot-treat any escapes. "We achieved 90% to 100% control of squarrose knapweed with this program. Overall, we had more areas with 100% control in the spring treatments, based only on our visual analysis," Fosse states.

Fosse says land managers should be confident that they can achieve the same results on other knapweed species. "Based on university research, squarrose knapweed is one of the more difficult species to control,

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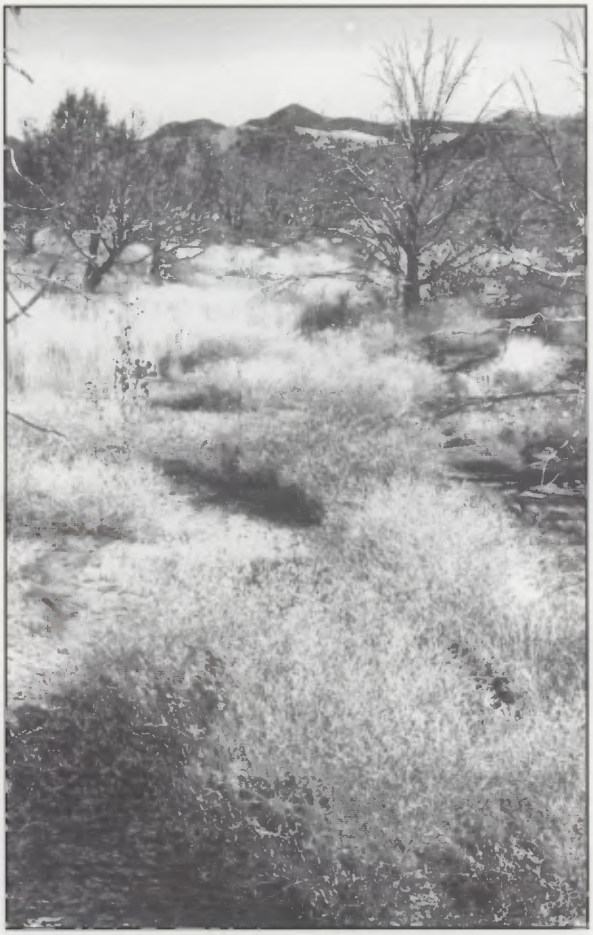


Contrast healthy, nearly weed-free range that has had invasives controlled after a fire (above) with areas after a fire where squarrose knapweed has not been managed (left) and thus dominates other desirable vegetation.

so results should be similar or even better on Russian, spotted, or diffuse knapweed."

"Re-seeding is critical in our situation," she says. "Plant competition enhances herbicide effectiveness and herbicides enhance grass competition. The two practices are integral in areas without adequate understory, so I recommend that if you don't have the budget to re-seed, then don't waste your money spraying. You must look at the understory with weed work to know a site's capability and how much competition is enough to keep unwanted weeds from re-invading the site."

Fosse also says that no one agency can do it alone. Their success is only achieved through the cooperation and assistance of local counties (Juab County and supervisor Bob Garrett in the Railroad Fire), state lands, the Utah Department of Agriculture, the USDA Forest Service Rocky Mountain Research Station, Utah Division of Wildlife Resources, and other agencies.

"Your plan and management tools must be operational to be successful," Fosse concludes. "Cooperation with private landowners and other agencies is the best way to save time and money so you can get the job accomplished."

Keys to Emergency Fire Rehabilitation Weed Management

1. **Be prepared.** In your Normal Year Fire Plan and NEPA make sure you include detection, control and monitoring for noxious weeds. Then when a fire burns through an area in which weeds occur or are likely to spread, you only need to complete a tier to your existing NEPA document.
2. **Make sure that your** Pesticide Use Proposal (PUP) covers the entire area under your jurisdiction, not just where you plan to treat for that year. This allows flexibility, not only to treat any new, small infestations of noxious weeds as they are found, but also to treat within any burned areas, as necessary.
3. **Have an existing GIS inventory completed!** When the fire is controlled, layer the fire perimeter over the weed inventory. It will be very helpful, not only in justifying your request for weed management funding in your EFR plan submission, but also in planning where to start your intensive weed mapping for post-fire weed management. To begin mapping, put the perimeter of the fire(s) over your weed inventory in GIS and print your maps. This will give you a good idea where to start. If you do not have an existing GIS inventory, don't let it prevent you from post-fire weed management. Weeds are easily seen to map and treat following a fire and it may be a good opportunity to start your GPS inventory.

One tip in EFR projects is to use different colored flagging to indicate different treatments. Example:

See "Weed Management Opportunity" on page 6

"Weed Management Opportunity"

Continued from page 5

drilling is marked by green flagging, chaining by orange flagging, survey corners and areas to avoid within the drill or chain areas are marked with pink, weeds with blue, etc. Once areas are flagged, GPS the different treatments and use your Arc View maps to prepare contracts.

4. Most noxious weeds are easily mapped in the fall following a fire. They are the first, and sometimes the only, species to emerge from the blackened soil during the first few months following the fire. For example, many plants of squarrose knapweed are 18 inches tall and in full flower during September or October following a fire.

5. Take your spray tank with you when you are mapping. Any very small infestations can be treated immediately without slowing you down in your mapping effort. Bigger infestations should be mapped either for ATV, truck, or aerial treatment depending on the size and density of the infestation.

6. Our ATV crew starts in burned areas in September. Roads and trails that will be used by other agency staff working on the EFR effort should be checked and if necessary, treated as highest priority to stop spreading weed seed into the burned areas.

7. We have been very successful with October and April aerial and ground treatments following a fire. Research completed by Steve Dewey, USU Extension Weed Specialist, shows that if knapweed occurs in an area that is burned and no treatment is completed, the knapweed would increase as much as 120% in one year ***(see page14)***.

8. Develop an Agreement or MOU with the County Weed Department. The county procurement process is much less time consuming than Federal agencies. Therefore, if you have an Agreement or MOU in place, money can be transferred to the counties and they can hire the aerial contractor or complete work that you do not have the capability to complete. There are two documents that can be used to transfer money to counties – Justification for Noncompetitive Procurement (JNCP) and Assistance Agreement (AA).

9. In areas you plan to aerial spray for weeds, do not include any forbs or shrubs in the seed mix for that area. If you spray in the fall, spray at least two to three weeks before you fly the seed on, so the herbicide does not affect the grass seed. If you spray in the spring, you must wait until the seeded grasses have their second leaf. In Utah, that is about mid-April.

(Top) Left to right: James Hone, R.B. Probst, and AdamTurner prepare to clean up missed patches of knapweed in Utah's Railroad Fire burn. (Middle) ATVs are equipped with Boom Buster nozzles for broadcast work. (Bottom) Each unit also carries a hand nozzle for precise spot treatments of individual plants.

10. Use an aerial applicator who has planes or copters equipped with GPS, as they are much more accurate in applying the herbicide where it is intended. If areas are mapped and flagged, it is easy to talk to the pilots every time they land and guide them through the areas. It is necessary to have someone very familiar with the area to do this.

11. Aerial treatments should be "cleaned up" by ATV crews about 6 months after the initial treatment to control any obvious survivors and protect your investment.

12. Any treatments should be monitored with at least photo plots. Permanent transects can also add valuable information.

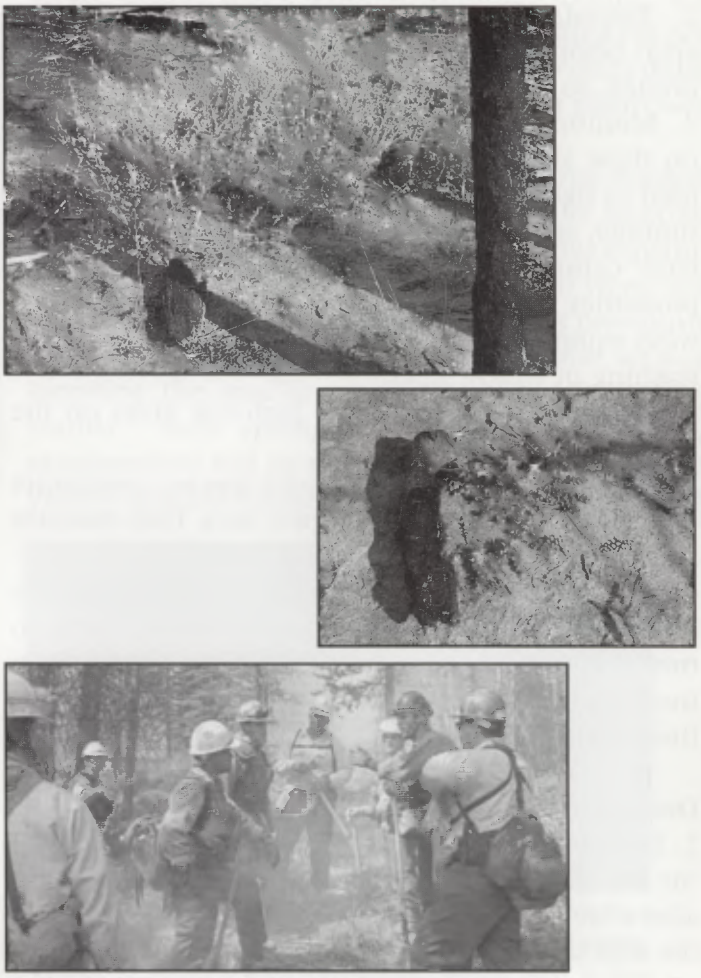
Prepare to Handle Post-fire Weed Explosion Within Two Years of a Fire

By Charles Henry
TechLine Editor

The rangeland management specialists on the Helena National Forest don't play with fire, but they do use prescribed burns to supplement their invasive species management and learn more about fire's effects on weeds. Jay Winfield, rangeland specialist on the Helena and Lincoln Ranger Districts in Montana, says they know that fires promote weed growth and spread. Forbs usually come back first after a fire and most invasives are forbs. "We see a doubling in density of some species such as Dalmation toadflax."

"You must be ready to handle this explosion and do the control work within two years of a fire because this window of opportunity is when your post-fire herbicide treatments are most effective." In recent trials, Helena range specialists treated Dalmation toadflax in the fall with Tordon* 22K herbicide at rates from 0.25 lb per acre to 0.5 lb per acre. The following spring they burned the area and repeated the herbicide applications. "On shallow soils inhabited with blue bunch wheat grass, we achieved good control. Heavier soils vegetated with rough fescue displayed excellent control results," Winfield explains.

"The Cave Gulch fire burned during the summer of 2000 on the Helena National Forest. This fire burned with high intensity with lethal effect to most of the vegetation in the path of the fire. The Cave Gulch fire burned into this area that had been prescribed burned and chemically treated within the past two years. Once the fire perimeter reached the previously managed area, the fire burned with reduced intensity and at a much slower rate of spread. The fuel reduction area actually stopped the Cave Gulch fire in some areas, forcing the fire to burn around the previously treated area. So we look at prescribed fire and the wildfires as an opportunity to get ahead of weeds, but you have to be prepared to follow up with aggressive herbicide treatments following fire. And you must plan ahead to reduce the role fighting wildfires play in spreading invasives," he explains.



(Top and middle) Dalmation toadflax emerges first after a forest fire in Montana. Mapping and treating weeds when they are visible and easy to find is one way to get ahead of difficult infestations. (Bottom) Make fire management teams aware of where you have treated weeds, have made biological releases, or done other weed management. At times they can move fire lines away from and minimize soil disturbances in these areas if they know about them ahead of time.

Following are operational techniques that will minimize invasive species spread:

Pre-fire Planning:

1. Pre-establish base camp locations for each mountain range and coordinate these locations with the forest

See "Prepare" on page 8

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Tordon 22K is a federally Restricted Use Pesticide.

"Prepare"

Continued from page 7

service, state forests, private landowners, the Department of Agriculture, and Department of Natural Resources and treat these accordingly.

2. Pre-establish heli-bases and heli-landing staging areas before the fire season. In timber, these sites are limited, so they are easy to designate.

3. Monitor and manage invasive species infestations on these sites so they are weed-free before they are used to fight fires. "On the Boulder Hill fire this past summer, spotted knapweed was scattered throughout base camps on U.S. Forest Service and private properties," Winfield states. "All base camps power-wash equipment, but this is somewhat futile if you are washing in weedy areas."

4. Flag off high-infestation, high-risk areas on fire maps.

5. It's critical to conduct invasive species inventories by mountain range or geographic area, then monitor and treat these areas before they burn.

6. Target your education efforts to experienced fire fighters regarding weed ID and the weeds' effects so they don't spread species such as houndstongue on their clothing and packs. Direct these fire fighters to then inform supplemental crews about weeds.

During the Fire:

1. If possible, determine the intensity and duration of the fire. This helps predict where weeds might occur after a fire. Fires change the hydrophobic condition of the soils so they shed water more because the organic bonding capability is reduced. After a fire, more sunlight reaches the soil and the litter component that aids in moisture retention is removed. These conditions predict high-risk areas for weeds after a fire.

Helena National Forest resource specialists recommend pre-establishing heli-bases and heli-landing staging areas before the fire season. In timber, these sites are limited, so they are easy to designate. Monitor and manage invasive species infestations on these sites so they are weed-free before they are used to fight fires.

2. Make fire management teams aware of where you have treated weeds, made biological releases, or performed other weed management. At times they can move fire lines away from and minimize soil disturbances in these areas if they are informed ahead of time.

Post-fire Management:

1. Verify your mapping and step up your monitoring after a fire so weed outbreaks are caught early and their management cost is covered in your budget.

2. Increase treatments if possible. The first two years are critical after a fire.

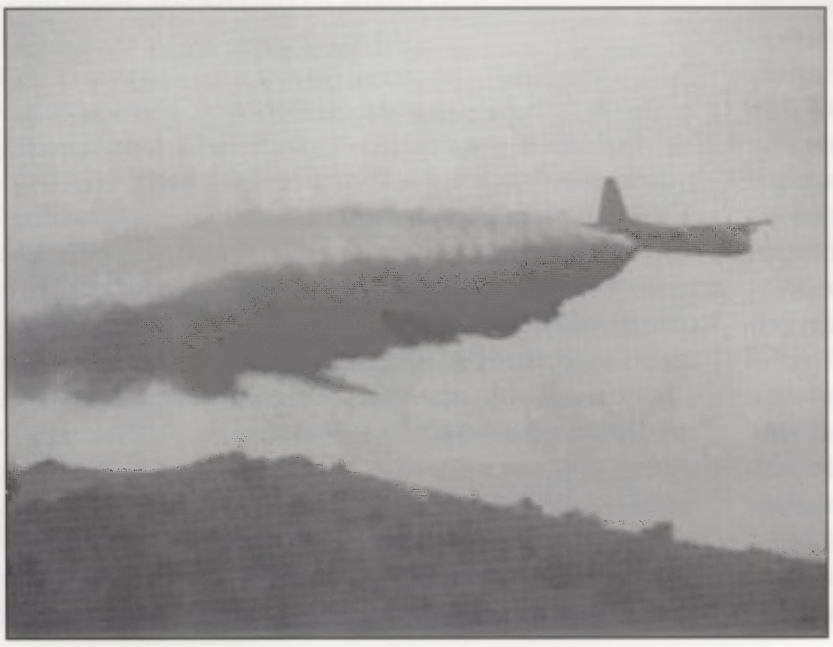
3. Re-vegetation work must go hand-in-hand with weed treatments.

4. If non-native grass species already exist on a site, they may be the best choice for initial re-vegetation work since they are more competitive than many native species. Decisions should be made site by site after field inspection.

5. Monitor all treatments and plan for re-treatments as needed.

6. Minimize human disturbances such as ATVs, snowmobiling, and even non-motorized uses to lessen weed spread and introduction from the outside.

7. Educate the public to avoid recreating in burned areas so they don't undermine weed treatments and re-vegetation work.



Range Fire Opens Door to Rush Skeletonweed Inventory and Management

By Charles Henry
TechLine Editor

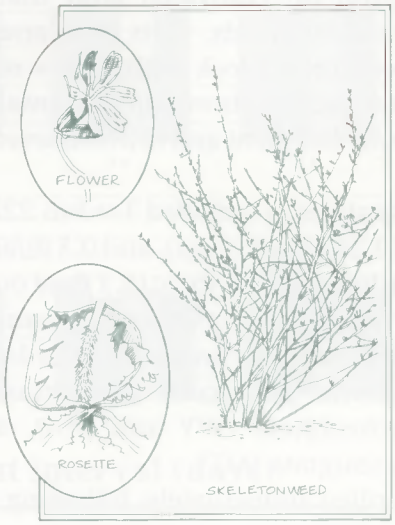
A lightening-caused fire presented an unexpected solution to a difficult invasive species management problem for BLM and private land managers in eastern Oregon. In addition to their normal practices for emergency fire rehabilitation (EFR), Lynne Silva and Jerry Erstrom, BLM weed program coordinators for the Malhuer and Vale Resource areas, saw a chance to get ahead of developing rush skeletonweed infestations after the 80,000-acre Jackson Fire.

"We knew there were scattered infestations out there, but we couldn't find them in any sort of efficient manner due to populations of mustard, brush, cheatgrass, and other vegetation. The fire opened the canopy and within three to four weeks we could see rush skeletonweed 18-inches to 2 ft. tall. Within six weeks it was blooming and setting seed, so we had little time to act."

Silva's solution, in cooperation with the Oregon Department of Agriculture, Malheur County, private landowners, and the local soil conservation district, was a helicopter. In four days of concentrated, slow, low-level flying, they spotted and GPS-positioned hundreds of sites right down to 25 plants or less on the entire 80,000 acres. Prior to drilling, seeding, and other rehabilitation efforts, BLM crews visited the new sites to clip and bag existing plants so the drills didn't spread them further. Sagebrush and other plants were re-seeded by air.

Where rosettes appeared, crews treated with Tordon* 22K herbicide at 1 qt./acre. "You could ascertain where we had used Tordon 22K before," Silva explains, "there were no weeds since there was no weed seed source. We had treated the larger patches previously, because we could find them. But after the fire, we were targeting the smaller, more isolated skeletonweed stands." Next spring the newly-found spots of skeletonweed will be monitored by horseback before yellow mustard flushes obscure the weeds again.

(Left and above) The fire opened the canopy and within four weeks rush skeletonweed 18-inches to 2 ft. tall was visible. Within six weeks it was blooming and setting seed. In four days of concentrated, slow, low-level flying, project cooperators spotted and GPS-positioned hundreds of sites right down to 25 plants or less on the entire 80,000 acres.



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Tordon 22K is a federally Restricted Use Pesticide.

The Effect of Tordon 22K and Transline on Establishment of Three Range Grass Species

By
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Roger Sheley, Montana State University
Jay Gehrett, SprayTech
Mary Halstvedt, Dow AgroSciences

Noxious weeds such as spotted, diffuse, and Russian knapweed, and yellow starthistle infest millions of acres in the Western United States. Although many infested sites have an understory of perennial native species, some areas are devoid of competitive desirable plants. Introducing and establishing competitive plants is essential for successful management of weed infestations on degraded rangeland. Single-entry methods of revegetation that include a herbicide treatment immediately followed by seeding desirable species would reduce costs and increase efficiency of rangeland restoration efforts.

The purpose of this study was to evaluate the effect of Tordon 22K and Transline on grass seedling establishment, vigor, and biomass at various time intervals following herbicide application.

Materials and Methods:

The study was conducted in Montana, Wyoming, and Washington on cultivated land that was not infested by noxious weeds. Plots were arranged as a randomized complete block with 3 or 4 replications per treatment at each location. Supplemental irrigation was used for establishment and to avoid severe drought stress.

Herbicide treatments included Tordon 22K at 0.125 lb/ac (1 cup), 0.25 lb/ac (1 pint), and 0.5 lb/ac (1 quart) per acre, Transline at 0.125 lb/ac (5.3 fluid ounces) and 0.5 lb/ac (21 fluid ounces) per acre, and an untreated control. Grass varieties included Nordon crested wheatgrass, Luna pubescent wheatgrass, Goldar bluebunch wheatgrass (WY and WA), and Secar bluebunch wheatgrass (MT).

Seed was drilled immediately following herbicide application (0 day), 3 or 4 weeks following application, and 6 or 7 weeks following application. Evaluations included percent vigor of grasses and grass establishment in 1997. Grass biomass was measured in 1998 by clipping plots, drying, and weighing each grass species. Data were analyzed by Analysis of Variance.

Results and Discussion:

Tordon at rates less than 0.5 lb/ac (1 quart) and Transline at all rates did not affect grass seedling establishment, vigor, or biomass at any application timings. Tordon 22K at 0.5 lb/ac applied at the time of seeding (0 day) did not affect grass establishment, but slightly decreased grass vigor especially on sandy textured soils.

Results of the study indicate that Transline at rates up to 0.5 lb/ac and Tordon 22K at rates up to 0.25 lb/ac could be applied immediately prior to seeding wheatgrasses without adverse effects to seedling establishment, vigor, or biomass.

Although these data indicate that wheatgrass seedlings are tolerant to Tordon 22K and Transline herbicides, some species, such as smooth brome, may be more sensitive. Therefore, the Tordon 22K label recommends that weed infested sites should be treated in spring or early summer, and grasses seeded in fall when conditions are favorable.

Another option would be a fall herbicide application followed by seeding 14 days following application. The 14-day delay in seeding will optimize weed control and reduce the possibility of injury on sensitive grass species. Tordon 22K application rates should be less than 0.5 lb/ac (1 quart per acre) on sites that will be seeded.

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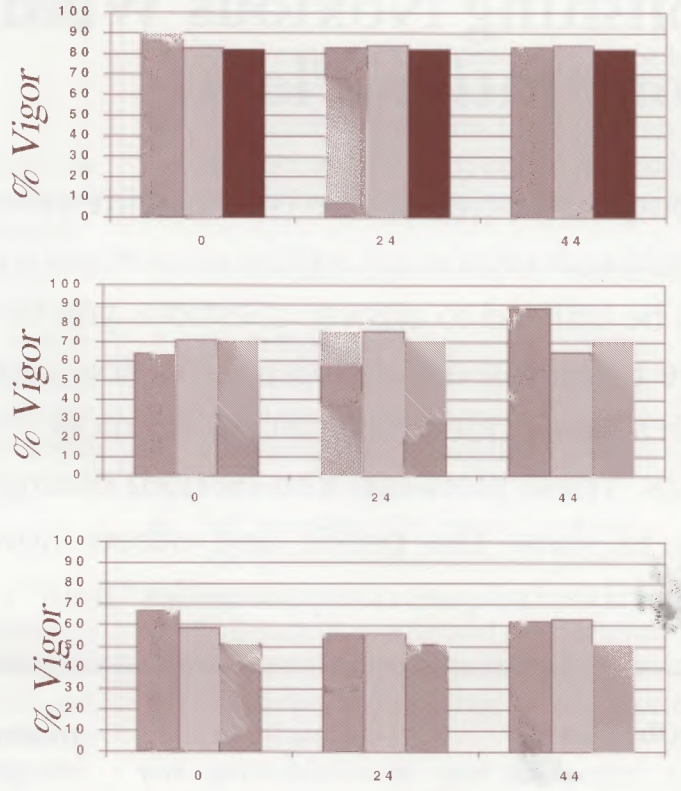
Figure 2: Effect of Transline Pre-Plant Applications

** There were no statistical differences.*

'Luna' pubescent wheatgrass

'Nordan' crested wheatgrass

'Goldar'/'Secar' bluebunch wheatgrass



0.125 lb/A **0.5 lb/A** *Untreated*

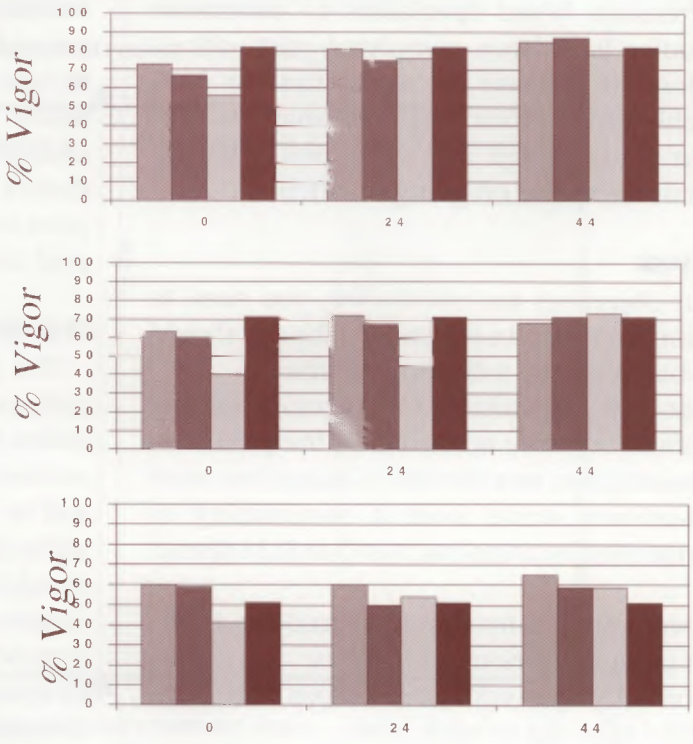
Figure 1: Effect of Tordon 22K Pre-plant applications

** There were no statistical differences.*

'Luna' pubescent wheatgrass

'Nordan' crested wheatgrass

'Goldar'/'Secar' bluebunch wheatgrass



0.125 lb/A **0.5 lb/A**
0.25 lb/A *Untreated*

Establishing Noxious Weed Demonstration Plots

By Celestine Duncan
Weed Management Services
Helena, Montana

The purpose of this article is to outline procedures for designing demonstration plots on noxious weeds. These plots can be utilized to answer questions you or the public may have regarding effectiveness of various management tools such as herbicides, physical, mechanical, or biological treatments. These plots can also be used during tours and meetings to show the public and others how different management techniques compare under "field" conditions.

Establish Objectives:

The most important step in establishing any demonstration plot is to develop a clear objective for the study, such as "Compare the effectiveness of various biological and mechanical treatments on cover and density of spotted knapweed."

In developing your study objectives, you should contact Extension Weed Specialists to determine whether studies have been completed that address your questions, or if there are demonstration plots already established in your area. You may want to modify your study design and objectives based on previously conducted or on-going research.

Site Location:

Once your objectives are established, you need to find a location that best fits the study. The site should be selected based on the following criteria:

1. Sites that will be utilized for "demonstration" purposes should be easily accessible to the public.
2. The demonstration area should be located no more than a 30-minute drive from a community or convenient meeting location (such as FS or BLM district office).
3. Weed cover and density should be uniform in the plot area to compare various treatments.
4. The site should be large enough so various treatments can be applied adjacent to each other.
5. The site should be typical of areas that are infested with the target weed.

Plot Size:

Plot size is dependent on the objectives of the study, treatments that are being applied, size of the application equipment, and sampling methods. In general, individual plots for demonstration purposes of herbicide, mechanical, or manual treatments should be about 20 by 30 feet with a minimum plot size of 10 by 25 feet. Buffer zones of 3 to 4 feet may be needed between treatments to minimize seed contamination, reduce the potential for drift between plots, and allow for good visual observation of the plot without walking through treatments.

Plot Arrangement:

Demonstration plots should be arranged so that various treatments can be viewed easily and treatments are on similar slope, aspect, soil, and vegetation type. Be sure to include an untreated control plot with the treated plots so that visual comparisons or quantitative measurements can be determined. Untreated plots should be located upwind and upslope from treated plots to minimize possibility of drift or movement of seed from other plot treatments.

Plot Identification:

This is critical once the site is located. Individual plot corners should be marked with wooden or metal stakes. Metal rebar can be buried level with the ground on the four outside corners to ensure that the plot area will be permanently marked (metal detectors can be utilized to find the corners if necessary). Treatments should be marked on metal tags and placed on the left corner stake of each plot (see diagram). If possible, the distance from two plot corners to a permanent fixture (telephone pole, building corner, section corner, fence line, etc) should be recorded in a field notebook in case plot stakes are destroyed by wildlife, livestock, or fire. On sites that have high livestock or wildlife use, metal

pins and large metal washers can be buried flush with the ground to mark plot corners. This will minimize disturbance by animals, but it also makes the markers difficult to locate in tall vegetation.

Application Equipment:

Use commercial application equipment or equipment that simulates commercial application, such as experimental plot sprayers for herbicide treatments. Seed drills or herbicide sprayers must be calibrated prior to application so that the rate that is being applied is accurate. In most situations, single nozzle backpack sprayers should not be used for applying herbicides to demonstration plots because of difficulty in maintaining a consistent pattern throughout the plot area. Proper application of all treatments is essential to maintaining integrity of the study.

Record Keeping:

Accurate records must be kept during all aspects of the study. This includes site location and directions to the site, plot layout and design, and application and monitoring information. A treatment list including application rates, date of application, and conditions during application are essential to the study.

Application records that must be recorded include:

1. Name of applicator
2. Date and time of day application was made
3. Make and model of application equipment
4. Equipment calibration records (speed traveled, output)
5. Total output in gallons per acre for herbicide application equipment
6. Application rates (this includes herbicide rate, number of biological agents released, number of people hand pulling, seeding rates, etc).

Environmental conditions to record at application include:

1. Air temperature
2. Soil temperature [at 3 or 4 inches]
3. Wind speed and direction
4. Percent relative humidity
5. Percent cloud cover
6. Soil moisture (dry, moist, or wet)
7. Soil texture (series name if possible), slope, and aspect
8. Soil organic matter and pH if relevant to the study
9. Date to first precipitation event
10. Vegetative growth stage of key species including the target weed

Monitoring:

Monitoring results is critical to the success of

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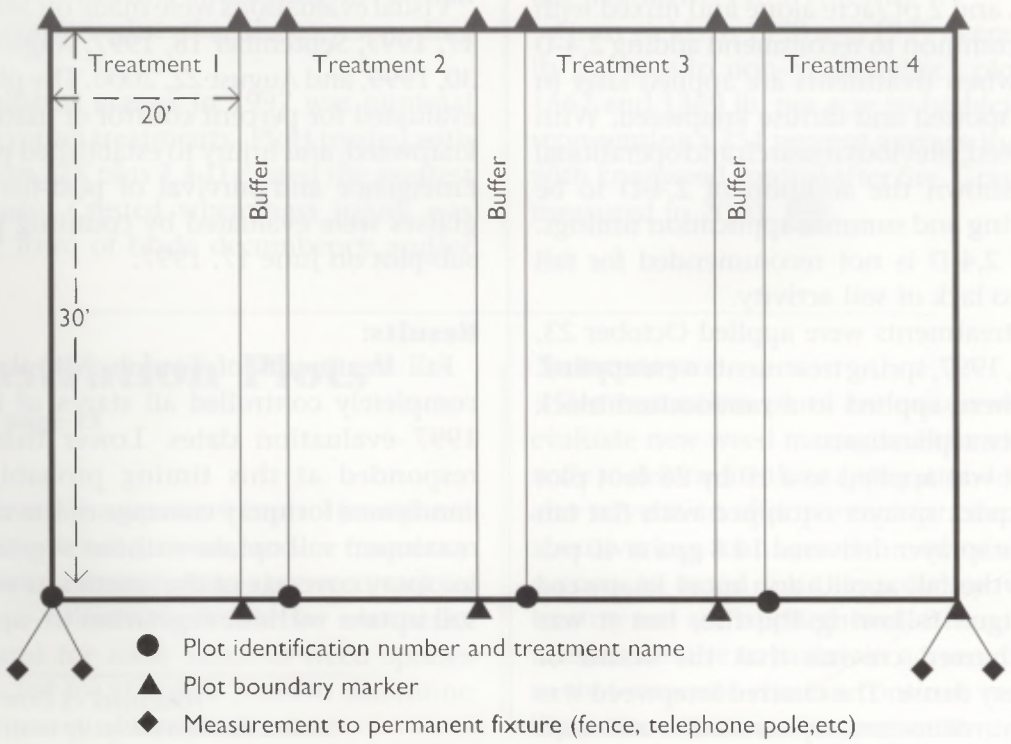
Sample Demonstration Plot Diagram



Squarrose Knapweed Control Following A Wildfire

Research Summary by
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Editor's Note: This article is a summary of research conducted in Utah by Steven Dewey, William Mace, Pat Fosse, Holli Murdock, and Melanie Ballard comparing fall and spring herbicide applications for squarrose knapweed control following a wildfire. The complete study, with chart, may be obtained from the Weed Management Resource Library.

Experimental Method:

An experiment was established at Tintic Junction, Utah. The purpose of this experiment was to compare the control of fall and spring herbicide applications on squarrose knapweed (CENSQ) following a wildfire. The soil type was a Borvant cobbly loam, with a pH of 7.8, and an organic matter content of 1.7%.

Tordon* 22K herbicide was applied at the label rate range of 1.0, 1.5, and 2 pt./acre alone and mixed with 2,4-D ester. It is common to recommend adding 2,4-D to Tordon 22K when treatments are applied later in the summer for spotted and diffuse knapweed. With squarrose knapweed, previous research and operational experience has shown the addition of 2,4-D to be beneficial for spring and summer application timings. The addition of 2,4-D is not recommended for fall treatments due to lack of soil activity.

Fall herbicide treatments were applied October 23, 1996. On May 29, 1997, spring treatments were applied. The treatments were applied in a randomized block pattern with three replications.

Each treatment was applied to a 10 by 25 foot plot with a CO_2 backpack sprayer equipped with flat fan 8002 nozzles. The sprayer delivered 14.8 gpa at 40 psi.

At the time of the fall application most knapweed had not re-emerged following the fire, but it was evident from charred crowns that the stand of knapweed was very dense. The charred knapweed was about ¼ to ½-inch in diameter and protruded ¼ to ½ inch above the soil surface. The ground was otherwise bare of vegetation.

In May, the stand of knapweed was still heavy with about half of the knapweed plants bolting, reaching heights of 4-8 inches, and the other half being seedlings or rosettes. Other plants found in the plots were crested wheatgrass, western wheatgrass, some native bluegrass, and wild sunflowers.

Visual evaluations were made on May 29, 1997, June 17, 1997, September 18, 1997, August 25, 1998, June 30, 1999, and August 22, 2000. The plots were visually evaluated for percent control of mature and seedling knapweed, and injury to established perennial grasses. Emergence and survival of post-fire aerially seeded grasses were evaluated by counting plants in a 1-m^2 sub-plot on June 17, 1997.

Results:

Fall treatments of Tordon 22K alone, at all rates, completely controlled all stages of knapweed at all 1997 evaluation dates. Lower than labeled rates responded at this timing probably due to ideal conditions for spray coverage of the rosettes as well as maximum soil uptake without vegetation conditions for spray coverage of the rosettes as well as maximum soil uptake without vegetation tie-up.

*Trademark of Dow AgroSciences, LLC
Tordon 22K is a federally Restricted Use Pesticide.

(Top) BLM assistant field manager Pat Fosse, Fillmore, UT, points to squarrose knapweed carcasses that emerged after wildfire, but were controlled with herbicide. (Right) Range grasses flourish after knapweed is controlled following a wildfire in the Great Basin of Utah.

Spring treatments of Tordon 22K alone at less than labeled rates did not achieve the same high level of control of corresponding fall treatments. Spring treatments of Tordon 22K plus 2,4-D were more effective than Tordon 22K alone, but still were less effective than corresponding fall treatments. This was especially evident on plants that were seedlings or rosettes at time of evaluation (some of which may have emerged after application).

At the June 1997 evaluation, fall treatments of Tordon 22K effectively controlled the wild sunflowers, but the spring treatments did not. By the September 1997 evaluation, spring treatments containing 2,4-D had higher sunflower control values than the corresponding fall-treated plots.

Injury to established grasses in 1997 was minimal from the fall and spring treatments. Plots treated with mixtures of Tordon 22K plus 2,4-D caused the greatest amount of damage. Crested wheatgrass injury was expressed in the form of blade decumbency and/or mild epinasty. Western wheatgrass and bluegrass plants did not show any damage.

Knapweed control from the 1996 fall applications of Tordon 22K at all three rates remained at levels between 97 and 100 percent through 1998, 1999, and 2000. By August of 2000, knapweed control from the 1997 spring applications 1 pt. + 1 pt./acre rates of Tordon 22K plus 2,4-D remained significantly lower (50% control) than from the corresponding fall timings. Only the 1.5 pt./acre and 2 pt./acre rate of spring-applied Tordon 22K plus 2,4-D provided knapweed control statistically equivalent to the corresponding fall treatments (92% control).

Grass yields in 1998 and 1999 averaged 503 and 533 lb. per acre in non-treated check plots, compared to 1562 and 1369 lb. per acre in herbicide treated plots, representing a 251 percent average increase associated with knapweed control after fire. Grass yields were not measured in 2000.

"Demonstration Plots"

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demonstration areas. Visual percent control (compared to untreated plots), density, cover, and/or frequency are often used to evaluate differences between various treatments. Data collection should be consistent between years, and for most noxious weed species should be conducted for at least 3 years to determine long-term effectiveness of treatments.

Summary:

Demonstration plots are an excellent method to evaluate new weed management methods on a small scale to determine their application to your area. They also serve as an effective tool for educating the public about various management methods. However, their success is based on the accuracy with which the treatments are applied and annual monitoring of results. Be sure to maintain accurate detailed records so that someone else can continue monitoring efforts if you move or transfer to another position.

Weed Management Resource Library 1-800-554-WEED (9333)

The *Weed Management Resource Library* (WMRL) contains a wide variety of information resources to improve your noxious and invasive plant management. The Library provides you with quick, convenient access to as many resources as possible in one location.

Through the *Weed Management Resource Library*, you may obtain complete copies or additional information on every subject that appears in *TechLine*. All aspects of noxious weed and invasive plant management are presented.

We want to answer your technical questions, so *TechLine* solicits your input and feedback. If you have a successful weed technique or program you would like to share with your colleagues— we welcome them. Please call us toll-free at the *Weed Management Resource Library* at 1-800-554-WEED (9333) with your suggestions, comments, and input.

There is no charge for using the Library. The Library serves as a network to place you in touch with other managers and experts. In this way, the Library serves as a central clearinghouse of weed management knowledge and expertise.

Call the 800 number for your Catalog copy.

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