1996

G96-1308 Management of Eastern Redcedar on Grasslands

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G96-1308-A

NebGuide

Published by Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln

Management of Eastern Redcedar on Grasslands

Developing an integrated control program including prescribed burning, herbicides, and cutting may be the best way to control eastern redcedar in Nebraska, according to recent research.

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Eastern redcedar is a serious threat to grassland productivity. Some control methods may be too expensive to use on grasslands, but in many cases, an integrated approach combining fire with more intensive follow-up methods will provide reasonable control at an acceptable cost.

Eastern Redcedar in Nebraska

Eastern redcedar (*Juniperus virginiana* L.) 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. Individual trees are either male or female. The small, berrylike cones are eaten by many birds and some small mammals that then spread the seed in their droppings. Digestion actually improves germination.

Figure 1. Prescribed fire alone is effective against smaller eastern redcedar trees. If properly timed, fire also benefits plant vigor and animal performance.

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. Today, volunteer stands of eastern redcedar can be

found on most grasslands in central and eastern Nebraska. It is likely that most of the state's grasslands east and south of the Sandhills are infested or eventually could be. Since European settlement 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 redcedar 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 have been planted in Nebraska for landscaping, windbreaks, and wildlife habitat. These plantings accelerated with the conservation programs of the 1930s. Meanwhile, wildfire suppression became effective for the first time after World War II, when rural fire departments were organized and equipped with military surplus vehicles. Thus, a maturing seed source from plantings and fire control converged in time.

Figure 2. Spot-gun applications of Tordon 22K herbicide are fast and cost-effective against smaller eastern redcedar trees that survive fire.

Eastern redcedar is a problem on grasslands primarily because it reduces forage production. Because developing trees alter the microclimate, the trees also encourage a shift from desirable warm-season native grasses to introduced cool-season grasses such as Kentucky bluegrass. 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 will get worse over time. On many sites complete coverage by eastern redcedar can be expected, resulting in total loss of production unless controlled. Control measures should be initiated as soon as possible, both to improve effectiveness and reduce total costs.

Control of Eastern Redcedar

Many methods have been explored or used to control eastern redcedar. These include prescribed fire, herbicide application, and cutting. All methods have some drawbacks when used alone.

Prescribed fire. This method is inexpensive and effective against smaller trees. However, its effectiveness declines as tree size increases. 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.

Herbicides. Foliar sprays and broadcast soil applications of herbicides have been ineffective against eastern redcedar. The preferred treatment method is an application of undiluted Tordon 22K[1]; liquid to the soil under individual trees at a rate of three or four milliliters per three feet of tree height. This method minimizes the amount of herbicide used and the exposure to non-target species. However, it still is time consuming and expensive when used on denser infestations or large tracts. Effectiveness also is variable on larger trees and label directions recommend against use on trees more than 15 feet tall. (Always read and follow pesticide label directions.)

Cutting. This method is even more time consuming than herbicide application. It is effective because eastern redcedar is a non-sprouter. Trees cut below the lowest foliage will not regrow. Larger trees require a chain saw or tractor-mounted shears, but trees less than three feet tall can be quickly cut with hand shears. Tractor-mounted shears may not be able to safely operate on steep slopes. Sawing is potentially dangerous because all

lower branches of larger trees should be removed before cutting the main stem. Otherwise, the operator can be injured when the tree falls.

Figure 3. Cutting may be the best option for larger eastern redcedar trees that survive fire because this species does not resprout. However, if trees are cut by hand, cutting is time-consuming because lower limbs should be removed before the main stem is cut to prevent operator injury when the tree falls.

Cutting alone also fails to remove all of the problem because felled trees continue to occupy space. Oklahoma research found that the durable skeletons of felled trees occupy 70% of the space of living trees. This area is lost to production for years because livestock are reluctant to graze among the sharp branches. In addition, removing large trees often releases a flush of tree and weed seedlings within the former canopy dripline. Removal of one large tree can result in hundreds of small trees in its place that soon can merge into a nearly impenetrable thicket.

Taking an Integrated Approach to Management

As described, Nebraska's eastern redcedar infestations have developed over several decades. Likewise, management of these infestations is best viewed as a long-term effort, both to reduce the initial infestations and prevent them from redeveloping to economically damaging levels. It is best to begin treatment as soon as possible, once treatment has begun considerable time is gained to continue long-term management. The 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.

While single-method approaches all have drawbacks, recent research in Nebraska and elsewhere has shown that integrating prescribed burning with herbicides or cutting combines the strengths of each method while overcoming their disadvantages.

Prescribed fire. The controlled use of fire is a large subject in itself. It is beyond the scope of this publication to provide detailed instruction on conducting prescribed fires. Two other Nebraska Extension publications provide information on the use of fire in general and on how to safely conduct fires. They are *NebGuide G88-894, Grassland Management with Prescribed Burning,* and *Extension Circular 90-121, Conducting a Prescribed Burn*. 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 earlier than previously recommended, 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 windspeeds, in a range of 5 to 10 mph, will increase the duration of high temperatures and damage to larger 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. These include selective treatment by height and reducing herbicide rates for

smaller trees.

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 the other vegetation, such as 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 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 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. This factor depends on manager preference. Low numbers of surviving trees will have little effect on future productivity. Most surviving trees will be the largest and oldest in the population. These may have a near-term value, for example as fence posts, and so 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.

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 often is 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.

Availability of labor vs. capital. Nebraska research indicates that the costs and effectiveness of cutting and herbicide 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 Tordon 22K 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.

Costs and Effectiveness of Eastern Redcedar Treatments

Recent 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 I* 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, indicative of a still-expanding infestation, and were growing mostly as single trees or in small groups. Tordon 22K was applied at a rate of four milliliter per three feet 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 will depend on initial tree density and fire intensity.

The main points in *Table I* 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, and
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 a number of 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 $16, then an additional $4 per acre should be charged to the fire cost. However, this cost likely will be recovered in reduced supplemental treatment costs if a more effective fire is achieved.

Table I. 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[1]	Time	Costs
	----------(%)----------					(hours/acre)	($/acre)
Fire alone	94	71	63	29	81	0.00	2

Fire+Tordon	98	95	93	60	95	0.25	20[2]
Fire+Cutting	95	99	100	94	96	1.25	16[2]
Tordon Alone	82	83	60	66	79	0.50	37
Cutting Alone	84	97	97	95	88	2.50	25

[1]Weighted means, based on different numbers of trees in each height class.
[2]These costs include the estimated $2 per acre fire cost.

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

1. some trees that at first appeared to survive the initial prescribed fire will die during 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; and
3. herbicide rates for trees less than 10 feet tall may be reduced to two milliliter per three feet of height without significant loss of effectiveness. Reducing rates will, however, void the manufacturer's warranty. *Table II* shows estimated costs of fire plus herbicide application based on these findings.

Table II. 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 estimated $2 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	20
2	1 year	4	All	14
3	3 weeks	2	All	12
4	1 year	2	All	9
5	3 weeks	4	<10 ft	13
6	1 year	4	<10 ft	9
7	3 weeks	2	<10 ft	9
8	1 year	2	<10 ft	7

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.

General Recommendations

If at all possible, prescribed fire should be incorporated into long-term eastern redcedar management on grasslands. Periodic fire is required both to reduce the cost and improve effectiveness of treatments, and to prevent reinfestation. If necessary, grazing management should be changed to ensure adequate fine fuel loads before the initial and subsequent fires. To prevent reinfestation, fire should be used no less than every eight years in central Nebraska, and no less than every four years in eastern Nebraska where eastern redcedar growth rates are higher. Alternately, fire can be applied whenever newly established trees are approaching three feet in height, the size above which significant numbers can survive fire.

The need for supplemental treatment should be assessed after the initial fire, in light of the variables discussed previously in the *Taking an Integrated Approach* section. Supplemental treatment should be delayed at least one year after the initial fire to take advantage of delayed mortality. The supplemental methods should be those best suited to individual circumstances. Selective treatment, based on tree height, should be considered to reduce costs.

[1]Use of tradenames is not an endorsement by the authors or the University of Nebraska-Lincoln.

File G1308 under: RANGE AND FORAGE RESOURCES
B-6, Pasture Management
Issued October 1996; 10,000 printed.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Elbert C. Dickey, Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources.