Spraying Big Sagebrush Range in Eastern Oregon: Management Insights

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SPRAYING BIG SAGEBRUSH RANGE IN EASTERN OREGON: MANAGEMENT INSIGHTS

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Eastern Oregon ranchers have several options for increasing forage resources for their livestock operations. One of these options is spraying big sagebrush range to increase the productivity of desirable understory species. Although spray costs have increased rapidly these past few years, economics of sagebrush spraying is attractive.

Management insights provided here should be helpful to those considering range improvements through sagebrush spraying. Information on returns to spraying, interrelationships between sagebrush kill and forage response, sagebrush reestablishment, forage utilization, and soil moisture are presented, along with other management insights. A worksheet is included as an aid to making spray decisions.

Spraying Response

Anticipated responses to spraying big sagebrush on native and seeded high desert and foothill ranges of eastern Oregon are briefly reviewed here. Responses are based on numerous spraying trials appropriate to Oregon range conditions. Detailed results of these trials, and an assessment of the economics of spraying ranges to release understory species, are presented in Oregon Agricultural Experiment Station Circular of Information 686, "Economics of Spraying Big Sagebrush Communities of Eastern Oregon." Copies of this circular can be obtained by writing to the Bulletin Room, Industrial Building, Oregon State University, Corvallis, OR 97331.

The primary objective of spraying sagebrush is increased forage production at competitive costs. Reducing sagebrush competition on native or seeded ranges often allows the release of existing understory vegetation. This increased production usually persists for several

years. In part, increased production comes from establishment of new plants, but the major increase in productivity is from an increase in vigor and growth of already established vegetation. Thus, it is critical that an adequate amount of desirable forage species exists before treatment in order for these species to fully occupy the area after sagebrush has been killed. An initial plant population of desirable species producing 150 to 200 pounds, or one plant per 10 square feet of forage per acre, is believed necessary to attain an economical response to sagebrush spraying. If a smaller population exists, either little release of forage will be achieved, or desirable species will account for only a small amount of the increased production.

It is also important to achieve a good sagebrush kill, because forage response is closely related to effectiveness of the spray treatment. In other words, surviving sagebrush can still suppress grass production. Effectiveness of the spray treatment also influences the life of the treatment, since surviving sagebrush is also a seed source of reinvading sagegbrush.

In addition to direct yield responses, other benefits often occur. Increased forage utilization, through better access, often is achieved. A reduction in soil erosion is likely. Interception of both rain and snow by sagebrush will be reduced, thereby increasing the amount of precipitation available to the understory species. Soil water content, at least in the upper soil horizon, should not be affected because most often sagebrush control merely shifts moisture use from sagebrush to understory vegetation.

High desert native range

Yield responses from spraying Wyoming big sagebrush on native, high desert range where annual precipitation rarely exceeds 11 inches, have been highly variable. Reported responses average about 280 air dry pounds per acre per year, but range from 60 to 700 pounds. Comparable responses should be attained on sites with an initial sagebrush crown cover of 20 to 25 percent producing between 200 and 225 pounds of desirable forage species per acre per year before treatment. Forage responses should be evident for at least 10, and possibly 15, years after spraying with a sagebrush kill of 90 percent or better and prudent grazing management.

An average forage response of 280 pounds per acre, beginning 1 year after spraying and valued at $0.01 per pound (approximately $6.67 per AUM), will amortize, at 18 percent interest, a spray charge of $8 per acre in 5 years. If this response was sustained over a 10-year period, spraying could generate an annual return to the spray investment of about 32 percent. Annual returns associated with forage responses sustained over 10 years on high desert and foothill range and at alternative spray costs are illustrated in Table 1.

Table 1. Annual Rate of Return Generated Over a 10-Year Period by Spraying Sagebrush on Native and Seeded High Desert and Foothill Range Sites in Eastern Oregon at Alternative Spray Costs

	Alternative spray costs[a] ($ per acre)							
Range type	$8	$9	$10	$12	$14	$16	$18	$20
	annual rate of return[b] (percent)							
High desert native[c]	32	28	24	19	14	11	8	6
High desert seeded[d]	38	34	30	24	18	15	12	10
Foothill native[e]	32	28	24	18	14	11	8	6
Foothill seeded[f]	66	58	52	43	36	30	26	23

[a] Assumes no federal cost sharing.

[b] Based on a forage response valued at $0.01 per pound which is equivalent to a charge of about $6.67 per AUM. Yield responses are considered available for 100 percent utilization.

[c] Forage response of 282 pounds per acre for the first 5 years after treatment, and 266 for the next 5 years.

[d] Forage response of 321 pounds per acre for the first 10 years after treatment.

[e] Forage response of 275 pounds per acre for the first 10 years after treatment.

[f] Forage response of 531 pounds per acre for the first 10 years after treatment.

High desert seeded range

Forage production of seeded range also can be suppressed by reinvading sagebrush. Compared to native range, yield responses to spraying Wyoming big sagebrush on seeded, high desert range were more substantial but equally variable. The average reported increase in forage yield was about 320 air dry pounds per acre per year. This response should be attained on sites producing about 400 pounds of forage per acre per year before treatment. A sagebrush kill of 90 to 95 percent, however, would have to be achieved.

Spraying of seeded, high desert range reinfested by sagebrush could generate an annual return to investment of about 38 percent. This return is based on a forage response of 320 pounds per acre per year over a 10-year period, a spray charge of $8 per acre, and forage valued at $0.01 per pound. A 320-pound per acre per year forage response will amortize, at 18 percent interest, a spray charge of $8 per acre in 4 years.

Foothill native range

Foothill range sites usually are found above the desert floor and below the coniferous forest. Mean precipitation, although highly variable, is more commonly 10 inches or above. Climatic conditions generally are not as harsh as in the high desert.

Yield responses from spraying mountain big sagebrush on foothill native range average about 275 air dry pounds per acre per year, but range from 90 to 560 pounds. Comparable responses should be attained on sites producing 325 to 350 pounds of forage per acre per year before treatment. These responses should be evident for at least 10, and possibly 15, years after spraying with a sagebrush kill of 90 percent or better, and with proper grazing management.

An average forage response of 275 pounds per acre, beginning 1 year after spraying and valued at $0.01 per pound, will amortize a spray charge of $8 per acre in 5 years, assuming an annual capital charge of 18 percent. If this response was sustained over a 10-year period, spraying could generate an annual return to the spray investment of about 32 percent.

Foothill seeded range

Yield responses from spraying mountain big sagebrush on seeded foothill range reinfested by sagebrush averages about 530 pounds per acre per year, but have been reported as high as 1,400 pounds per acre. An average response, or better, should be attained on sites with an initial sagebrush crown cover of 15 to 20 percent, producing about 450 pounds per year before treatment. With a sagebrush kill of 90 percent or better, responses should be evident for at least 10, and possibly 15, years after spraying.

Valuing a 530-pound per acre forage response, obtained over a 10-year period at $0.01 per pound, and at a spray cost of $8 per acre, spraying seeded foothill range produces a return to investment of about 65 percent per year. This response valued at $0.01 per pound, will amortize, at 18 percent interest, a spray charge of $8 per acre in 2 years.

Management Insights

In order to realize the maximum benefit from spraying sagebrush range to release understory production, the following management insights are offered.

- It is critical that an adequate amount of desirable forage species exist before treatment in order for these species to fully occupy the area after sagebrush has been killed. If desirable species exist at a lower level, either little release of forage will be achieved, or desirable species will account for only a small amount of the released production.

- Spraying sagebrush on cheatgrass problem sites is not recommended because it will encourage even more cheatgrass growth. On these sites, the problem of cheatgrass first must be overcome before spraying should even be considered.

- As sagebrush kill increases, expect greater and longer-lasting forage responses. With a 90 to 95 percent kill and proper grazing management, the effective life of the treatment should exceed 10 years.

- To achieve a good sagebrush kill, spray sagebrush when it has begun active growth and before soil moisture is limiting. Excellent

kills can be attained by spraying shortly after the first new shoots of sagebrush plants are 1 inch to 1-1/2 inches long. However, an easier index to go by is based on the growth stage of Sandberg bluegrass, beginning with early heading and ending when the green head color is half gone.

• Effective kills of big sagebrush can be achieved by using 2,4-D in a water carrier that includes a surfactant. Check with your local extension agent for latest recommended rates.

• Gray and green rabbitbrush can be controlled simultaneously with big sagebrush by using 2,4-D at an acid equivalent rate of 3 pounds per acre. Gray rabbitbrush, however, is more susceptable to 2,4-D than green rabbitbrush. To attain simultaneous control, spraying should begin when new rabbitbrush twig growth exceeds 3 inches in length. It is difficult to attain above a 90 percent kill on green rabbitbrush. Also, in dry years, satisfactory kills of green rabbitbrush probably cannot be obtained.

• Spraying will reduce growth of various broadleaf plants in the spraying year, but complete kill usually is not obtained on most of these species.

• Defering grazing during the year of spraying has no effect on either yield response or life of the spray treatment.

• With an effective sagebrush kill (90 percent or better), respraying decisions should not have to be considered until at least 5 to 7 years or more after initial spraying. A small plot might be treated to obtain estimates of yield responses to respraying. This additional effort will generate more insights on rangeland spraying and make possible more informed and superior spray decisions.

Budgeting the Spray Decision

Spraying decisions should be carefully evaluated before the actual commitment of any capital resources. One reason is spraying requires an expenditure of capital well in advance of when returns are generated. Furthermore, several years often elapse before total accumulated returns equal or exceed spraying costs. Another reason spray decisions should be carefully evaluated is ranchers have alternative uses of capital.

One method of evaluating spraying decisions is through use of the accompanying worksheet. The worksheet is used to determine if the estimated cost of obtaining forage via spraying sagebrush is more or less than the value of the forage, given opportunity costs of capital. Completing the worksheet forces you to thoroughly consider potential costs and returns associated with the spray decision. This economic insight should prove helpful in making the spray decision.

The worksheet is used to calculate spray costs and the future value of estimated forage responses beginning in the year of spraying and continuing for up to 10 years after spraying. It is during this time period when costs and returns most seriously affect the spray decision. The value of future forage responses are then discounted to make these benefits directly comparable to the present cost of spraying. Discounting recognizes that $1 received a year from today is less valuable than $1 received today because of the time preference for income. The discount factor represents the opportunity cost of capital; in other words, what earnings are foregone because capital is used for spraying instead of alternative investments.

Use of this worksheet can be both a time and money saver, as it directs you away from unprofitable decisions, and it forces you to plan and study the decision.

The worksheet is divided into three sections: forage responses and values, spraying costs, and costs and returns comparison.

Forage responses and values

In Section I, enter the estimated forage responses on an acre basis, forage value on a pound or AUM basis, and discount factors reflecting your opportunity cost of capital. Calculate, then sum, the annual discounted values of forage responses to produce an estimate of the total discounted value of the forage response directly attributed to spraying.

In Column A of Section I, enter only the estimated additional forage production attributed to spraying sagebrush for the year of spraying as well as each following year up to the 10th year after spraying. Although forage responses should continue well beyond 10 years, they

are ignored in this budget because accurately predicting forage responses and estimating values beyond 10 years is difficult.

In Column B, enter the unit value of the forage response. This value, if appropriate, can change over time. It can be stated in terms of a lease or rent value, or, if the forage response replaces hay, the purchase price of hay. If, through spraying, you can increase animal carrying capacity, value can be stated in terms of increased livestock production. Whatever value chosen, be sure it is realistic for your operation.

In Column C, enter the discount factors reflecting your opportunity costs of capital. Refer to Table 2 for instruction on selection of appropriate discount factors.

After Columns A, B, and C have been completed, compute Column D. For each year beginning with the spray year, calculate the discounted value of the forage response by multiplying additional production (Column A) by the value of the forage response (Column B) by the discount factor (Column C). For example, given a forage response of 500 pounds per acre in the first year after spraying, a forage response value of $0.01 per pound, and an opportunity cost of 15 percent (the discount factor from Table 2 is .8696), the discounted value of the forage response entered in Column D for this year is $4.35 (500 x $0.01 x .8696 = $4.35).

After the discounted value of the forage response has been calculated on a year-by-year basis, enter the sum of these values in Row E. This value in Row E represents the total economic benefits attributed to spraying, corrected for your time preference for income.

Spray costs

Spray costs on a per acre basis are calculated in Section II. Since spraying is generally a contracted custom service, costs are not difficult to determine. When materials costs are included in the custom application charge, enter the custom charge on a per acre basis in Line I and ignore materials costs items in Lines F, G, and H. Other costs also on a per acre basis, such as flagmen (Line J), your time, either monitoring or actual spray work, and cash expenses associated with use of a pickup

Table 2. Discount Factors for Various Production Years Associated with Alternative Interest Rates Reflecting Your Time Value for Money

Instructions: First select the interest rate that reflects your time value of money. That is, what you consider to be the rate of return on your next best productive investment. Once you select this interest rate, proceed down that column of discount factors and enter these numbers in the corresponding rows in Column C of Section I of the worksheet. Enter only those numbers which correspond to the years you anticipate achieving a forage response from spraying. For example, if your opportunity cost of capital is 15 percent, the discount factor for the first year after spraying is .8696. Discount factors for the second, third, and fourth years after spraying are: .7561, .6575, and .5718, respectively.

Year after spraying	Alternative interest rates reflecting your time value of money								
	10	11	12	13	14	15	16	18	20
Spray year	.9690	.9650	.9610	.9570	.9530	.9515	.9300	.9400	.9350
1	.9091	.9009	.8929	.8850	.8772	.8696	.8621	.8475	.8333
2	.8264	.8116	.7972	.7831	.7695	.7561	.7432	.7182	.6944
3	.7513	.7312	.7118	.6931	.6750	.6575	.6407	.6086	.5787
4	.6830	.6587	.6355	.6133	.5921	.5718	.5523	.5186	.4823
5	.6209	.5935	.5674	.5428	.5194	.4972	.4761	.4371	.4019
6	.5645	.5346	.5066	.4803	.4556	.4323	.4104	.3704	.3349
7	.5132	.4817	.4523	.4251	.3996	.3759	.3538	.3139	.2791
8	.4665	.4339	.4039	.3762	.3506	.3269	.3050	.2660	.2326
9	.4241	.3909	.3606	.3329	.3075	.2843	.2630	.2255	.1938
10	.3855	.3522	.3220	.2946	.2697	.2472	.2267	.1911	.1615

truck or other equipment, should be entered on Lines K and/or L. When estimating your labor costs, remember your time has opportunity costs and should be charged as a spraying cost. After all cost items have been estimated, enter their sum in Row M.

Costs and returns comparison

A costs and returns comparison is made in Section III. In Row N, enter spray costs taken from Row M and compare to the discounted value of the forage response taken from Row E. If this total discounted forage value is less than spraying costs, spraying is not a profitable use of your limited capital. Based on your opportunity cost of capital, you have more productive alternatives. If costs and returns are equal, spraying is as profitable as your next best alternative use of capital. When forage value exceeds spray costs, spraying is expected to generate a return greater than your opportunity cost of capital. That is, spraying appears to be an economically justifiable use of your limited capital.

Spraying Worksheet
(acre basis)

I. Forage Responses and Values

(Year after) spraying	(A) Estimated additional production from spraying (pounds or AUM's) per acre		(B) Value of response ($ per pound or AUM)		(C) Discount factor (see Table 2)		(D) Discounted value of response ($ per acre)
Spray year	_____	X	_____	X	_____	=	_____
1	_____	X	_____	X	_____	=	_____
2	_____	X	_____	X	_____	=	_____
3	_____	X	_____	X	_____	=	_____
4	_____	X	_____	X	_____	=	_____
5	_____	X	_____	X	_____	=	_____
6	_____	X	_____	X	_____	=	_____
7	_____	X	_____	X	_____	=	_____
8	_____	X	_____	X	_____	=	_____
9	_____	X	_____	X	_____	=	_____
10	_____	X	_____	X	_____	=	_____

(E) Total discounted forage value = _____ ($ per acre)

II. Spraying Costs

Materials Costs

(F) Chemical _____ (application rate per acre) X _____ (unit cost) = _____

(G) Carrier _____ (application rate per acre) X _____ (unit cost) = _____

(H) Surfactant _____ (application rate per acre) X _____ (unit cost) = _____

(I) Custom application (rate per acre) = _____

Other Costs:

(J) Flagmen (charge per acre) = _____

(K) _____ (charge per acre) = _____

(L) _____ (charge per acre) = _____

(M) Total spray Costs (per acre) = _____ (F+G+H+I+J+K+L)

III. Cost and Returns Comparison

(N) Spray Costs $_____ (M) versus $_____ (E) total discounted forage value.

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