Interseeding and Transplanting Shrubs and Forbs into Grass Communities

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Throughout the western United States, hundreds of thousands of acres of rangeland have been seeded to and are dominated by desert wheatgrass *(Agropyron desertorum)*, crested wheatgrass *(A. cristatum)*, and other introduced and native grass species. Monostands, seeded or natural, of any one species do not constitute good, healthy wildlife or livestock ranges. Two means of establishing desirable species into grass stands are interseeding and transplanting.

Interseeding

Equipment

To effectively interseed into existing vegetation, scarification is needed that is: (1) deep enough to remove all seeds, crowns, and rhizomes of existing vegetation; (2) wide enough to allow seeded species to become established before reinvasion or competition occurs from surrounding vegetation; and (3) of such a shape and size as to be effective water harvesters.

The Forest Service Equipment Development Center, San Dimas, Calif., was assigned a project to develop and validate a demonstration interseeder that could operate on rangelands. In 1977, the center developed a five-component interseeder consisting of a prime mover, seed-metering device, an implement-carrying hitch, a seed transfer system, and a scalper. Over the past 3 years, it has been validated and tested in Utah and southern Idaho, with modifications made as needed.

A John Deere, model 350, diesel, crawler tractor rated at 42 drawbar horsepower was the prime mover. An implement-carrying hitch was also designed and constructed by the Equipment Development Center. The drawbar hitch was attached to the center of the track frame at the tractor's real-hitch point. By using the real-hitch point, the implement is able to remain in the soil despite varying conditions such as when the tractor turns, moves up and down, around rocks, or on uneven ground.

Three scalpers were used to remove existing vegetation:

A. Single-disc trencher with a 28-inch-diameter disc. The disc can be adjusted 45 degrees left or right.

B. Sieco fireplow consisting of a v-shaped, heavy duty, sulky-type plow with two 16-inch discs, one on each side, making a scarification 30 inches wide and 9 inches deep.

C. Modified Hansen scalper, which is a heavy duty, 24-inch-wide v-shaped, sulky-type plow.

Five component interseeder: (1) prime mover, (2) seed-metering device (thimble seeder), (3) implement-carrying hitch, (4) seed-transfer system, and (5) scalper.

Seed was metered with a thimble seeder mounted on the side of the tractor. The thimble seeder is driven by rotation of the tractor's track through a small rubber-tired wheel riding on the track. The tractor's speed differentials, variation in seed size, type, purity, and desired quantity can be compensated for by changing thimble sizes and numbers. The thimble seeder will accommodate rough, hairy, plumed, trashy as well as smooth, hard seed. Seed is metered by the thimble seeder, dropped in a port, and carried to the discharge point behind the scalper by an airstream provided by a turbocharger or electric fan. The seed is then covered by dragging a looped chain.

Drawings of the demonstration hardware are available from the Equipment Development Center, San Dimas, Calif. (drawings No. RM35-01 through 09).

Methods

The three scalpers were evaluated on how effectively each removed perennial grass competition and created an acceptable environment for the successful establishment of 15 different shrub and forb species seeded individually and in selected mixes. The machinery tested included the Sieco fireplow, the Hansen scalper, and a single-disc trencher. Each species was seeded into three separate 200-foot-long scarifications for each scalp type. The scarification types and species were established during October and November at random in a stand primarily composed of intermediate wheatgrass *(A. intermedium)* with lesser amounts of desert wheatgrass. The planting site is near Holden, Utah, at an elevation of 5,800 feet. The site receives an average of 13.5 inches precipitation annually.

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Funds were provided through Federal Aid in Wildlife Restoration Project W-82-R and USDA Forest Service, Equipment Development Center, San Dimas, Calif., and Intermountain Forest and Range Experiment Station, Ogden, Utah.
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The success of each type of scarification was measured by rate of reinvasion and establishment of perennial grasses into the scalp. Seeding success was measured by counting the number of seeded plants per species established per linear foot of scalp, and by determining plant vigor by scalp type and species.

Results

Reinvasion by grasses generally occurred from the edge to the center of each scarification. Where the scarification treatments were not deep enough to remove roots and rhizomatous material, reinvasion occurred from within the scalp. After the first growing season, the Sieco fireplow scalps had the least amount of grass reinvasion and the Hansen scalper the greatest. Those made with the single-disc trencher were in between. The same order held true at the end of the second growing season, with Sieco fireplow scalps, once again, having fewer grass culms. With present rates of reinvasion, scalps made with the single-disc trencher and Hansen scalper could be fully dominated by grasses within 3 years. By the end of the second growing season, most seeded species in the Hansen and single-disc trencher scalps were showing adverse effects (low vigor, stunted growth, death) from competition produced by bordering and invading grasses. It is postulated that seeded species will become well established if competition from grasses is suppressed for 4 to 5 years.

Sieco fireplow that makes a scalp 30 inches wide and 9 inches deep.

The Hansen scalper 4-inch-deep scarification was not deep enough to completely remove all rooting and rhizome materials. Scalps made with the single-disc trencher were so narrow (20 inches) that grass roots quickly grew into the center of the scalp from the borders and subsequently sprouted. Sieco fireplow scarifications were 30 inches wide and 9 inches deep. They were, therefore, large enough to remove most of the competing vegetation and seemed to also be the most effective water harvesters.

With all 15 seeded shrub and forb species considered, the highest number of seedlings occurred in the Sieco fireplow scalps with an average of 5.22 plants per linear foot at the end of the first growing season. At the end of the second growing season, there were 2.84 plants per linear foot, which represented a 45.6% loss between the first two seasons. A 64.7% loss (3.09 plants to 1.09 plants per linear foot) occurred between the first and second growing seasons in the single-disc trencher scalps, and a 69% reduction (4.46 plants to 1.38 plants per linear foot) between seasons in the Hansen scalper treatments. Seeded plants in the Sieco fireplow scalps were the most robust and vigorous.

In single-species comparisons on the Sieco fireplow scalp plantings, the species response varied after 2 years of growth. Species that averaged more than five plants per linear foot were: basin big sagebrush *(Artemisia tridentata tridentata)*, mountain big sagebrush *(A. tridentata vaseyana)*, prostrate kochia *(Kochia prostrata)*, and showy goldeneye *(Viguiera multiflora)*. Ladak alfalfa *(Medicago sativa)*, Lewis flax *(Linum lewisii)*, cicer milkvetch *(Astragalus cicer)*, and cliffrose *(Cowania mexicana stansburiana)* averaged from two to five plants per linear foot after 2 years. And finally, species with less than two plants per linear foot after 2 years were fourwing saltbush *(Atriplex canescens)*, giant fourwing saltbush (*gigas* form of *A. canescens*), white rubber rabbitbrush *(Chrysothamnus nauseosus albicaulis)*, mountain rubber rabbitbrush *(C. nauseosus salicifolius)*, Pacific aster *(Aster chilensis adscendens)*, small burnet *(Sanguisorba minor)*, and bitterbrush *(Purshia tridentata)*, which had the least of any species.

After two growing seasons, basin and mountain big sagebrush and white and mountain rubber rabbitbrush had put on exceptional amounts of vegetative growth within the Sieco fireplow treatments. Prostrate kochia, showy goldeneye, Lewis flax, small burnet, and mountain big sagebrush all flowered and set seed during the second year. Species that did well seeded in mixtures were the sagebrushes, prostrate kochia, small burnet, Lewis flax, and showy goldeneye.

Transplanting

Equipment and Methods

In an effort to readily establish shrubs and provide soil stabilization, forage, and cover in a short time, transplanting was investigated.

The transplanting of shrubs was tested using four types of mechanical transplanters: Forestland, Whitfield, modified Whitfield (heavily reinforced), and Skinner tree transplanters. Transplanting tests were carried out during March under favorable soil moisture conditions. Location of the trials was in the same intermediate wheatgrass communities in which the scalping-direct seeding trials took place.

Workers transplant a variety of shrubs with a modified Whitfield tree transplanter equipped with a v-shaped, double-sulky type scalper.

Mountain big sagebrush, transplanted with the modified Whitfield tree transplanter, obtained an 80% survival success rate after 2 years.

The prime mover for the Forestland and modified Whitfield tree transplanter was the above-described John Deere 350, crawler tractor equipped with the Forest Service implement-carrying hitch. The prime mover of the Whitfield and Skinner tree transplanters was a David Brown, rubber-tired, 43-horsepower diesel tractor equipped with a standard 3-point hitch.

Shrubs were transplanted with the various equipment into scarifications made with the Sieco fireplow. Shrubs were also transplanted into scalps made with a v-shape, double-sulky type scalper mounted on the tongue of the Forestland and modified Whitfield transplanters. This machine made a scalp 25 inches wide by 9 inches deep. Transplanting also occurred directly into grass sod without scalping using the modified Whitfield transplanter.

Results

The Whitfield and Skinner transplanters with standard 3-point hitch would not remain in the soil, and when in the soil, they would not remain at constant depths. Very poor shrub transplanting resulted (less than 10% survival) with the Whitfield and Skinner transplanters. However, the Forest Service-designed, implement-carrying hitch permitted the Forestland and modified Whitfield transplanters to maintain constant depths at all times.

Automatic pickup and planting systems on the Forestland and Skinner transplanters did not work well. Automatic planters worked sporadically on uneven ground and were continually plagued by rocks, sticks, and other material, including plowed soil and plant material. Most transplantable shrub materials have multiple branching, fibrous and/or fairly large root systems. Consequently, they were not picked up or released properly to ensure correct planting. The branches and roots continually tangled in the fingers and chain of the automatic planting devices.

At the end of the first growing season, survival of bareroot stock planted with the Forestland transplanter's automatic planting device was only 33%. When the automatic planter was removed and the plants placed by hand, survival success increased to 59%.

Survival of 95% was obtained with bareroot shrub stock hand planted through the more substantially built, modified Whitfield with the scalper attached. This transplanter was the heaviest built of all machinery tested. Transplanting trials were conducted using the modified Whitfield and over 40 different species of shrubs. Highest success by species within that treatment (over 80% survival after 2 years) was obtained with mountain big sagebrush, winterfat *(Ceratoides lanata)*, woods rose *(Rosa woodsii)*, Tatarian honeysuckle *(Lonicera tatarica)*, common lilac *(Syringa vulgaris)*, squawapple *(Peraphyllum ramosissima)*, and chokecherry *(Prunus virginiana melanocarpa)*.

The most successful transplanting results were obtained with bareroot stock having roots from 6 to 12 inches long and with tops at least 3 inches long. The transplanting rate varied between 10 and 18 plants per minute depending on plant species, size and condition of plants, soil type, and surface conditions. Shrubs were planted at a spacing of between 3 to 8 feet.

Transplanting container stock by hand using the modified Whitfield plus scalper worked fairly well with species that had well-developed root systems. At the end of the first season, an average survival rate of 61% was achieved with antelope bitterbrush, cliffrose, woods rose, and chokecherry. Survival success averaged only 13% for green ephedra *(Ephedra viridis)*, fourwing saltbush, Saskatoon serviceberry *(Amelanchier alnifolia)*, and mountain big sagebrush, which had poorly developed root systems. Survival of good container stock of all tested species was less than 10% when planted with the automatic Forestland planter equipped with a scalper.

Using the modified Whitfield without the scalper, bareroot stock of 24 species was transplanted directly into grass sod. For comparison, the same number of species were transplanted into scalps made with the scalper attached to the transplanter. After 2 years, survival of mountain big sagebrush in the scalps was 87% and in the grass sod 95%. Growth of sagebrush plants in the scalps was 21% greater than those plants growing in the grass sod. Survival of the other 23 species tested in the grass sod was poor, with 20% and 34% survival, respectively, for woods rose and Tatarian honeysuckle and only 0% to 5% for the remaining species. Over 80% survival of all species was achieved on the adjacent scalped area. The 25-inch-wide by 9-inch-deep scalps were sufficient to remove existing vegetation and rooted material and at the same time provided an effective water harvesting mechanism.

Summary

Direct seeding of shrubs and forbs into scalps (30 inches wide, 9 inches deep) made with a Sieco fireplow in heavy perennial grass sod can be accomplished successfully. Excellent results were obtained from direct seeding with basin and mountain big sagebrush, prostrate kochia, and showy goldeneye. Acceptable success was achieved with seedings of Ladak alfalfa, Lewis flax, cicer milkvetch, cliffrose, fourwing saltbush, white and mountain rubber rabbitbrush, Pacific aster, and small burnet. Poor seeding success resulted with bitterbrush.

The Forest Service implement-carrying hitch greatly facilitated the effectiveness of scalping and transplanting equipment by keeping the implements at a constant depth despite varying conditions. The thimble seeder proved to be versatile as the rate of seeding could be easily changed. Seed of any size, purity, or surface condition could be metered without trouble. The seed was successfully transferred from the thimble seeder to the deposit point behind the scalper using an airstream.

Bareroot stock of many native and introduced shrubs can be transplanted successfully with a hand-fed tree transplanter into 25-inch-wide by 9-inch-deep scalps made in heavy grass sod. Mountain big sagebrush can be successfully transplanted directly into heavy grass sod. Transplanting success of bareroot stock was found to be superior to container-grown stock. ●

Ranchers Evaluate Contour Furrows for Livestock Grazing

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Contour furrowing is a land-surface treatment that has been used to increase herbage production and reduce runoff and erosion on western rangelands. In southeastern Montana, this mechanical treatment increased herbage production by as much as 165% on panspots range sites. Panspots are "areas of silty, clayey, or sandy soils in complex with shallow depressions of hard clays or other nearly impervious materials at or near the surface." Although the Bureau of Land Management contour furrowed 36,000 acres of Montana rangeland during the 1960's and early 1970's, only a few Montana ranchers have used this rangeland treatment. Many ranchers feel that contour furrowing has not had adequate economic evaluation. Although researchers haven't evaluated the problem, there is also a belief among ranchers that contour furrowing increases livestock losses, especially of sheep, because the animals are sometimes trapped on their backs in the furrows. Cattle and sheep normally lie on their side, but sometimes they roll over onto their backs in order to scratch and rub against the soil surface. Normally, the animal will roll completely over, but sometimes it becomes trapped against a rock or shrub or in a depression. When a ruminant is trapped on its back the esophagus often becomes plugged. This interrupts the normal process of eructation (belching of gas), and the animal soon dies of bloat. Suffocation is caused by either gas pressure or by the animal bloating to the point of vomit. Thus, if the animals become trapped on their backs in furrows, death could occur.

The purpose of this article is to identify livestock management problems on the contour-furrowed rangelands and to recommend practices to minimize the problems.

Information Sources

We used rancher survey and sheep observation studies to identify livestock management problems associated with grazing contour-furrowed rangeland. Both studies were conducted during the fall of 1979.

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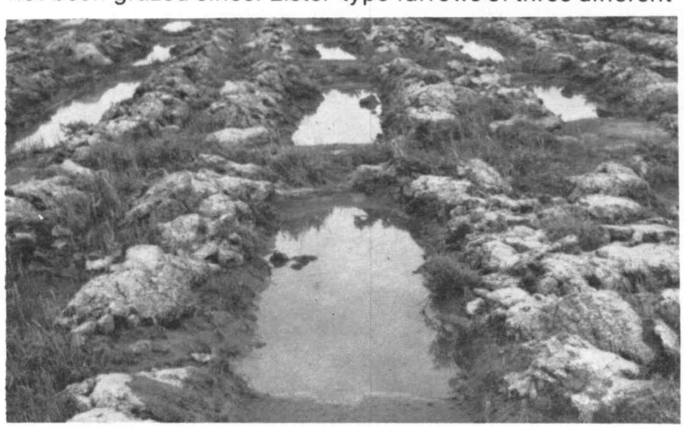
This article is a contribution from the USDA, Science and Education Administration, Agricultural Research, in cooperation with the Montana Agricultural Experiment Station.

Contour furrowed panspot rangesite 8 years after contour furrowing with an Arcadia Model B-type contour furrower.

From BLM records, we identified 19 ranchers in southeastern Montana and northwestern South Dakota, who grazed livestock on contour-furrowed rangelands. We interviewed 15 of these ranchers concerning their experience with livestock grazing in contour-furrowed pastures.

In addition, we observed 62 sheep (ewes and lambs) in a 50-acre pasture for 8 days. Twenty-eight percent of the pasture had been contour furrowed in 1976, and the pasture had not been grazed since. Lister-type furrows of three different



Lister-type contour furrows.