Chiseling Rangeland in Montana

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Dense clubmoss is distributed throughout the northern Great Plains, but is especially common on the glaciated plains of northern Montana. It is a perennial native forb of the spike moss family (Fig. 1). Clubmoss is a compact plant that forms dense mats. It is usually less than one inch in height. It reproduces by spores and not by seeds.

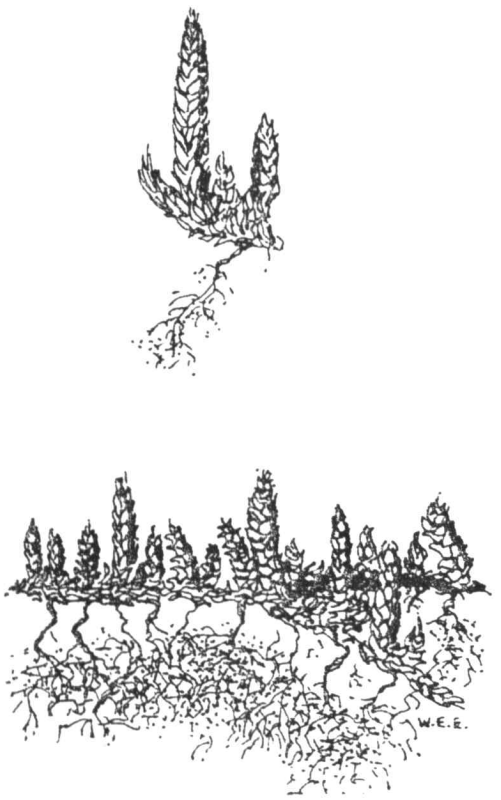

Fig. 1. *Clubmoss, a perennial, native forb reproduces by spores, not by seeds. Plants are usually less than one inch in height, and form dense mats*

Clubmoss has no grazing value and increases with grazing pressure. However, the plant reportedly spreads slowly. Rather than blaming recent grazing management practices for dense clubmoss infestations, it is likely that dense clubmoss has been prevalent in many areas for centuries.

Clubmoss often grows with blue grama. The shallow, extensive roots of these two species absorb most of the moisture from storms of 1/4 inch or less. Thus, a clubmoss-blue grama sod is very resistant to plant succession, and is not noticeably affected by grazing management. Opportunities for improving plant composition through burning and herbicides are limited by insufficient fuel and by economic and ecological concerns, respectively. Therefore, rangelands are frequently chiseled to promote plant succession (Fig. 2). However, landowners have many questions regarding herbage response, potential of interseeding a legume, and the economics of treatment. To find answers, we conducted a 4-year study.

Methods

Our study was done on the Clarence and Kevin Kuehn Ranch, located 20 miles north of Terry, Montana. Clubmoss, blue grama, junegrass, and western wheatgrass are the most common plants on the silty site. Annual precipitation averages 13.5 inches. Cattle graze the study site annually during the fall.

Five treatments (control, chisel only, chisel with tires, chisel with alfalfa, and chisel with alfalfa and tires) were applied on May 1, 1990. Treatments were replicated three times. The chiseling, with 4-inch twisted spikes on 12-inch centers, disturbed about 60% of the soil surface. Alfalfa-seeded plots were broadcast seeded with Spredor II (1 lb/ac) prior to chiseling.

Fig. 2. *Kevin Kuehn chiseling a silty range site in May 1990, to improve vegetation composition.*

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Forage production plots were clipped to estimate herbage response. Vegetation was separated into grasses and forbs. Because there was little or no alfalfa establishment, alfalfa was lumped with the forbs. Although there was little fringed sagewort on the site in 1990, it appeared to increase after the first year. Therefore fringed sagewort was separated and analyzed in 1991 and 1992. All plots were clipped during August of 1990, 1991, and 1992.

Ground cover (on the control, chisel with tires, and chisel without tires treatments) was estimated in 1992 using a line intercept method. Cover at 50 points per treatment was recorded as dead club moss, live clubmoss, vegetation (basal area of grasses and forbs or canopy of shrubs), litter or bare soil.

The economics of chiseling were evaluated by using a LOTUS® spreadsheet to calculate net present value. The spreadsheet is available through the Phillips County Extension Office, Malta, Montana.

Vegetation Response

Total production did not differ among treatments in 1990, the year of the treatment. By 1991, more vegetation was produced on the chisel with tires, chisel only, and the chisel with alfalfa and tires, than on the control and the chisel with alfalfa treatments. By 1992, all of the chiseled plots produced more than the control (Fig. 3), but total production did not differ among the chiseling treatments. Differences in annual production among years were likely influenced by annual precipitation: 10.2, 19.0, 15.2, and 17.4 inches in 1990 to 1993, respectively.

In 1990, grass production was about 50% less on the mechanically treated, rather than on the control plots. By 1991, more grass was produced on the chiseled with alfalfa and tires, chiseled with tires, and chiseled only treatments, than on the control or the chiseled with alfalfa treatments. In 1992, grass production on all chiseled treatments exceeded production on the control treatment.

Forb production varied among years, but not by treatment. Production in 1991 was two-fold greater than in 1990, but then decreased in 1992, to the 1990 levels. We believe that a dry spring limited alfalfa establishment. During the first year of the study, 1.17, 2.69, and 1.71 inches of rain fell during May, June, and July, respectively. This was about 50% below the long-term average. Alfalfa establishment may have been possible, and rate of vegetation response would have been faster, if the chiseling treatment had been immediately followed by some good rainfall.

Fringed sagewort appeared to increase during the study period. However, clipping data indicated that sagewort production was not significantly influenced by treatment or by year.

A comparison of grass, forb, and total forage production in treatments which included dragging tires behind the chisel plow, did not differ from mechanical treatments which did not include tires. Chiseling treatments reduced live clubmoss cover from 60% to less than 5% (Fig. 4). The use of tires did not enhance the clubmoss-reducing ability of the chiseling treatment (Fig. 5). Furthermore, the roughness of the soil surface was reduced by tires which would impair snow catch and water infiltration. Thus, tires likely reduce the effective life of the treatment.

Economic Analysis

To evaluate the chiseling, the following assumptions were made: 1) a 1,000 lb cow consumes 22 lbs of forage daily, or about 660 lbs of forage per month, 2) livestock harvest

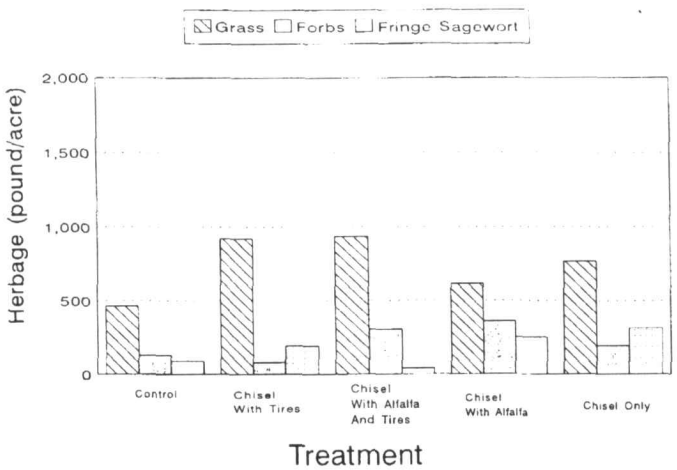

Fig. 3. *Herbage production in 1992 following mechanical treatments in May 1990, Kuehn Ranch.*

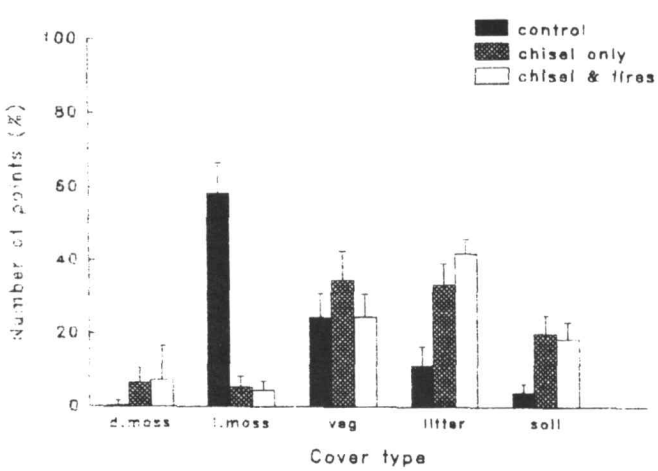

Fig. 4. *Live clubmoss was reduced from 60% to less than 10% by chiseling, while bare soil increased slightly. Vegetation production did not differ between chiseling with or without tires.*

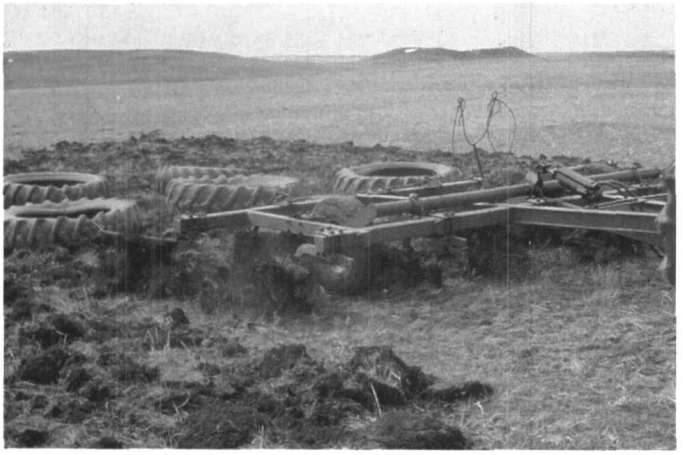

Fig. 5. *Dragging tires behind the chisel plow did not increase clubmoss control.*

25% of the total herbage, 3) and the treated area was rested during the treatment year. Six input variables were entered into the LOTUS® spreadsheet: 1) forage (AUMs) without improvement (mean production of herbage on control plots in 1991 and 1992—685 lbs), 2) forage (AUMs) with improvement (mean production of herbage on chiseled plots in 1991 and 1992—1301 lbs., 3) a $7.50/acre cost of chiseling, 4) a discount of 7% (to discount for time), 5) an AUM value of $12, and 6) an annual maintenance cost of zero.

Two separate scenarios, proper and less-than-satisfactory grazing management, were analyzed. The former scenario assumed that the improved native plant community would maintain itself during the evaluation period. Under improper management, herbage production on the chiseled range was assumed to decline 25% from the 6th to 10th year, with an additional 25% decline from the 11th to the 20th year.

Under proper management, with no long-term loss of productivity, the per acre net present value of chiseling at 10, 15, and 20 years was $22.53, $31.44, and $37.80, respectively. Net present value may be interpreted to mean that if funds can be borrowed at 7% interest and if the best alternative investment does not yield a larger return, over its 20-year life the project would yield a profit of $37.80 per acre.

The 20-year net present value of chiseling declined to $7.98 per acre when grazing management was less-than-satisfactory. Loss in value was directly related to the reinvasion of blue grama and clubmoss, the loss in vigor of major forage plants, and the corresponding decline in forage production. The difference between the NPV of the two scenarios emphasizes the need for research to quantify long-term herbage response to range improvements.

Implications

Chiseling and other mechanical treatments can improve forage production in the northern Great Plains. Improvement is most feasible on productive sites, where forage production is limited by blue grama, clubmoss, and other shallow-rooted plants. Depending on grazing management practices, net present value of chiseling varied from $8 to $38 per acre. These results clearly emphasize the wisdom of following a mechanical treatment with proper grazing management.