Tilling May Improve Annual Plant Rangelands

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Will tilling or stirring up the surface layer of soil increase herbage yields on annual plant rangelands? Will tilling affect species composition? We know sulfur in the form of gypsum will increase herbage yields substantially (Bentley et al. 1958; Westfall 1966). What we need to know is whether tilling alone or in combination with fertilization is as effective as fertilization alone.

This study compared herbage yields and species weight composition from tilling and fertilization on the Westfall ranch at Bailey Flat, Madera County, in central California, in the Sierra Nevada foothills.

The study site was used for a previous study on the Westfall ranch. The elevation there is 1,200 feet. The soil is moderately shallow vista sandy loam, of granitic origin, and annual rainfall is about 22 inches.

The previous fertilization was in 1958; because of the elapsed time there was no residual effects (Bentley and Green 1954).

Two replications of each treatment (a) unfertilized and tilled, (b) fertilized and untilled, and (c) fertilized and tilled were used in a randomized block design. Unfertilized and untilled served as a control. Gypsum was applied before tilling at the rate of 550 pounds per acre, an amount equal to 96 pounds sulfur per acre. The soil then was tilled to about 3 inches deep with a rotary tiller. The soil was treated in late September 1966, before fall germination occurred.

Twenty soft chess plants in each of the eight study areas were measured in 1967. Herbage consumption by a large population of Beechey ground squirrels prevented clipping the plots in 1967. Height of soft chess was measured, however, before extensive rodent use occurred.

Herbage on five 1-square-foot plots was clipped in each of the eight study areas at peak of growth in 1968 and 1969. The clippings were air dried, then sorted to estimate total weight and species composition. Individual species sorted were soft chess (*Bromus mollis*) and filaree (*Erodium botrys*). Remaining herbage was sorted into groups: legumes, other grass species, and other broadleaf species.

Data from each year were analyzed by analysis of variance. Replications in the study were not enough to lend statistical validity to tests for differences between treatments. The results, however, do provide indications as to where real differences might be found with more intensive study.

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The fenced study site on the Westfall ranch at Bailey Flat, California. The rocky, brushy hills in the background yield less herbage than the study site, which is representative of the more productive areas of the ranch.

Heights of soft chess in 1967 were about the same on the unfertilized and tilled and control plots, but plants averaged 2 inches taller on the fertilized and untilled and fertilized and tilled. These data suggest that tilling did not stimulate height growth of soft chess.

Total herbage yields in 1968 and 1969, however, indicate that tilling may have some beneficial effect either alone or in combination with gypsum. In both years, average yields from tilled plots were more than from the control, and yields from fertilized and tilled plots averaged more than from fertilized only plots. Averages over the 2 years support these statements.

Data suggest that tilling may also influence species weight composition. Yields of soft chess were considerably more from all treatments than from the control in both years. Data from yields of other species are more difficult to interpret. But pounds per acre of legumes and other broadleaves in 1969 indicate that effects of the full treatment—fertilized and tilled—may be longer lasting than either partial treatment.

In 1967, we observed that areas fertilized with gypsum produced large proportions of legumes. In the earlier study at the ranch, legumes comprised 87% of the herbage the first year after fertilization with gypsum, and 88% the second year. In the present study, fertilization does not appear to have had any effect the second year (1968), and neither partial treatment-

fertilization or tilling—appears to have had an effect in 1969. Precipitation in 1968 was about 11.9 inches—36% below the long-term average. Low precipitation in 1968 may have resulted in lack of fertilizer response that year. The response of legumes to the full treatment—fertilized and tilled in 1969—appears to be the result of interaction between the two partial treatments. Tilling may extend the time hold-over effects will be obtained.

Although a more intensive study with more replications is needed to test these indications, our data suggest that tilling annual plant rangeland may increase total herbage yields and alter species weight composition. Annual plant rangeland fertilized with sulfur, however, will give higher yields than unfertilized areas in drought years (Woolfolk and Duncan 1962). Gypsum fertilizer, therefore, may be more reliable than tilling to increase yields. But the full treatment—tilling and fertilizing—may just be better than fertilization alone.

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Management Program for Leafy Spurge

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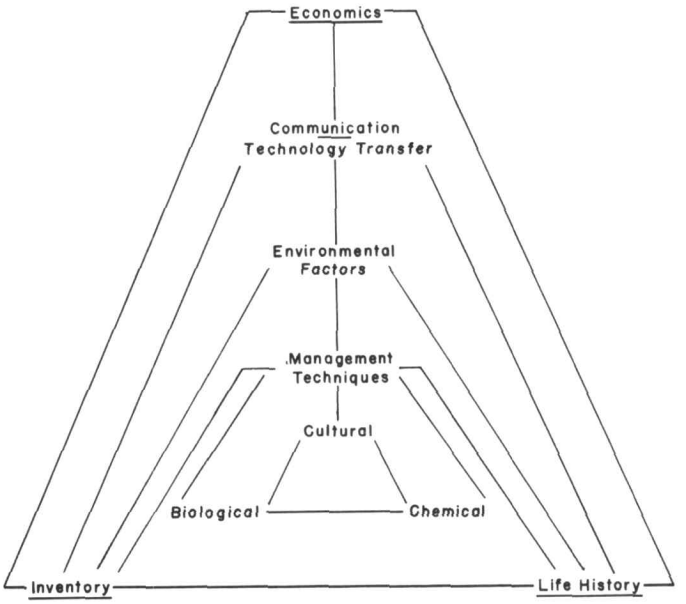
Leafy spurge is a tenacious perennial weed problem on rangelands of the northern Great Plains, with nearly 2½ million acres infested in North America (Noble et al. 1979). This weed, with a distribution center in the Caucasus Region of the U.S.S.R. (Croizat 1945), is distributed across the northern hemisphere from China in the east to the U.S. and Canada in the west. It is found in 25 states in the United States and has reached economic importance in 14 states, with an estimated control cost in 1978 of 10.5 million dollars. Interest in this serious problem is indicated by passage in 1979 of resolutions by both the Montana and North Dakota legislatures and the Old West Regional Commission supporting accelerated research and application programs for development of an integrated pest management (IPM) program[1] to control leafy spurge.

Current control measures for leafy spurge on range and wildlife land depend heavily on herbicides[2]—2,4-Dichlorophenoxyacetic acid (2,4-D), picloram (Tordon), and glyphosate (Roundup). These chemicals are expensive and some infestations are increasing in spite of herbicide treatment. It is not clear whether this is due to leafy spurge tolerance, methods of application, or both. Furthermore, repeated application of these chemicals on rangelands, particularly habitats involving water, may result in confounding environmental problems.

The need for an IPM program which would utilize biological and cultural controls in addition to herbicides is apparent. Also needed is a reemphasis of range management techniques effective against pests—regulations, early detection and eradication, and maintenance of quality rangeland competitive against invasion from noxious weeds.



An organization diagram showing interrelationships of subject matter for an integrated pest management program.

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[1] The proposal is a joint effort supported by the U.S. Forest Service and the Science and Education Administrtion—Agriculture Research with additional support from state and local agencies.

[2] The use of trade, firm, or corporation names in this article is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others which may be suitable.

Although this report discusses research involving pesticides, such research does not imply that the pesticide has been registered or recommended for the use studied. Registration is necessary before any pesticide can be recommended.

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