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Integrated Management of Eastern Redcedar

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Integrated management of eastern redcedar on pasture and grasslands should be based on a combination of cultural, mechanical, biological and chemical tools to keep this tree from continuing to spread while protecting grassland production and profits. Tree height should be used as a determining factor for control options. Burning, cutting, digging, mowing, use of goats and broadcast herbicide application are effective on trees up to 2 feet tall. Cutting and individual tree herbicide treatments work well on eastern redcedar 2-10 feet tall. Trees over 10 feet tall are most effectively and economically controlled by cutting. The bottom line is "control trees while they are small."

History and Biology

Eastern redcedar (*Juniperus virginiana* L.) *(Figure 1)* is one of 13 juniper species native to the United States. It is the most widespread tree-sized conifer and is native to every state east of the 100th meridian. Throughout this vast range, eastern redcedar grows on many soils and under varying climatic conditions. This adaptability has enhanced eastern redcedar's recent spread into areas where it was formerly rare or absent. Eastern redcedar is a dioecious species, which means individual trees are either male or female. Starting in the sixth or seventh year of growth, female trees produce small, berrylike fruits that are eaten by many birds and some small mammals, which indirectly helps spread the seed via droppings. Digestion actually improves germination.

First accounts of Nebraska vegetation mention eastern redcedar as a native tree species, primarily along the steep valley of the Niobrara River in northern Nebraska, as a minor component in deciduous forests in eastern Nebraska, and as a dominant species on canyon sides in the rugged Loess Hills region of central Nebraska *(Figure 2)*. Today, native stands of eastern redcedar can be found on most grasslands throughout central and eastern Nebraska and in much of the Midwest.

Since Europeans settled in the region, many factors have changed, allowing this minor native tree to become a serious grassland pest. Early records from the Loess Hills note that eastern redcedars were confined to the steepest canyons, usually on north-facing slopes where moisture levels were highest. The role of wildfire in confining the trees was obvious — trees near the edges of these stands displayed repeated fire damage. The species' adaptability and hardiness made it a favorite of pioneer tree planters. Millions of eastern redcedar trees have been planted in the Midwest for windbreaks, landscaping, and wildlife habitats. These plantings accelerated with the conservation programs of the 1930s.

Figure 1. Eastern redcedar *(Juniperus virginiana* L.*)*

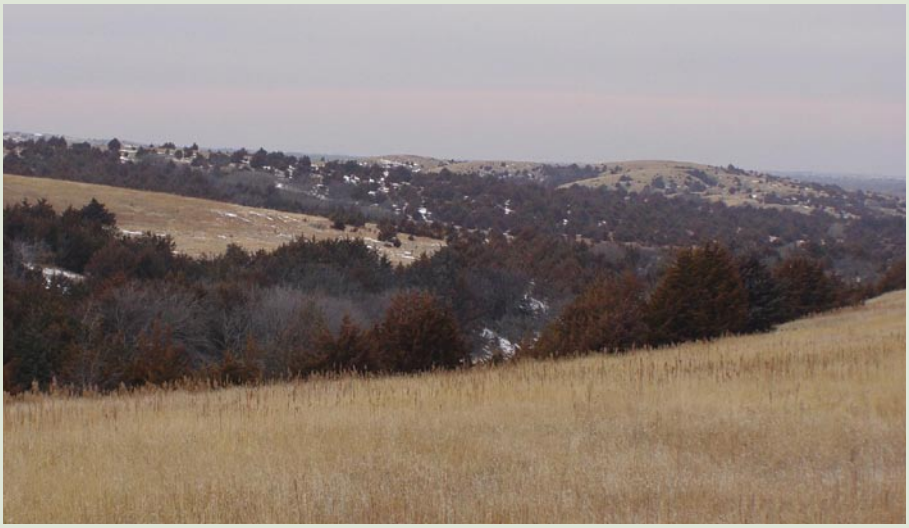

Figure 2. Redcedar is a dominant species on canyons of central Nebraska.

Impact of Eastern Redcedar

Eastern redcedar is a problem on grasslands primarily because it reduces forage production. Developing trees alter the microclimate, which encourages a shift from desirable warm-season native grasses to introduced cool-season grasses such as Kentucky bluegrass *(Poa pratensis* L.*)*. Heavy infestations make livestock handling more difficult. All these adverse effects can be reflected in lower rental rates or sale prices for infested grassland. Established infestations usually get worse over time due to overproduction of seeds and established trees get bigger, thus shading grass even more. On many sites, complete coverage by eastern redcedar can be expected, resulting in total loss of grass production unless controlled. Control measures should be initiated as soon as possible, both to improve effectiveness and reduce total control costs.

Integrated Management of Eastern Redcedar

Integrated management has been commonly described as "a multi-disciplinary approach utilizing the application of numerous alternative control measures." In practical terms, it means developing a management program based on the best combination of methods for a particular site, which could include mechanical, biological and/or chemical practices.

Eastern redcedar infestations in Nebraska and surrounding states have developed over several decades. Management of these infestations is best viewed as a long-term or on-going effort, both to reduce the initial infestations and prevent them from redeveloping to economically damaging levels. Emphasis should be on management of the infestation, rather than eradication. Eradication is not economical and probably not physically possible in most cases. Instead, it should be recognized that some remaining larger trees, which are the most difficult and expensive to kill, do little damage. In fact, at low levels, eastern redcedars can be viewed as a potential resource, providing livestock shelter, wildlife habitat, timber products, and aesthetic values. Most

important, long-term selective management is considerably less expensive than a more intensive, short-term approach.

If the goal is to reduce overall number of trees and stop further spreading (e.g. management of wildlife habitat), it is recommended to cut female trees only. Female trees are the ones that produce berry-like fruits with seeds. This would allow "male trees" to grow and provide much needed cover for wildlife or land beautification, while reducing further spreading.

Figure 3. Variety of hand tools that are effective on short trees.

Figure 4. Mechanical means of controlling larger trees.

Manual and Mechanical Control

Manual and mechanical control involves methods such as digging, cutting and mowing trees. It is very effective for small areas, and it is most efficient on trees up to 2 feet tall.

Cutting is an effective method of control because eastern redcedar is a non-sprouter. Trees cut below the lowest branches will not regrow. A variety of handheld or motor-powered cutting tools can be used. Handheld tools (shears, saws, spade, shovel, heavy hoe) *(Figure 3)* are effective on small trees (less than 3 feet tall), while larger trees require a chain saw or vehicle-mounted shears. The equipment varies from tractor-pulled PTO-driven shredders to hydraulic drive devices that mount on skid steer loaders. Most of the shredders can easily handle up to 3-4 inch stem diameter trees, while some can cut trees up to 15 inches in diameter *(Figure 4)*. Tractor-mounted shears may not be able to safely operate on steep slopes. Sawing larger trees with a chainsaw can be potentially dangerous because all lower branches must be removed before cutting the main trunk. Otherwise, the operator can be injured when the tree falls.

An alternative and relatively new tool for cutting trees up to 3 inches in stem diameter is commonly known as a "cedar eater" *(Figure 5)*. It is a simple device containing two stationary blades within the fork-like frame. The whole unit can be mounted in the front of an ATV or a small tractor. The operator drives the unit into the tree and the blades cut the tree off, leaving just a flat-cut stump *(Figure 6)*. This can be a very effective method on those pastures with many trees varying in height from 1 to 6 feet tall *(Figure 7)*.

Figure 5. An ATV-mounted "cedar eater".

Figure 6. Remains of stump cut by cedar eater.

Figure 7. Grassland with many trees varying in height from 1 to 6 feet tall.

In general, cutting is a method that can be time consuming and labor intensive. Cutting alone also fails to remove all of the problem because fallen trees continue to occupy space. Oklahoma research found that the durable skeletons of fallen trees occupy 70% of the space of living trees. Such areas can be lost to production for years because livestock are reluctant to graze among dry and sharp branches. Thus, all cut trees should be gathered and burned, or permanently removed from the grassland.

Prescribed Burning

This method is inexpensive and very effective against smaller trees. Its effectiveness declines as tree size increases, but there are cases of successful burning of tall trees (*Figure 11*). Adequate fine fuel (usually last year's dead grass) is necessary for satisfactory results. Safety also is a concern since many managers lack experience with fire and the equipment required to conduct fires.

The controlled use of fire is a large subject in itself. It is beyond the scope

Figure 11. Tall eastern redcedar trees controlled with fire.

of this publication to provide detailed instruction on conducting prescribed fires. For future information on the use of fire in general and on how to safely conduct fires, check with your local Extension office. A fire plan should be prepared and a prescribed burning permit obtained from the local fire jurisdiction, as required by state law. Specialized fire equipment can be purchased. Two sources are the Ben Meadows Company, 3589 Broad St., Chamblee, GA 30341; and Forestry Suppliers, Inc, Box 8397, Jackson, MS 39284-8397.

Regarding eastern redcedar specifically, prescribed fire is important both to initially reduce infestations and to maintain trees at economically tolerable levels. Research indicates that prescribed fires used primarily to control eastern redcedar should be conducted about April 1. Foliage is drier then and ignition of large trees is more likely. Fires should be conducted under conditions which are as warm and dry as is consistent with safety. Lower wind speeds, from 5 to 10 mph, will increase the duration of high temperatures and damage to larger trees. On the other hand, higher winds increase flame length and the potential for ignition of trees. In some cases fire alone may be adequate. In other cases supplemental treatment may be necessary. Fortunately, a number of treatment options are available to fit different circumstances.

Several variables should be weighed when considering options. These include location within the state, difficulty of burning the area in question, age and density of trees, the density of surviving trees that can be tolerated, kind of grassland vegetation, and the availability of labor or capital.

Location

Eastern Nebraska lies within the tallgrass prairie region, while central Nebraska, including the Loess Hills, is in the mixed prairie region. The tallgrass region potentially produces greater fine-fuel loads, and thus more intense fires and higher eastern redcedar mortality. Fire can be used more frequently here with less risk of adverse effects to other vegetation, which can occur when drought follows spring fire. This means that fire alone on a short rotation, perhaps even annually, may suffice in the east. In the mixed prairie region, fine-fuel loads tend to be lower and control from fire alone may be less, while arid post-fire conditions also are more likely. In central Nebraska fire should be used more conservatively, at intervals of several years. This makes it more likely that limited supplemental treatments will be necessary to achieve management goals.

Difficulty of Burning Individual Land Units

Lighting a prescribed fire often carries some risk of it escaping. Eastern Nebraska pastures more often are isolated by roads, cultivated lands, and other firebreaks that will confine the fire and minimize risk. This means that fire may be safely used more often and under more favorable burning conditions. In central Nebraska, pastures often are located within large blocks of rangeland, making escape more likely and serious. This suggests the need for more planning and care on how to conduct the fire safely. It also argues for a more sparing use of fire and reduces the chance that fire alone will suffice.

In some cases, the difficulty and risks of burning in areas of extensive grasslands can be greatly reduced by conducting "landscape-scale" fires, rather than burning pastures individually. Under the landscape-scale concept, the fire boundary is extended until adequate existing firebreaks are encountered. These may be roads, watercourses, cultivated lands, stands of broadleaf trees, relatively non-flammable canyon bottoms, or areas of short or green vegetation. Such large areas frequently contain the holdings of multiple landowners. Obviously, all landowners and managers within the area must be in agreement about the proposed burn.

Age and Initial Density of Trees

Eastern Nebraska infestations tend to be younger and more dispersed. This will improve control levels achieved by fire alone. In the rugged Loess Hills, where eastern redcedar is native, infestations include dense stands, usually on north-facing slopes, and larger trees. These stands are less susceptible to fire and may require supplemental treatment. In fact, some dense stands may be better left alone because little vegetation remains under the canopy and the danger of soil erosion is great on steep slopes if trees are removed. Management efforts may be better concentrated on developing stands that are easier to attack and threaten future productivity much more.

Density of Surviving Trees that Can be Tolerated

The number of surviving trees that can be tolerated depends on the owners' preference. Low numbers of surviving trees will have minimum effect on future productivity. Most surviving trees will be the largest and oldest in the population. These may have a near-term value as fence posts and would pay for their own removal. Low numbers of such trees also furnish livestock shelter and improve habitat for popular game animals such as deer and wild turkey.

Table 1. Percent eastern redcedar control and grass injury levels (burning) at about 100 days after treatment as influenced by the tree height (feet) when herbicide treatments were broadcast applied.

	Dose	Tree Height (ft)				Grass Injury
Treatments[a]	pt/acre	0 to 1	1 to 2	2 to 4	4 to 6	
1. Surmount	4	84	70	52	12	35
2. Surmount	5	95	81	46	20	55
3. Grazon P & D	6	90	59	51	16	15
4. Grazon P & D	8	95	79	60	18	20
5. Tordon 22K	2	85	65	33	25	20

[a]Treatments 1 and 2 were mixtures of picloram + fluroxypyr each at 0.66 lbs ae/gal. Treatments 3 and 4 were picloram at 0.54 lbs ae/gal + 2,4-D at 2.0 lbs ae/gal. Treatment 5 was picloram at 2.0 lbs ae/gal.

Kind of Existing Vegetation

Most research on prescribed fire in grasslands relates to warm-season native grasses, either in rangeland or planted pastures. Much less is known about the use of fire on cool-season grasslands. For planted cool-season pastures, fires would have to be conducted as much as six to eight weeks earlier than on warm-season grasses, probably no later than mid-March to minimize damage to the grass.

The situation on degraded, cool-season dominated range is more complex. Fires conducted early will encourage the cool-season grasses at the expense of the remnant warm-season grasses. Fires conducted around May 1, at the optimum time to favor warm-season grass growth, will damage the cool-season grasses. While that is often desirable, a manager may have come to depend on early production from a cool-season range. Much of this production will be lost if fire is used. Total production also may be temporarily reduced if the remnant warm-season grasses are too scarce or weakened to take advantage of the suppression of the cool-season grasses.

Use of fire should be carefully considered on all lands. Ideally, fire should be incorporated as part of a long-term pasture-management plan designed both to reduce eastern redcedar infestations and improve range condition while maintaining or improving productivity.

Chemical Control

Herbicides also can be considered for control of this tree species as an important part of the integrated management program. Depending on the application method and chemical type, the use of herbicides can be time consuming and expensive, especially when used on denser tree infestations or large tracts of land. Effectiveness also is variable depending on the tree size and label directions and/or restrictions. Therefore, always read and follow herbicide label directions. Herbicide information on control of troublesome plant species, including eastern redcedar, is updated annually in the *Guide for Weed Management in Nebraska* (EC130). In general, herbicides for eastern redcedar control can be used for broadcast application or individual tree spraying.

Broadcast Treatments

Broadcast application is the most common method of applying herbicides in agricultural settings. The key message for the efficacy of broadcast treatments in eastern redcedar control is: "the shorter the tree, the better the control."

Since tree height was the most important factor influencing the level of chemical control (tree injury) with broadcast treatments, the herbicide efficacy data from a Nebraska study was categorized by tree height *(Table 1)*. Recommended herbicides for trees that are up to 2 feet tall include: Surmount, Grazon P&D, and Tordon *(Table 1)*. However, the same herbicides will not provide satisfactory broadcast control of trees taller than 2 feet, indicating the importance of tree height. Surmount at the rate of 5 pints per acre can also cause short-term grass injury in the form of leaf yellowing and top growth burning *(Table 1)*. Estimated herbicide costs are updated annually in the *Guide for Weed Management in Nebraska* (EC130).

Individual Tree Treatments

Individual tree treatments can be applied directly to the tree foliage or to the soil around the tree base. Soil treatments can minimize the amount of herbicide used and the exposure to non-target species. However, soil treatments may not be effective unless applied before rainfall, preferably in spring or fall. Rainwater is needed to move the herbicide into the root zone, allowing uptake by a tree. Recommended herbicides for soil application around a tree base include Tordon 22K at the rate of 1 cc (ml) per every foot of tree height, and Velpar-L at 4 (cc) ml and Spike 20P at 1 cc (ml) per every inch of tree diameter. Cost of Tordon is about $85 per gallon, Velpar is about $65 per gallon and Spike 20P is about $9 per pound of product.

Individual tree foliage also can be treated with various herbicides. Based on a study conducted in northeastern Nebraska, recommended herbicides for control of 2-10 feet tall trees include Surmount at 1.5 percent volume per volume (v/v), Grazon P+D at 2.0 percent (v/v) and Tordon 22K at 1.0 percent v/v (*Table 2*).

To help you determine the volume per volume basis, note that the 1 percent v/v equals 1 gallon of the product per 100 gallons of water. For smaller backpack

Table 2. Percent of eastern redcedar and grass injury (burning) 100 days after treatments were applied to individual trees.

Treatment[a]	Dose (v/v)[b] (%)	Tree Injury (%)	Grass Injury (%)
1. Surmount	1.0	75	39
2. Surmount	1.5	89	48
3. Grazon P & D	2.0	90	50
4. Tordon 22	1.0	94	60
5. Roundup Ultra	1.0	5	55
6. Roundup Ultra	2.0	31	91

[a]Treatment 1 and 2 were mixtures of picloram + fluroxypyr each at 0.66 lbs ae/gal.
Treatment 3 was picloram at 0.54 lbs ae/gal + 2,4-D at 2.0 lbs ae/gal.
Treatment 4 was picloram at 2.0 lbs ae/gal.
Treatments 5 and 6 were glyphosate at 3.7 ae/gal
[b]Dose was a herbicide/water solution on a volume/volume basis.

Table 3. Effectiveness and costs of eastern redcedar control treatments as measured one year after treatment.

Treatment	Mortality By Height Class					To Apply Supplemental Treatments	
	0-3 ft	3-6.5 ft	6.5-10 ft (%)	>10 ft	Total[a]	Time (hours/acre)	Costs ($/acre)[b]
Fire alone	94	71	63	29	81	0.00	8
Fire+Tordon	98	95	93	60	95	0.25	262
Fire+Cutting	95	99	100	94	96	1.25	222
Tordon Alone	82	83	60	66	79	0.50	37
Cutting Alone	84	97	97	95	88	2.50	25

[a]Weighted means, based on different numbers of trees in each height class.
[b]Costs include the estimated $8 per acre fire cost.

sprayers use an equivalent of 1.3 ounces of product per every gallon of water. Apply about 1.5 ounces of the herbicide spray solution for every foot of tree height. Walk around the tree and just spray enough solution to get a glisten (shine) on the canopy surface. Solution dripping off the canopy indicates a rate that is too high and a likely waste of time and money. As an example, it was calculated that 1 gallon of spray solution could cover 15 individual trees that are 6 feet tall at a pressure of 20 psi and a single nozzle type XR8002.

Grass injury in the form of temporary yellowing and burning of top growth was evident among all treatments, especially for Tordon 22K. Roundup and other glyphosate-based products are not recommended for use in pasture settings due to poor activity on eastern redcedar and high injury level to the grass *(Table 2)*. Cost of Grazon P+D and Tordon 22 K can range from $11 to $16 per treatment.

Practical Hint for Chemical Conrtol

Use of selective herbicide treatments should be based on tree height. Broadcast treatments are effective only on short trees (up to 2 feet tall), while medium height trees (2 to 10 feet) can be controlled with individual tree treatments. For broadcast treatments use 6-8 pints of Grazon P&D or 4-5 pints of Surmount in 20 gallons of water per acre. To prepare 1 gallon of spray solution for individual tree canopy treatments, use 1.3 oz of Tordon, or 2.6 oz of Grazon P&D or 2 oz of Surmount. For larger spray tanks adjust herbicide rates accordingly.

Biological Control

Biological control is the use of natural enemies to reduce weed populations to economically acceptable levels. In the case of eastern redcedar control, goats can be used as a helpful bio-control agent *(Figure 8)* for trees that are up to 3-4 feet tall *(Figure 9)* as part of an integrated control approach. Most eastern redcedar trees less than 24 inches tall can be killed by goats in a paddock grazing system within the first year. The control level was reduced by 50 percent on 4-8 foot tall trees, however the goats managed to defoliate bottom branches and strip bark from branches and trunks up to three inches in diameter *(Figure 10)*. That size tree may take three to five years of browsing to kill.

Generally, goats are browsers with diets consisting of about 70% of non-grassy species, which indicates that they should not compete much with cattle for grass. Goats prefer non-grassy species, but they would eat grass if no other species were available. This also suggests that goats in general can help in controlling many plant species that cattle do not eat, including various noxious weeds (eg. leafy spurge, thistles).

Important factors in managing goats include the use of appropriate stocking rates, quality fencing and protection from predators. In essence, the number of goats needs to be adjusted to the amount of plant material needing control. Younger animals will not eat eastern redcedar as well as older ones. Precise stocking rates for cedar control have not been established by research in Nebraska nor elsewhere. The bottom line is that goats must be fenced in the area where unwanted plants are to be controlled. Thus, per acre stocking rate should be at least 10 goats/acre of infested land. This stocking rate with moderate eastern redcedar infestation should result in significant damage to the trees within 30 days. Higher stocking rates would be better, but will require moving the fence more often. Trees and other perennial plants have high energy reserves in their root systems and repeated defoliation over several years is required to control them. Eastern redcedar trees, however, will not resprout and if the goats remove most

Figure 8. Goats in action.

Figure 9. Goat-damaged 2-foot tall tree.

Figure 10. Goat-damaged eastern redcedar tree trunk and branches.

of the needles and/or bark, the tree will eventually die.

Close monitoring of the feed supply and the body condition of the animals is required for this method to be sustained long term. Forcing goats to eat too much of the eastern redcedar forage alone without balancing their diet would result in poor performance and even death of the animals, if taken to extremes. Also, the does (nannies) need to be in fairly good body condition in the fall to survive cold winters in Nebraska. Goats consuming a high level of eastern cedar, especially in winter, should be supplemented with high protein feed. For example, feeding 1.5 lb of good quality alfalfa hay (about 50 percent of daily intake) per 125 lb doe per day would provide good protein base. However, the body condition should be monitored and the feed adjusted accordingly.

Fencing options for goats include net wire and electric fences. One example is the use of one electrified offset steel wire (12-16 inches above ground) inside a barbed wire fence. Also, two to three strand polywire temporary fences have worked well for making smaller enclosures or paddocks.

Other issues that need to be addressed before using goats include predator control (e.g. coyotes) and perhaps learning how to raise goats for meat production. A good place to start is at the ATTRA National Sustainable Agriculture Information Service web site. The Web page "Goats: Sustainable Production Overview, Livestock Production Guide" at *www.attra.org/attra-pub/goatoverview.html* has information on numerous topics relating to meat goat production.

Costs and Effectiveness of Eastern Redcedar Treatments

Nebraska research has provided detailed information on the results and costs that can be expected when a variety of eastern redcedar control measures are applied under realistic conditions. The values in *Table 3* were generated on a site in the Loess Hills in Custer County. The eastern redcedar population on the site had developed since about 1960 and had reached a density of about 250 trees per acre. Trees were mostly less than six feet tall, indicating an expanding infestation, and were growing mostly as single trees or in small groups. Tordon 22K was applied at a rate of 4 cc (ml) per foot of tree height. It was apparent that there were some misses, and some trees were treated twice.

When herbicides are used, some form of marking should be used to prevent this. Sprinkling a few kernels of popped popcorn by each tree as it is treated is fast and inexpensive. The cutting treatments used hand tools and chain saws. Supplemental treatments were applied one to two months after the fires. Actual costs and effectiveness achieved would depend on initial tree density and fire intensity.

The main points in *Table 3* are:

1. The total costs and effectiveness for trees less than 10 feet tall are about equal for fire plus Tordon 22K and fire plus cutting.
2. Burning first reduced the time requirement by half for both Tordon 22K and cutting treatments.
3. Burning first reduced total costs by nearly half for both treatments. It should be noted that supplemental treatment is a one-time expense that can be spread over many years. This is true only if fire is used periodically to prevent reinfestation.

These costs do not include charges for changes in grazing management. For example, if grazing is reduced by 0.25 animal unit month (AUM) per acre in the year before fire to accumulate fine fuels, and an AUM's value is $24, then an additional $6 per acre should be charged to the fire cost. However, this cost likely will be recovered in reduced supplemental treatment costs if an effective fire is achieved.

The Nebraska research also indicated that treatment strategies can be modified to further reduce costs. It was reported that:

1. Some trees that at first appear to survive the prescribed fire will die the following year.
2. Surviving large trees, which make up a small percentage of an expanding population, will make a negligible contribution to future production losses unless they are female trees.
3. Herbicide rates, estimated costs of fire plus herbicide application based on these findings are reported in *Table 4*.

Availability of Labor vs. Capital

Nebraska research indicates that the costs and effectiveness of cutting and her-

bicide application are similar for trees less than 10 feet tall. However, the sources of those costs are different. Labor accounts for most of chain sawing costs. Shearing costs include purchase or rental costs of the shears plus considerable labor, or payment to a contractor. For any herbicide application, the purchase price of the herbicide accounts for most of the cost. Cutting and herbicide application both are rational choices, but managers should choose based on their own circumstances.

Summary

Since there are many different scenarios under which eastern redcedar trees grow, there is no single best weed control method for all circumstances. However, if the methods are implemented in a systematic manner, significant advances in eastern redcedar control can be achieved. There are many ways to start developing an IWM program. The easiest start will be to try one or two techniques and then add more practices as time goes on or field conditions change. Cost of control methods can also vary so choose the operation that best fits your budget.

We recommend using tree height as a determining factor for control options. There are many control options for trees that are up to 2 feet tall, including: cutting, pulling, digging, mowing, burning, use of goats and broadcast herbicide application. Trees that are 2-10 feet tall can be controlled effectively by cutting and individual tree herbicide treatments of soil or foliage. Trees that are over 10 feet in height are most effectively and economically controlled by cutting. Remember, to save time and labor expenses control redcedar trees while they are small.

Table 4. Estimated costs per acre of fire followed by Tordon 22K application under combinations of delaying treatment after fire, reducing the rate by half, and selective treatment by tree height. Costs include the estimated $8 per acre fire cost.

Treatment Option	Treatment Date	Herbicide Rate	Trees Treated	Cost
	(time after fire)	(ml/3 ft)		($/acre)
1	3 weeks	4	All	26
2	1 year	4	All	20
3	3 weeks	2	All	18
4	1 year	2	All	15
5	3 weeks	4	<10 ft	19
6	1 year	4	<10 ft	15
7	3 weeks	2	<10 ft	15
8	1 year	2	<10 ft	13

The assumptions regarding delaying treatment for one year after fire and selectively treating only smaller trees also can be made for cutting and could be expected to reduce these costs as well. A further refinement would be to focus supplemental control on seed-producing females to reduce reinfestation.

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