Foam Marking Systems for Rangeland Sprayers

Maurice R. Gebhardt, L. Allen Torell, James A. Young, and Raymond A. Evans

There are numerous foam marking systems commercially available and in general use in intensive agriculture in the Midwest and Great Plains states. However, on the rangelands of the far West, range managers may not be familiar with these systems. When applying herbicides to rangelands with a ground sprayer, marking systems are very valuable in avoiding skips and overlaps, especially in undulating terrain or when spraying tall brush.

Sagebrush Sprayer

Recently, we developed a prototype ground sprayer for use on sagebrush *(Artemisia)* rangelands. The sprayer consists of simple modifications that can be done in farm shops, so that commercially available sprayers can be used to apply herbicides to sagebrush infested rangelands.

The large areas on rangelands that are usually involved in spraying and the difficulty in pulling a ground sprayer through rocks, brush, gullies, and on steep topography has limited the application of herbicides to aerial spraying. There is no question about the relative ease of aerial versus ground application of herbicides on most sagebrush range sites. However, we have found that private landowners who wish to treat relatively small areas in a systematic annual improvement of their rangelands may have difficulty in obtaining custom aerial applicators at reasonable cost. This difficulty is due to the remoteness of some rangelands from areas of intensive agriculture where aerial applicators are located and the additional cost of ferrying aircraft to the spray site. Conflicts in timing application of herbicides on rangelands versus more lucrative pesticide applications to other field or row crops near the aerial applicator's base of operations also make it difficult to attract aerial applicators for sagebrush control. If the spray job consists of 1,000 acres or more, the job will attract a number of potential applicators. However, if the job consists of only 50 acres at a very remote site, the aerial operator may not be interested in the job and it may be more feasible to apply the herbicide with ground equipment.

Application of herbicides for sagebrush control can be relatively fast, efficient, and cost effective provided the proper equipment and a knowledgeable and experienced operator is available. Proper equipment includes a sprayer, nurse tank, and a power unit for transfer of water and spray material.

The sprayer operator must know what has been sprayed in order to guide the sprayer in the field. Ground sprayer operators have always been plagued with the problem of knowing where they have applied the herbicide. This guidance problem is of particular concern when spraying sagebrush on rangelands. Range sites are rarely rectangular and even if the area to be treated is rectangular, it is difficult to maintain a straight path while dodging rocks and crossing gullies. It is almost impossible for the operator to maintain orientation as the sprayer traverses the cone of cone-shaped alluvial fans that often characterize sagebrush rangelands.

Skips or overlaps in herbicide application resulting from loss of orientation by the sprayer operator are a concern because of poor brush control in the skipped areas and excessive cost of herbicides when double coverage occurs. Soil active herbicides used for controlling cheatgrass *(Bromus tectorum)* require that there are absolutely no overlaps in application since excessive residues in the soil can prevent later forage seedling establishment and plant growth.

Because of the remote site and difficulties in obtaining good clean water, the application of herbicides must be made using low carrier rates. We applied 10 gal/acre total volume (herbicide plus carrier) when using our prototype sprayer to apply herbicides for brush control. However, these low carrier rates almost preclude the use of a dye in the carrier as a marker since so little spray material is deposited on the soil and brush surfaces. At times, the dyed sprays can be seen deposited on cow chips or light colored rocks. However, in dense sagebrush the brush must be more clearly marked in order for the marking system to be effective.

Foam Generators

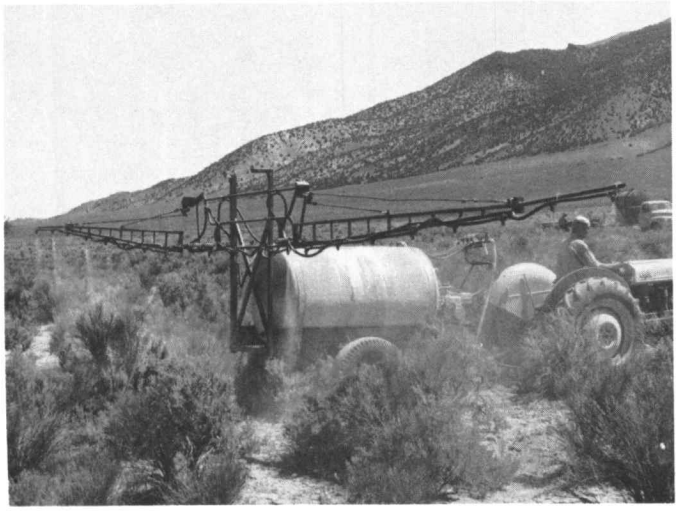
There are several manufacturers of foam marking systems. These systems usually consist of a low pressure tank that serves as a reservoir for the foam concentrate and its carrier, which is normally water, an air compressor for an air source, plumbing to distribute the foam, and a control system for operator control.

Foam is generated within the compressed air/water tank by injecting air from a nozzle into the water at the tank bottom. Foam is formed at the surface of the liquid as air rises and escapes into the air above the water surface within the tank. The foam moves with the air as it escapes through the distribution tubes and valves that are connected to the foam nozzles or emitters. The tubes that carry the foam from the tank to the nozzles must be rather large to carry sufficient foam to mark adequately. Often, 1-inch (2.5 cm) I.D. PVC flexible tubing is used to distribute the foam. The foam nozzle or emitter often consists of an expanded tube about 5-inches (12.5 cm) in diameter that is attached to a 90-degree elbow. Foam collects inside the nozzle until enough accumu-

Authors are agriculture engineer, USDA-ARS, Columbia, Mo. 65211; agricultural economist, Utah State Univ., Logan; range scientists, USDA-ARS, Reno, Nev. 89512.

Foam emitter nozzle. These hang from end of boom. Enlarged tip accumulates a glob of foam which hangs on brush when it drops. Elongated neck of nozzle is flexible if boom drops into brush.

lates so that its weight causes it to no longer adhere to the walls on the nozzle. The accumulation of foam drops to the ground periodically as the sprayer traverses the field. These globs of white foam are especially useful as markers when treating brush because the foam will remain on branches of the shrub for 15 minutes. The white foam is very conspicuous and easily seen from a distance. (Note 1)



Prototype sagebrush sprayer. Foam line runs along boom and foam emitter nozzles hang from end of boom.

Only one of the nozzles needs to operate at any particular time. The nozzle on the opposite end from the one being used can be used as a guide in keeping on the previous foam mark. The electric control system is used to control the alternate opening and closing of valves on the tubes to the foam nozzles. These electrical solenoid valves are operated by switches near the operator on the tractor. The operator can also control the frequency of foam marks by operating the control valves. It may not be necessary for the foam to be deposited as frequently in some fields as needed in other fields, depending on the terrain or brush characteristics.

Foam marking concentrates are available from commercial suppliers. Some of these concentrates are nonphytotoxic while others may produce some injury symptoms to plants. Follow the instructions supplied with the concentrate. Observe the mixing ratios shown on the label. These ratios may have to be adjusted in cool weather when foams are hard to produce. Be sure to experiment with the mixing ratios under your field conditions. Hardness of the water has a great deal to do with the performance of these foam concentrates. Some suppliers sell a water softener to use with the foam concentrate. The normal mix ratio is about 1-gal to 40-gal of water.

The foam marker used on our prototype sagebrush sprayer uses compressed air generated by a compressor driven by a 12 v. D.C. electric motor. The foam marker tank contains 40-gal of foam concentrate and water solution. This tank capacity is enough for three tank-loads of herbicide spray when using a 300-gal tank on the sprayer. This allows us to spray 90 acres of sagebrush before we have to refill the foam generator when we are spraying 10 gal/acre using the 300-gal tank on the sprayer. The amount actually required for a given field is dependent on the complexity of the site to be sprayed and the experience and skill of the operator. Foam is only used when needed for proper orientation, since the operator has controls for turning the marker on and off.

Benefit/Cost Analysis of Marker System

The costs involved in the use of the foam marking system are involved in the initial purchase of the equipment and the purchase of foam concentrate. The benefits potentially include improved rate of application and quality of weed control, direct savings in reduced pesticide cost, and increased forage production.

The cost of the foam marker solution for average sagebrush range sites is about $.12 per acre. When the cost of the investment in the foam generator and distribution system is included, the cost per acre increases to about $.23 (Table 1).

Benefits from the foam marker system are large relative to the $.23 per acre cost. Reduction in spraying costs are estimated to be $1.93 per acre because of less herbicide used and reduced sprayer operation. This cost savings alone would more than pay for operating expenses of the marker system.

Note 1: The turnarounds must be timed so the equipment is back within 15 minutes. This means that swath length should not exceed one-quarter mile. If the area is not finished at the end of the day the last swath must be marked with flagging tape.

Table 1. Costs and benefits per acre from operating sprayer foam marker system.

I. BENEFITS	
1. Cost Savings	
.45 lbs. less 2,4-D × $2.50/lb.	$1.13
.225 lbs. less Atrazine × $3.00/lb.	.68
less sprayer operating time and use	.12
2. Annual Forage Increase	
.088 AUM's × $8.36/AUM[a]	.74
Total First Year Cost Savings	1.93
Total Forage Benefits (Present Value of $.74 for 10 years, 10%)	4.55
TOTAL DISCOUNTED BENEFITS PER ACRE	$6.48
II. COSTS	
Additional Spraying Labor	$ .00
Additional Fuel	.00
Additional Repairs	.03
Foam	.12
Depreciation ($.36/hr. × .208 hours)	.07
Interest ($.038/hr. × .208 hours)	.01
TOTAL COST/ACRE	$ .23
III. BENEFITS/COST ANALYSIS	
Total Discounted Benefits/Acre	$6.48
Total Foam Applicator Costs/Acre	.23
NET PRESENT VALUE PER ACRE	$6.25
BENEFIT/COST RATIO ($6.48/$.23)	

[a]Reflects the average lease rate paid for pasturing cattle on privately owned non-irrigated lands during 1982 (USDA/ARS 1982).

Because the foam marker system would eliminate most skips and areas of poor brush kill, use of the marker system could also be expected to result in additional forage production. We have estimated a conservative forage benefit of 3.5 AUM's per year for 10 years for a 40-acre plot located on big sagebrush range sites. This represents a .088 AUM benefit per acre.

Total per acre benefits of the foam marker system are estimated at $6.48. After the $.23 per acre foam marker operating and investment cost is subtracted, the net present value of using the foam marker is estimated to be $6.25 per acre. The benefit/cost ratio is estimated at 28.2:1.

The foam marker system is a very economical way to improve sagebrush kill while spraying. Just as importantly the needed investment is relatively small, approximately $1,000 for tank, compressor, and foam distribution system.

DEADLINE DATES FOR *RANGELANDS* AND *JRM*

Items such as columns, advertisements, announcements, lists, and reports must be in the Denver office by the following dates to ensure publication in the respective issues of *RANGELANDS:*

April—**March 5**
June—**May 6**
August—**July 2**
October—**Sept. 3**
December—**October 28**

Position announcements must be in the Denver office by the following dates to be published in the respective issues of the *JOURNAL OF RANGE MANAGEMENT:*

March—**February 5**
May—**April 9**
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September—**August 8**
November—**October 8**
January 1986—**December 12**

Publications will normally be mailed by the 11th of the month of publication. Allow at least 2 weeks for delivery in the US.

Tebuthiuron-Environmental Concerns

W.E. Emmerich

Through mismanagement, abuse and neglect, many millions of once productive rangelands have been invaded by undesirable brush species, greatly reducing rangeland productivity. The controlling of unwanted plants has been one factor in our ability to greatly increase our production of food. Herbicides represent one tool that has been used for brush control in rejuvenating deteriorated rangelands. Air Products and Chemicals, Inc. first synthesized and discovered the herbicidal properties of tebuthiuron in the early 1970's. Eli Lilly and Company, through its Elanco Division, has promoted tebuthiuron, under the trade name of Grasslan®[1], as a herbicide for selective control of woody brush species on rangeland and permanent pastures. The Environmental Protection Agency (EPA) has recently registered

Editor's Note: William Emmerich is a soil scientist at the USDA-ARS, Southwest Rangeland Watershed Research Center, Tucson, Arizona. This paper is a summary of some of his research studies.

[1]This paper reports results of research only. Mention of a herbicide in this paper does not constitute a recommendation by the USDA. Mention of trademarks or proprietary products does not constitute a guarantee or warranty of the product by the USDA, and does not imply their approval to the exclusion of other products that may also be suitable.