## PROPANE-POWERED LOW-VOLUME SPRAYER AND WEED BURNER

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It is often difficult to apply small amounts of spray solutions uniformly over experimental plots, and the difficulty is increased when working with brushy range weeds which prohibit the use of a plot sprayer mounted on wheels.

A number of sprayers designed to apply small amounts of solution to experimental plots have been described in the 1951 Research Report of the North Central Weed Control Conference and by Buchholtz (1950), Robinson and Dunham (1950), Shaw (1950) and Ries and Terry (1952). These sprayers use compressed air or carbon dioxide. In experiments where both burning and spraying treatments are employed, it would be necessary, in using such a sprayer, to have a separate unit for the burning treatments.

A back-pack, propane-powered sprayer (Figure 1) was used successfully in Nevada this past season for spraying low-growing weeds such as halogeton (*Halogeton glomeratus*) and tall-growing shrubs such as big sagebrush (*Artemisia tridentata*) and rabbitbrush (*Chrysothamnus* spp.) at rates of 3 to 10 gallons of spray solution per acre.[1] Possible herbicidal effects of propane which may have become dissolved in the spray solutions have not been determined. Since the gas is in contact with the solution for only an instant, it is believed to be slight.

A measured quantity of solution is sprayed over the plot through a siphon-type paint gun. The problem of drift which is encountered in airplane spraying also applies to this sprayer, so that it is necessary to spray during hours of low wind movement. It has been found advantageous to have a two-man team in spraying operations, one to operate the sprayer and the other to locate plots and measure solutions.

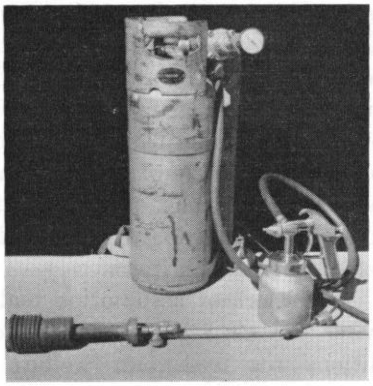

Figure 1. Back-pack, propane-powered unit with low-volume paint-gun sprayer and interchangeable weed-burning torch.

The propane tank may be easily filled in the field from cylinders containing 100 pounds of liquid propane. Since the propane is also carried in the back tank in a liquid state, the continuity of operation possible with a two-man crew sometimes results in lowering of the temperature of the propane to a point where the pressure falls below that set on a reduction valve. This leads to eventual freezing, particularly if a water solution is being applied on a cold morning. It has been necessary in these cases to stop at intervals to allow the temperature of the gas to rise. This can be hastened by setting the sprayer in the heated truck cab for a few minutes.

A unique feature of the apparatus is its ready convertibility to a weed burner. The paint gun and hose are replaced with a burner attachment which is available from a commercial supply source.

The weight of the empty sprayer is about 20 pounds, and the tank holds 10 pounds of propane. With the price of propane at $6.50 per 100 pounds, the cost of applying one gallon of water solution, if the sprayer were run continuously, has been calculated at approximately 30 cents. The initial investment in equipment was $60.50, and was itemized as follows:

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| Container | $17.50 |
| Regulator and pressure gauge | 10.50 |
| Paint gun | 16.00 |
| Hose, clamp and backboard | 3.00 |
| Weed-burning torch | 13.50 |
| Total | $60.50 |

[1] *This sprayer is a modification of one used by E. H. Sutliff of the Bureau of Reclamation, Department of the Interior.*

### LITERATURE CITED

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## ECONOMICS OF WESTERN RANGE RESOURCE USE[1]

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The central economic problem relative to range resource use is the allocation of all scarce resources

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available to the Western Range Area so as to obtain a maximum of the goods and services desired by all individuals and groups concerned. The resources considered were: (1) all land resources west of the eastern boundary (placed near the 100th meridian), including climate as well as physiographic features; (2) all labor resources available to the area, including the skills, productivity and mobility of the workers; and (3) all capital and management resources available to the area.

The primary purpose of this study was to develop a logical framework for economic analysis of western range resource use. The basic deductive theorems of the framework were taken from general equilibrium theory and welfare economics adapted to dynamics.

The marginal conditions underlying the theoretical models were enumerated, their limitations to specific situations were pointed out, and the policy and research implications of the maximizing solutions were discussed.

In general, the economic problems of range resource use fall under four main types of theoretical solutions: (1) optimum factor combination and use; (2) optimum scale of firms; (3) optimum product combination; and (4) the pricing of factors and products. The latter set of problems arises out of the environment in which some of the factors and products are rationed and their respective prices are administered.

The marginal conditions governing the optimum combination of factors of production specify that factors be so allocated that the ratio of the discounted expected marginal value of product to the discounted expected price of the factor be equal for every resource. This ratio should also be equal for every possible alternative use for each factor. (In absolute equilibrium this ratio would be 1.00.) The physical input-output relationships needed for making maximizing solutions come from the science of range management. However, the logic of the maximizing principles is not a part of the theories and principles of range management as currently defined, but comes from the science of economics.

Optimum scale of firms occur when it is impossible to increase or decrease the size of firms and thus obtain a lower cost of production for the same products or increase the amount of products from the same resources. There is strong evidence that substantial scale maladjustment occurs with the smaller firms. The extent of conflict between resource efficiency and income distribution criteria for determining optimum scale adjustment depends on the real nature of the economies of scale. There are conflicts in the kind of recommendations one makes based on each criteria.

An important assumption underlying the necessary marginal conditions for maximum welfare is that the factors and products are priced so that the market is cleared of all factors and products that are offered at that price and that no demand at that price goes unsatisfied. This assumption was found to be invalid for several instances of federally owned forage resulting in pressures tending toward malallocation. A general procedure was presented for evaluating the forage in terms of: (1) the quantity and quality of forage and the production coefficient rate at which grass was transformed into animal product; (2) the price of livestock products; and (3) the cost of resources other than forage associated with range-livestock production.

The marginal conditions specifying an optimum combination of enterprises (products) were explored for three different types of allocation problems. The first was that of determining the type of agricultural production for areas that are marginal between range-livestock production and dryland cropping. A part of this problem for some regions is the integration of irrigation into range and dryland farming operations. The existing economic criteria for determining the feasibility of irrigation development was appraised.

The second type of product combination to which the marginal conditions were applied was that of determining the optimum rate of of product (resource) use over time. This is the general problem of conservation.

A theoretical model for determining optimum intensity of grazing over time was developed and adapted to conditions of weather uncertainty.

The third type of product combination pertained to the optimum combination of the products of multiple-use resources, *viz.*, livestock, wildlife, timber, recreation and hydrological products. The general solution to this problem was approached through a series of partial solutions.

In each case the solution was a function of the physical marginal rates of product substitution between the two alternatives in question for a specific range site and the relative preferences of society for the products being considered. The general nature of several physical transformation functions was suggested, and procedures for estimating others were outlined.

The relative preferences of society for alternative products are usually expressed in terms of market prices. Not all products are allocated through the market mechanism, however. In some cases individuals express their preferences for alternatives by voting. Many of the allocation decisions pertaining to range resource use have been delegated to elected and/or appointed representatives. The complex and interrelated allocation decisions that are made by the several different elected and appointed representatives (Congress, the President and the bureaucracy) can be improved by the use of: (1) a central planning and coordinating board; and (2) a professional sampling staff to estimate the preferences of individuals relative to alternatives by means of statistical sampling.

Where the information needed for a decision is known, the theoretical models lead directly to the maximizing solution. Where the information is not known, the models direct the search for the needed facts. In the meantime they furnish the only logical basis for decision making in the absence of information.

## New Publications of Interest

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**Methods of Crop Forecasting.** By Fred H. Sanderson. *Harvard University Press, Cambridge, Mass. 254 pages. 1954. $5.00.*

**Our American Weather.** By George H. T. Kimble. *McGraw-Hill Co., N. Y. 320 pages. 1954. $4.50.*

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