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ESTABLISHING 'GARRISON' CREEPING FOXTAIL IN WET/SALINE MEADOWS IN SOUTHERN WYOMING

BY
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ABSTRACT
Mountain meadows represent a significant amount of the irrigated area in the Wyoming. Many of these meadows produce low yeilds and low quality forage. Improvement by various means could greatly increase the quality and quantity of forage produced. Inter-seeding and sprigging of improved legumes and grasses has potential in economic improvement. Several Soil Conservation Service (SCS) employees and ranchers within their respective southern Wyoming counties became interested in the Bridger Plant Materials Center sprigging activities. Four individual trials were established from 1982 through 1985 to compare interseeding, direct seeding and sprigging in no-till, conventional tillage and herbicide treatment plots. Two grasses were used-'Garrison' creeping foxtail, Alopecurus arundinaceus and 'Shoshone' beardless wildrye, Leymus triticoides. The degree of successful grass establishment varied by cultural treatment method, plant species and time lapse before production increase. The land manager's choice of treatment option will depend on his management objectives, available capital and patience for increased forage production and quality in low producing, low quality wet meadows.

INTRODUCTION

Mountain meadows represent a significant amount of the irrigated area in the United States. Lewis (1957) esimates there are 5,540,000 hectares of mountain meadows in the ll western states. This figure is about 12% of the total irrigated land in the United States.

Burman defines wet mountain meadows as high elevation irrigated grasslands usually rangeing from 492-9842 foot (1500 to 3000 meters) in elevation obove sea level. The grasses in these meadows are usually native and their composition depends upon long term moisture and other management conditions (Siemer and Rumberg, 1975). Rushes and sedges tend to dominate in very wet sites and timothy, bluegrasses and other grasses appear in drier sites. Weeds are often significant. Irrigation is often applied in early spring as soon as spring snow-melt runoff occurs. Irrigation is often on a continuous basis until streamflow becomes low or water is withheld to dry up fields for hay harvest. Most mountain meadows have rocky soils and a rough topograhy. This is particularly true where the irrigated land contains numerous former ox-bows of stream beds.

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Many of these mountain hay meadows are yeilding .5 to 1.5 tons per acre depending on the site, the condition of the meadow and how it is managed. Combined with the low yeilds are the relatively low quality hay. Productive, improved species can produce up to 5 or 6 tons of hay per acre with fertilization, good water management and the two cutting system (Siemer and Gery, 1989). Undoubtedly, improvement by various means could greatly increase the quality and quantity of forage produced. Increased production on deeded lands may become increasingly important in the future because of the possible decreased public grazing. Research is needed to determine the economic feasibility of different intensities of mountain meadow improvements on different sites (Jacobs and Kearl, 1979).

Interseeding and sprigging of improved legumes and grasses in hay meadows and pastures has a potential economic advantage over conventional methods (Delaney et al., 1979). Interseeding is the practice of seeding a preferred species into an existing plant community. Sprigging is a vegetative planting method whereby rhizomes, rootstocks, and or stolens are planted, sprouting new plants from stem meristem and rhizome nodes. Instead of six trips of the field to work the soil and establish new grass stands, you do the same job with just two trips-herbicide application and drill seeding or vegetative sprig planting.

Low yields often reflect the high percentages of low productive species in pastures and haylands. New and more productive species may need to be introduced to increase forage yields. Complete seedbed preparation for reseeding has often been impractical due to economic considerations, or because the terrain is too wet, rocky or sloping to lend itself to conventional tillage practices. Sod seeding may allow establishment of forage species without plowing and total sod destruction.

PREVIOUS STUDIES

There have been numerous interseeding projects funded by the Old West Regional Commission throughout Montana, Wyoming, North and South Dakota and Nebraska beginning in 1979. The projects in North and South Dakota and Nebraska concentrated on rangeland interseeding while the projects in Montana and Wyoming delt with improving wet meadows. Colorado also conducted research to establish improved legumes and grasses in old, native, high altitude mountain meadows to improve forage production and quality. Additional trials of various types have been conducted by researchers, cooperative extension service and ranchers throughout Montana and Wyoming.

Considerable research to develop sod seeding methods has been conducted in western Montana, Wyoming and Colorado on irrigated and sub-irrigated pastures and haylands, wetlands and high rainfall rangelands. The research objectives covered all facets of sod-seeding, i.e. competition control with herbicides, no-till planter types, species and seeding rates, planting time etc. A brief summary of some of the results are presented in this paper.

Success in sod-seeding depends upon good seed placement, adequate but not excessive soil moisture, limited competition from existing plants, good legume innoculation and soil fertility and management to promote increasing vigor of seeded plants (Siemer and Gery, 1989). Interseeding is one of many grazing management practices. To be effective it must become a part of the total grazing management plan, otherwise it will likely fail (Dodds and Manske, 1987).

Many landowners, in the interest of cutting expenses, have become interested in interseeding into existing vegetation to replace unproductive plant communities with plant species having a higher forage production potential. This "quick fix" concept has failed more times than it has succeeded. The use of a non-selective herbicide to control competing sod is critical. Generally, glyphosate suppressed sod longer than paraquat and resulted in better legume and grass establishment. Even with the use of herbicides to supress existing vegetation, many problems have been encountered with direct sod-seeding. Welty et al. observed that in many situations where herbicides provided adquete control, forage stands were inadequate. They concluded that factors other than sod control were limiting successful establishment of small-seeded legumes and grasses. Suspected reasons for poor establishment are residual toxicity of non-selective herbicides and/or allelopathic effects of decaying swards on germination, emergence and growth of legumes and grasses. After researching the problem they found that a separation between spraying of sod and interseeding forage species allows time for toxin dissapation. Wyoming research (Delaney, Anderson and Becker) showed that herbicides were nearly essential to getting acceptable stands by sod seeding, experiencing 15

failures out of 16 trials without herbicide, and they sited Montana research by Welty, et al. in which there were 25 failures out of 26 attempts without herbicides.

Siemer and Gery, 1989, found that herbicides may not be required, if great care is used to reduce the competiveness of existing plants, or if native stands are poor to begin with. Where stands are inherently poor, management may need to be improved to promote seedling growth.

The other facet of sod-seeding researched was the drill. A sod-seeding drill must meet three requirements to function properly in sod: 1)provide sod penetration; 2)provide seed depth control; and 3) have addequete packer wheel system. After modification, the John Deere Powr-till 1500 met the obove requirements and functioned well (Welty et al., 1983). Siemer and Gery, 1989, also used the John Deere Powr-til seeder Model 1550 in Colorado trials.

Sod-seeding success has been limited on very wet sites where rushes and sedges dominate the sward because these species are resistant to glyphosate (Welty et al, 1983). Many of the research trials have been conducted either in rangelands of mixed plant communities or in pastures with dominating species in plant communities. Thus, as previously mentioned, little success has been realized in interseeding range and mixed success have been reported in pastures. Re-establishing monoculture pastures has been done successfully by treating exsiting vegetation with glyphosate and interseeding preferred pasture species.

Numerous species have been planted on one or more test sites. Seimer and Gery,1989, found alfalfa, red and alsike clovers were most easily established while grass trials established poor. Welty et al., 1983 found alfalfa and pubescent wheatgrass established better than crested wheatgrass and Russian wildrye under dryland conditions. Alfalfa and orchardgrass established better than ladino clover and meadow bromegrass on irrigated, well drained locations. However, ladino clover and meadow bromegrass stands were acceptable in some cases. Tall fescue and reed canarygrass established better than 'Garrison' creeping foxtail and alsike clover under wetland conditions.

Sucessful establishment has been achieved in wetland sites by seeding in late August when rushes and sedges have lost their competitive edge. It is also when the water tables in wet meadows have reseded so equipment can transverse the sites. The Soil Conservation Service (SCS) plant materials center, Bridger, Montana, have been successful in planting wet/saline sites dormant in November.

The USDA-Soil Conservation Service (SCS) Bridger, Montana plant materials center (PMC), is testing various techniques of establishing forage plants in wet saline-alkaline soils. With inconsistant establishment from seed, sprigging as an establishment technique was considered. Theoretically, sprigs have a better chance of establishing in salty soils than do seeds because they are planted deeper, below the high concentration of surface salts, and are physically and physiologically more mature than a seedling (Majerus, 1990). They can also establish faster when introduced in an existing plant community than can seedlings.
The studies conducted by the Bridger PMC found the following factors necessary when establishing forages by sprigging: (i) the sprigs must not be allowed to dry out prior to planting, (ii) they must not be allowed to overheat, (iii) the species must be adapted to the site, (iv) the sprigs must be planted in a moist seedbed (mid-September in Montana trials), (v) competition must be

controled just like when planting from seed, and (vi) the planting must be defered for two growing seasons for plant establishment.

The Bridger PMC tried various rhizomotous plant species in their sprigging trials and found 'Garrison' creeping foxtail to be the species best adapted to sprig propagation. Garrison is very opportunistic and aggressive. It has been reported to become established in wet intermountain meadows where previously only wiregrass and sedges existed. Garrison establishment increased the forage value and productivity of these wet sites.

Establishing Garrison in wet sites that cannot be transversed with equipment is possible by introducing the seed through feeding Garrison hay on the site or broadcasting the seed over the area. Livestock hoof action will plant the seed and with proper management of irrigation water and fertilizer Garrison will establish a productive stand on the site. This process is the cheapest way to establish Garrison and also the slowest requiring from 5-10 years for a stand to establish.

MATERIALS AND METHODS

Several SCS employees and ranchers within thier respective counties in southern Wyoming became interested in the Bridger PMC sprigging activities. They requested That the Bridger PMC conduct sprigging trials in southern Wyoming high mountain meadow to determine if sprigging Garrison creeping foxtail and 'Shoshone' beardless wildrye would be an effective method for revegetating or improving forage quality and quantity in wet and/or saline meadows. A subirrigated wet meadow site was selected on the Bob Johnson ranch, 1/2 mile north of Elk Mountain, Wyoming.

The Johnson site has shallow soils, is stoney stoney to the surface, subirrigated and non-saline/alkaline. The existing plant community consists of mottled stands of sedges, rushes, timothy, tall fescue and alkali grass.

Four individual trials were installed from 1982 through 1985: 1982 interseeding trials, 1983 sprig and seeding trials, 1983 herbicide trials and 1985 sprig trials

1982 Interseeding Trials

In the late summer of 1982, Johnson rented a John Deere 1500 Powr-til interseeder. The interseeder was 8 foot wide and cut through the sod with mechanized rotary culters every foot, disturbing about 3/4 inch of sod where it dropped the seed. Several 16 foot wide strips with 40 foot interspaces where interseeded with Garrison creeping foxtail at a 3 pure live seed pounds per acre rate in the late summer-early fall.

1983 Sprig and Seeding Trials

The site used for this sprigging trial has the same soil and vegetative conditions a previously mentioned in the 1982 Powr-till trials.

An area 150 X 300 foot (1 acre) was selected as the test site. Four site preparation treatments were applied: 1.) no- treatment, 2.) cultivation (disk) periodically throughout the 1983 growing season, 3.) chemical (2 qts glyphosate a.i./acre with .25% v/v non-ionic surfactant) applied broadcast in the late spring, to adequete plant growth, and again in the early fall and 4.) a combination of herbicide treatments and cultivation. The cultivated area was conventionally tilled whenever the area could

be transversed. Garrison and Shoshone were each sprigged and seeded across each preparation treatment resulting in a 75 X 150 foot species plot for each method. The sprig plots were sprigged September 15,1983 and the seeded plots were seeded in late October, 1983. 280 lbs/acre 30-10-0 was applied across preparation treatments to 1/2 of the 4 species plots, i.e. sprigged and seeded.

September 13,1983, Garrison sprigs were harvested from the Clyde Johnson Ranch using the Bridger PMC Bowie 70-cm wide sprig harvestor. The Shoshone beardless wildrye sprigs were transported from the PMC. One plot each of Garrison and Shoshone were sprigged using the PMC Bermuda King single-row planter into rows approximately 4 foot apart at a rate of 10-15 sprigs per meter of row (approximately 750 kg/ha). The digging-to-planting ratio was about 1:15, i.e. sprigs dug from one hectare were sufficient to plant 15 hectares using a 1 to 1.25 meter row spacing. The soil was moist at planting but the sprigger would accassionally plug from the excessive residual residues.

The seeded plots were direct dormant fall planted in late October by the ranch manager using a conventional grain drill. Garrison and Shosone were planted at the SCS recommended rates, 3 and 6 pure live pounds of seed per acre respectively.

Herbicide Trials

During 1983, Harold Alley, Professor Plant Science, University Of Wyoming, set up herbicide trials on the wet meadow adjacent to our plots. The objective of his trials was to test various herbicides for controlling the wet meadow vegetative competition. Twenty-five different herbicide treatments were applied in 3 replicates.

1985 Sprig Trials

On a site adjacent to the 1983 trials, another trial was installed in 1985 to utlilize Harold Alley's herbicide trial results. This trial involved applying glyphosate at 2 quarts a.i. per acre plus .5% v/v non-ionic surfactant in 1 foot bands at various inter-spacings and at various times during the growing season,i.e. 40, 60, 80 and 120 inches in July, July and August, June-July-August, June and July, June and August and June only. The glyphosate was applied at the same rate used in the 1983 trials, except in 1 foot bands. The Garrison sprigs were harvested from Clyde Johnson's ranch and the Shoshone sprigs were harvested at the Bridger PMC and transported to the test area. A very small area was sprigged to Shoshone due to the limited amount of sprigs transported. Garrison was the major species sprigged in this trial and it was sprigged into the herbicide treated bands September 18, 1985. The 7 herbicide treatment areas each contained all the band spacing treatment intervals resulting in 7-300 X 24 foot plots(.16 acre). The sprigging procedure was the same as described in the 1983 trials except the sprigs were planted in rows within the herbicide bands at the various inter-spacings.

The 1982 and 1983 trials were evaluated in 1985 for herbicide competition control, grass stand establishment and vigor. All the successful trials were evaluated in 1989 for the same factors plus forage yeild was sampled from planted species and control plot composition to provide quantitaive data. Only the June-July-August, June and July herbicide bands and their corresponding control

plot (paired plot sampling) were harvested for forage yeild. The data and results for each trial will be reported and discussed in the following section.

RESULTS AND DISCUSSION

The Johnson trial results will be presented in three parts: 1.) herbicide trials, 2.) seeding/sprigging trials by years and 3.) the economic feasibility of the various herbicide/seeding/sprigging combinations.

Herbicide trials

Of the 25 herbicide combinations applied to the wet meadow site by Dr. Alley in 1983, glyphosate at 2 quarts a.i./acre with a .25% v/v non-ionic surfactant provided the best competition control. Optical evaluations of the trial showed that two treatments (June and again in July) provided the best overall competition control for the mixed species meadow plant community. (Table 1) Welty, et al. reported that the sedges and rushes grow during the warmer portion of the growing season. Therefore the two herbicide treatments resulted in controling the early green-up species as well as the species that green up later in the growing season. As stated earlier, competition control is paramount to introducing improved forages into these wet meadows. However, the cost of the herbicides may make the practice economically unfeasible.

The 1985 plots were designed to cut the herbicide application costs by band spraying 1 foot strips and leaving various width inter-spaces. The theory was to use quik establishing plant species, such as Garrison, planted vegetatively from sprigs. This species has the ability to out compete the inter-space competition over time and establish itself from rhizomes rapidly given favorable conditions-primarily adequete water.

The 1985 trials showed that three herbicide treatments applied separately during June,July and August controled the competition the best followed by the June-August combination. (Table 2) The late herbicide applications (July or August) or the single application early (June) provided the least competition control.

Sprigging/seeding trials

1982 Interseeding Trials

Little evidence of Garrison was observed on the Powr-tilled strips until the fall of 1985-three years following inter-seeding. At that time, light green strips could be recognized but the stands were sparse. 1989 evaluations showed that good Garrison stands established in the strips and was competing well with the original plant community. Forage yields were sampled from three paired plots on July 18, 1989. The total herbage production from the Garrison interseeding yielded 1.6 times the production of the non- seeded areas, a significant yield increase. (table 3 and 4) Garrison made up over 57% of the total plant community composition by weight. However, it took 6 years to realize the benefit of inter-seeded Garrison.

These results indicate that Garrison can be introduced into a wet meadow plant community with seed and become established and productive with time. The ranch manager will have to decide what a reasonable time period given his ranches forage balance objectives.

1983 Sprig and Seeding Trials

An analysis of variance showed no significant difference between the 6 herbicide/tillage treatments. However there was a significant difference between the treatments overall and the non-treated meadow relative to forage yield. (Table 6) The herbage yeild averaged over all treatments produced 1.5 times the forage produced from untreated plots. (Table 7) Stand establishment, optically evaluated for stand density 9/18/85, showed that good stands of Garrison established in the Roundup treated plots of June and July, June alone and June and August with cultivation. Very poor stands resulted from cultivation alone and within the non-herbicide treated areas. Table 1.

There were significant differences between the drilled and sprigged plots. Good stands established from the sprigged plots whereas fair stands were established from seed. No Shoshone beardless wildrye was ever identifed in any of the plots. Garrison appeared to be competing with the indigenous meadow species and suppressing it to a low vigor understory component. The addition of nitrogen fertilizer would have increased plant vigor and perhaps accelerated establishment time towards a productive stand. (Ludwick, 1979) Garrison is very responsive to nitrogen fertility.

1985 Sprig Trials

The June-July and the June-July-August herbicide treatments estalished good vigorous stands. (Table 7) The July and August only treatments resulted in poor stands and plant vigor with the June, June-August and July August rating average stands and vigor.

There were no significant differences among band inter- spacing of the glyphosate herbicide band and sprigged plots compared to the control. (Table 8) However, Garrison made up almost 65% of the herbage composition by air-dry weight. The Garrison will eventually fill in the inter-spaces and provide a greater component of total yield. There is excellent visual evidence that the Garrison is moving rhizomoutously laterally away from the treated bands and establishing in the untreated inter-spaces and is competing with the meadow species. Even now, without and significant difference in yield between the treated bands and the control, the Garrison is probably providing a higher quality forage than the meadow plants. (nutritioal value was not analysed) The rate of Garrison spread will likely be similar for all inter-spacings, the variable being how long it takes to invade the progressively wider inter-spaces and become a productive solid stand.

Over time, the Garrison has been observed out competing meadow species and spreading into them. As stated earlier, the purpose of band applying glyshosate was to cut down the cost of wet meadow renovation. Based on observations from this study, it appears that strip esablishment will eventually provide an almost pure productive stand of Garrison. The major economic question is how long the manager is willing to wait for increased forage production and qualilty?
Economic Analysis of the Various Inputs and Outputs

Seeding strips with a powr-till drill, without herbicide, is the least costly alternative, but it will be five years before a producer knows if new plants are established and it will take another 3 years after that to fill in the stand and reach the three ton per acre production level. The amortized cost is $19.50 per acre for seven years. Figure_.

Sprigging without herbicide will reach the three ton per acre level of production in nine years instead of fifteen but at a higher amortized cost of 26.50 per acre per year for seven years. Figure_. It will take about three years to determine if the plants are established.

Banded or broadcast herbicide applications, followed by sprigging, will reach the desired three ton per acre level of production in seven years but at higher costs of $33.00 and $46.50 per acre per year for seven years respectively. Figure_. Of these two, the least costly banded herbicide treatment reduces the current level of production by only 25% the first year. Broadcast herbicide application, however, will reduce the current level of production by 100% the first year. One advantage, with either of these alternatives, is that the producer can evaluate new plant establishment the within one year.

SUMMARY

Control of competing vegetation is costly, but new plant establishment can be verified in one year. Seeding or sprigging without control of other vegetation, may take as long as five years before new plants become evident. The land manager's choice of treatment options will depend on his management objectives and patience for increased forage production and quality in low producing, low quality wet meadows.

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