Design, Fabrication, and Use of Specialty Equipment for Rangeland Research

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Preface

Rangeland research often requires specialty equipment that cannot be purchased from standard research supply companies. The specialty equipment must be designed and fabricated. This report describes the specialty equipment designed and used by the rangeland research team at NDSU Dickinson Research Extension Center for rangeland research projects: 1) that investigated the problems related to the techniques and processes of interseeding plant material into existing intact plant communities; 2) that relieved the physical exertion hardships of research technical crews collecting range field data fully exposed to all of the open prairie environmental elements; 3) that relieved the strenuous physical exertion required by technical crews to extract soil probes during the collection of range soil samples; and 4) that humanely captured and extracted soil beasties from rangeland ecosystems anytime during the growing season and also prevented injury to the beasts and to the rangeland technical crews. The latter three pieces of specialty equipment remain in annual usage during rangeland research data collection.

Techniques and Mechanical Processes for Interseeding Alfalfa into Grasslands

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Report DREC 04-3037

Interseeding alfalfa into existing grassland ecosystems poses considerably more problems than seeding alfalfa into cropland. The application of the information collected at the Dickinson Research Extension Center during the twenty years of scientific investigation into problems related to procedures of interseeding plant material with minimal disturbance to existing plant communities is summarized in this report. The summary provides information on procedural techniques and guidelines and on mechanical processes performed by a rugged simple interseeding machine that could be used to interseed alfalfa into semi-arid grassland plant communities.

The conditions needed for an alfalfa seed to develop into an established plant within an existing grassland plant community include access to mineral soil, adequate soil water, sufficient quantities of nutrients and minerals, and abundant sunlight.

Techniques and Mechanical Processes

The method that creates the best potential for successful establishment of alfalfa plants within grassland communities combines several techniques and mechanical processes: the interseeding is performed during mid to late April; an alfalfa variety that has a high percentage of *Medicago falcata* in the parentage, like Travois, is used; the furrow rows are spaced ten feet apart; a seeding rate of 0.50 lbs PLS per row per acre is used; and both nitrogen and phosphate fertilizers are added at low rates, around 30 lbs per acre each, to the furrow row so that the fertilizer and seed are not in direct contact. A simple machine fabricated with three toolbars (figure 1) is used to mechanically prepare a suitable seedbed and control competition from the vegetation of the established sod through treatments performed separately by plow shank tools.

An adequate seedbed is mechanically prepared with double straight coulters that are placed side by side and three inches apart, set to cut the sod to a 3-inch depth, and followed by a 3-inch twisted chisel plow shovel that is set 3 inches deep, with the "V" point extending a little deeper (figure 2). The alfalfa seed is delivered at metered quantities from hydraulically driven hopper boxes, through plastic hose and a solid pipe mounted behind the plow shank with the 3-inch twisted chisel plow shovel, and into the "V" trench in the prepared seedbed (figure 1). The seed is covered and the seedbed is firmed with a pack wheel (figure 2). The competition for soil water, nutrients, minerals, and sunlight from the established vegetation is controlled with a 12-inch cultivator sweep (figure 2) with the tip removed by a cut in a reverse "V" and the fins of the sweep set to undercut the sod at a depth of 1.5 to 2 inches below the soil surface. Mixed nitrogen and phosphate fertilizers are delivered at low metered rates from hydraulically driven hopper boxes, through plastic hose and a solid pipe mounted behind the plow shank with the 12-inch cultivator sweep, and to the seedbed, one inch above the alfalfa seed (figure 1).

Alfalfa Plant Material

Alfalfa was identified as the plant material that had the greatest potential for interseeding treatments because it could be established within grassland plant communities and, on the short term, the combined quantity of herbage the alfalfa produced and the quantity of herbage the remaining intact grassland plants produced was 32% to 36% greater than the quantity of herbage produced on the undisturbed control plant community managed with traditional practices. Nonalfalfa perennial legume, domesticated grass, and native grass plant materials had low potential for interseeding treatments because they were not readily established successfully into grasslands through interseeding and the few plant types that had partial establishment produced less herbage than the previously intact grassland plant community.

The alfalfa varieties that perform the best when interseeded into grassland ecosystems have 45% to 100% *Medicago falcata* in the parentage. These creeping pasture type alfalfas have small narrow lanceolate leaves; variegated, white, or yellow flowers; and an extensive branching root system that grows from a wide crown located mostly below ground level. These alfalfas can reproduce vegetatively from rhizomes, which are horizontal underground stems. Pasture type alfalfas are persistent and have a very high tolerance to cold and dry conditions and, because they recover relatively slowly after grazing or cutting for hay and they reduce aboveground production during late summer and early fall, they perform well when managed with summer grazing or with a one- or two-cut hay harvest system.

Row Spacing

The row spacing that caused the least disturbance and fewest detrimental changes to the intact plant community between the furrow rows is the 10-foot row spacing. The intact plant community on the 10-foot row spacing treatments did not decrease in plant density or in net herbage production compared to the undisturbed plant community during the short term (6 years). The effects from mechanical interseeding treatments of row spacings less than 10 feet apart cause reductions in plant density, increases in open spaces in the plant community, decreases in desirable species, increases in less desirable species, and a net decrease in herbage production.

Established alfalfa plants become a detrimental source of competition for the native grassland plant community between the furrow rows. Increased soil water use from established alfalfa plants extends at least five feet from the crown, causing increased water stress in the adjacent plant community; after a period of several years, this competition results in a shift from native species to domesticated species of smooth bromegrass and crested wheatgrass. The taller alfalfa plants shade a portion of the intact plant community; the competition for sunlight results in losses of some native plants.

Seeding Date

There are two periods in the Northern Plains (spring and dormant season) during which interseeding into grassland ecosystems can result in an adequate density of alfalfa. Interseeding alfalfa during late summer or early fall has limited potential for success in the Northern Plains. Successful interseeding depends on adequate soil moisture to ensure that enough plant development and leaf growth occur and that the seedlings produce and store adequate carbohydrates for the plants to survive the winter period. Water deficiencies great enough to hinder alfalfa plant establishment occur from July to October during 67.0% to 92.9% of the years, and successful establishment from late-season seeding would be expected to occur during only 7.1% to 25.9% of the growing seasons.

Dormant-season seeding can be successful when seed viability is maintained during the winter, until soil temperatures rise above those required for seed germination. Seed exposed to air during the winter can desiccate. Completely covering the alfalfa seed with soil will help prevent desiccation, but this safeguard is extremely difficult to accomplish when the soil is dry or frozen. Dry or frozen soils form into angular blocks that can leave cracks allowing the seeds to contact air, which can remove moisture and kill the seeds by desiccation. Complete seed-soil contact needs to be accomplished to permit successful dormant-season seeding.

Early spring (mid to late April) is the preferable interseeding period. Spring seeding dates in the Northern Plains need to be early so the seedlings can develop root systems large enough to survive the periods of water deficiency that usually occur during July to October. Seeds of perennial plants can be placed in cooler soils earlier in the spring than seeds of annual crop plants. The mid to late April seeding dates produced alfalfa plant densities that reached the respective potentials of the mechanical interseeding techniques used. The May and June seeding dates were too late in the spring and produced plant densities below the potential for the interseeding techniques used.

Seeding Rate

The desired alfalfa plant density after the first year is 3 to 6 plants per meter of row. The less-than-ideal seeding conditions that exist with interseeding practices and the extremely high seedling loss during the first year suggest the use of a higher seeding rate for interseeding treatments than would be used under normal solid seeding conditions with conventional field practices. With proper interseeding techniques, a seeding rate of 0.50 lbs PLS per row per acre can provide the desired alfalfa plant density. The 0.50 lbs PLS seeding rate deposits the same amount of seed per row that solid seeding does when the seeding rate is 12.38 lbs PLS per acre, which is about double the recommended solid-seeding rate. Determination of seeding rate for interseeding treatments is quite different from determination of the rate for solid-seeding treatments because with interseeding, the area of the actual seedbed is some fraction of the total area receiving treatment. The basic seeding unit for interseeding treatments is the seeding rate per furrow row rather than the seeding rate per acre as in solid seeding, because with the potential variation in the number of furrow rows per acre in interseeding treatments, the rates per acre from the same seeding rate per row vary. A furrow seeding rate of 0.50 lbs PLS per row is 0.82 lbs per acre with 10-foot row spacings, and with 3-foot row spacings it is 2.75 lbs per acre. Increasing the interseeding seeding rate from 0.50 lbs per row to 1.00 lbs per row increases the equivalent solid-seeding rate to 24.75 lbs per acre: the seeding rate with 10-foot row spacings is 1.65 lbs PLS per acre, and with 3-foot row spacings it is 5.50 lbs PLS per acre. Increasing the interseeding rate to 1.00 lbs per row, however, does not increase the number of alfalfa plants per row. The seeding rate of interseeding treatments should be about double the rate that would be used per row in solid seeding with conventional practices. Seeding rates greater than double the solid-seeding rate per row do not improve stand density.

Mechanical Seedbed Preparation

One important aspect of the mechanical interseeding process is the preparation of a suitable seedbed. Seedbed preparation requires the use of methods that mechanically disturb a small portion of the land area without creating a rough terrain and that produce a furrow large enough to provide growing alfalfa plants with access to mineral soil, adequate soil water, sufficient quantities of nutrients and minerals, and abundant sunlight. The 3-inch twisted chisel plow shovel was the narrowest tool that produced a suitable furrow and seedbed. Attempts to sod seed or interseed alfalfa into seedbeds narrower than two inches wide met with problems that attempts using the 3-inch seedbed did not. Broadcast sod-seeding alfalfa into grasslands requires access to mineral soil seedbeds. Grasslands in average or better condition have very low quantities of bare soil because of the plant density and litter cover. Grasslands in poor condition have greater quantities of bare soil but still have relatively low amounts of mineral soil available for seedbeds. The inch-wide seedbeds prepared by modified no-till drills were too narrow to be beneficial for alfalfa seedling development. The actual causes of the problems associated with seedbeds narrower than 2 inches were not identified, and remedies for those causes were not determined. The 2-inch straight spike prepared an inferior seedbed in a furrow that was extremely narrow at the bottom and much wider near the soil surface. The 4-inch twisted chisel plow shovel produced a seedbed of less-than-desirable quality because the tool had a flat cutting edge like a plowshare on a moldboard plow. The 6-inch twisted chisel plow shovel had a “V” bottom, but the furrow was wider than necessary and the great width of the chisel caused a large portion of the treatment area to be disturbed. Both the 4-inch and 6-inch twisted chisels produced furrows wider than the 3-inch chisel, but their use did not improve the density of established alfalfa plants.

Chisel plow shovels do not cut clean edges at the same width as the chisel, but rip out areas of sod wider than the chisel. The narrower chisels enlarge the furrow a greater percentage of the chisel width than larger chisels. The problem of creating a furrow width larger than the chisel width can be corrected by cutting the sod ahead of the chisel with two straight coulters placed side by side at a distance the same as the width of the chisel (figure 3); following the double coulters, the chisel will remove the cut furrow sod strips cleanly (figure 4). The size of the furrow produced with double straight coulters spaced 3 inches apart and placed ahead of a 3-inch twisted chisel plow shovel is 77.5% narrower than the size of the furrow produced with a 3-inch twisted chisel plow shovel without the double coulters.

Seedbed Firming

A pack wheel following the deposition of seeds into the prepared seedbed helps cover the seed and firms the soil above the seeds (figure 3). The small seeds of alfalfa can desiccate easily when they are directly exposed to air. The rate of desiccation is greatly reduced when the seeds are covered completely with soil. Firming the soil above the seed acts like a blotter, allowing moisture to move upward and helping to maintain moisture closer to the soil surface.

Mechanical Sod Control

A second important aspect of the mechanical interseeding process is the control of competition from the established vegetation. Sod control requires the use of methods that mechanically disturb a small portion of the landscape without creating a rough terrain and that reduce competition from the established grassland plants on a large enough area to provide growing alfalfa plants with adequate soil water, sufficient quantities of nutrients and minerals, and abundant sunlight. The function of the cultivator sweep is sod control of the plant community adjacent to both sides of the seedbed furrow. A 12-inch cultivator sweep (figure 2) controls the sod without major destruction of the landscape. The sweep fins undercut the sod that remains in place, and the result is a relatively smooth land surface (figure 4), unlike the extremely rough terrain produced by lister-type interseeding machines. The lister-type machines achieve excellent sod control and reduce the competition from the established plants by scalping a large portion of the land area. These machines completely remove the sod from the lister blade furrow and deposit the sod clods onto the undisturbed portions, causing major destruction of the established plant community, physically exposing the soil surface to wind and water erosion, and creating an extremely rough land surface.

An alternative sod control treatment of chemical herbicides has additional costs and poses more and greater obstacles than mechanical sod control. Because the chemical herbicides are effective only on actively growing plants, interseeding must be delayed into June, too late for adequate alfalfa seedling development before the usual water deficiency period during mid summer. In addition, dust produced from accompanying treatment processes deactivates the herbicide action so that no control of the sod results.

Mechanical sod control by cultivator sweeps is effective and causes a minimum of landscape destruction. The 6-inch cultivator sweep, however, does not undercut a large enough area on each side of the furrow to reduce the competition from the established plant community adequately. The alfalfa density on the treatment with the 6-inch sweep was only 60% of that on the treatment with the 12-inch sweep, but the density that resulted when the 6-inch sweep was used was greater than the density that resulted when the twisted chisel plow shovel was used alone. The 16-inch cultivator sweep undercut an area 44.4% larger than the area of the established plant community undercut by the 12-inch sweep, but the use of the larger sweep did not improve the density of the established alfalfa plants. Adequate sod control is achieved on the area undercut on each side of the furrow by the fins of a 12-inch cultivator sweep (figure 2). The sweep fins cut at a depth of 1.5 to 2 inches below the soil surface and separate the crowns of grass plants from a large portion of the grass plants' roots. The grass plants are not killed, but their growth processes are greatly impaired, and the result is reduced competition from the established plant community for soil water and nutrients. The reduction in competition is beneficial for alfalfa plant establishment, but also for less-desirable perennial plants and annual species. The portion of the sweep that passes directly over the prepared seedbed serves no function and can disturb the furrow so that seedling emergence and the number of seedlings per meter of row are reduced. Removing the tip from the 12-inch cultivator sweep by cutting a reverse "V" shape (figure 2) can eliminate potential seedbed disturbances, and the alfalfa plant density is 33.6% greater on the treatments conducted with the sweep tip removed than on treatments conducted with the sweep tip intact.

Fertilization Rate

Alfalfa plant density and plant height are improved by nitrogen fertilizer. Phosphorus fertilizer helps improve alfalfa seedling success by encouraging root growth. Both nitrogen and phosphate fertilizers help improve interseeded alfalfa plant growth as long as the fertilizer is not in direct contact with the seed. Low fertilization rates of nitrogen and phosphate, around 30 lbs per acre each, would be sufficient to benefit alfalfa plant density and plant height and enhance alfalfa stand establishment. The rates of fertilization on interseeding treatments are determined for the land area of the seedbed in the furrow rows.

Interseeding Machine

The techniques and mechanical processes of interseeding alfalfa into grasslands were performed with a rugged simple triple toolbar machine (figure 1) that was a modification of the innovatively uncomplicated double toolbar interseeding machine developed at South Dakota State University.

The 1979 model of the SDSU pasture interseeder was a relatively simple fabricated double toolbar machine with 4-inch or 6-inch twisted chisel plow shovels mounted on four plow shanks spaced three feet apart. The main frame was made of two 10.6-foot lengths of 4 X 4 inch steel tubing placed fourteen inches apart. The front toolbar held the three-point hitch assembly and the parking stand. The back toolbar held the four plow shanks and the two gauge wheels. A 5 X 3 inch steel tube was mounted three feet above the back toolbar to hold four hydraulically driven hopper boxes with two spouts each for seed or fertilizer (Chisholm et al. circa 1980).

The frame of the SDSU pasture interseeding machine was modified by the addition of a third toolbar 30 inches behind the second toolbar and by the addition of a marker disk on each side. The major modifications were in the plow shank tools and the arrangements of the tools placed on the toolbars. The modified machine held two sets of tools spaced 10 feet apart. The front toolbar carried double straight coulters placed side by side and three inches apart and set to cut the sod to a 3-inch depth (figure 2). The middle toolbar carried a 3-inch twisted chisel plow shovel set to produce a furrow 3 inches wide and 3 inches deep, with the "V" point extending a little deeper (figure 2). The back toolbar carried a 12-inch cultivator sweep with the tip removed by a cut in a reverse "V" and the fins of the sweep set to undercut the sod at a depth of 1.5 to 2 inches below the soil surface (figure 2).

Machine Performance

The standard interseeding machine built according to South Dakota State University plans had a double toolbar and had 4-inch twisted chisel plow shovels mounted on four plow shanks spaced at three feet. The four-year mean alfalfa plant density on the treatments conducted with the standard machine was only 0.39 plants per meter of row (table 1). Changing the 4-inch twisted chisel plow shovels to 3-inch wide twisted chisels increased the alfalfa density 2.6% (table 1). Use of a developmental-stage machine modification with 4-inch twisted chisel plow shovels mounted on two plow shanks spaced ten feet apart resulted in a four-year mean alfalfa plant density of 0.94 plants per meter of row, which was 141.0% greater than the plant density on treatments conducted with the standard machine (table 1). Changing the 4-inch twisted chisel plow shovels to 3-inch wide twisted chisels on plow shanks spaced ten feet apart on a developmental-stage modified machine resulted in an alfalfa plant density 151.3% greater than the alfalfa density on treatments conducted with the standard machine (table 1).

The final-stage modified triple toolbar interseeding machine (figure 1) had double straight coulters placed side by side and three inches apart, followed by a three-inch twisted chisel plow shovel, followed by a 12-inch cultivator sweep with the tip removed, and had the two sets of plow shanks spaced ten feet apart. The treatments conducted with the triple toolbar machine produced a four-year mean alfalfa plant density of 3.59 plants per meter of row, which was 820.5% greater than the plant density on treatments conducted with the standard machine (table 1).

Rhizobium and Rhizosphere Organisms in Grassland Soils

Alfalfa plants form symbiotic relationships with rhizobium bacteria. The bacteria need to be in the proximity of the developing seedling roots in order for infection to occur. Mixing rhizobium bacteria with alfalfa seed inoculates the soil at the same time the alfalfa seed is planted. The rhizobium bacteria infect the seedling roots and form nodules. The bacteria living in the nodules change (or fix) the nitrogen in the air from a form that the alfalfa plant cannot biologically use into a form that the alfalfa plant can use. The plant uses nitrogen fixed by the rhizobium bacteria in the root nodules, along with the mineral nitrogen absorbed from the surrounding soil, for growth and herbage production. The quantity of herbage biomass produced by alfalfa plants growing in soils with low levels of mineral nitrogen is related to the number and size of nodules formed on the roots.

Grassland soils sampled at a single point in time reveal low levels of mineral nitrogen, but grassland soils are not low in nitrogen. Grassland soils contain abundant quantities of nitrogen, although most of it is in the organic form and unavailable for direct use by plants. Grassland rhizosphere organisms play a major role in the biogeochemical nutrient cycles that are necessary for an ecosystem to function properly, like the nitrogen cycle. Rhizosphere organisms have a symbiotic relationship with roots of perennial grass plants and convert organic nitrogen to mineral nitrogen, the form that plants can use. Elevated microorganism activity in the rhizosphere results in increased mineral nitrogen available to the grass plants. Grassland ecosystems that have a high biomass of active rhizosphere organisms produce greater quantities of herbage biomass than ecosystems with low rhizosphere organism biomass.

Cropland soils do not have rhizosphere organisms, and the soil organisms that live in cropland soils do not exist at population biomass levels comparable to the biomass levels in grassland soils. The rhizospheres in grassland soils have populations of bacteria, protozoa, nematodes, mites, and small insects capable of consuming rhizobium bacteria.

Alfalfa plants interseeded into grassland ecosystems have greater seedling mortality and slower rates of growth than the same varieties solid seeded into cropland. The roots of interseeded alfalfa seedlings have low numbers of small nodules. Low nodulation rates of interseeded alfalfa plants indicate that the inoculated rhizobium bacteria were harvested by the indigenous soil organisms and did not survive in the grassland soil long enough to permit infection and nodulation of the young alfalfa plants after they had grown sufficient root material. The presence of rhizosphere organisms in grassland ecosystems is a serious hindrance for interseeded alfalfa establishment.

The revelation that beneficial rhizosphere organisms were the cause of the reductions in the success rates for interseeded alfalfa establishment compared to the rates for alfalfa solid seeded into cropland did not lead to research projects in soil fumigation techniques. Instead, the original problem that the interseeding research program was attempting to solve by introducing alfalfa plants into grassland ecosystems was reassessed. Low herbage production on grasslands is not the actual problem; it is a symptom of low activity and/or low biomass of rhizosphere organisms, which is caused by antagonistic management practices. The research program to evaluate alfalfa interseeding techniques was terminated in 1989, and a research program to evaluate techniques that increase rhizosphere organism activity and biomass was initiated.

Management Implications

The set of techniques, guidelines, and mechanical processes developed during the interseeding research program provides a combination of procedures that produce the best potential for successful establishment of alfalfa plants interseeded into native grassland ecosystems with minimal disturbance to the existing plant communities. However, because rhizosphere organisms harvest inoculated rhizobium bacteria, the alfalfa plant density per meter of row is lower and the rate of growth and development is slower for alfalfa interseeded into grassland than for alfalfa solid seeded into cropland. Interseeding alfalfa into native range pastures does not solve the problem of low herbage production on grasslands. Low herbage production is not the actual problem but a symptom of that problem. The problem is low levels of rhizosphere organism activity that are caused by antagonistic grazing management practices. Implementation of biologically effective grazing management that coordinates defoliation with grass phenological growth stages to stimulate the defoliation resistance mechanisms and the activity of the symbiotic rhizosphere organisms corrects the problems in grassland ecosystems and results in greater herbage biomass production. Interseeding alfalfa into grasslands does not increase aboveground herbage biomass production, and it is not a recommended practice.

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Table 1. Alfalfa plant density per meter of row compared at developmental stages of modified interseeding machines with the standard machine built according to South Dakota State University plans.

Toolbar Plow shanks and spacing Twisted chisel width Cultivator sweep width	1st year	2nd year	3rd year	4th year	5th year	Means of growing seasons after 1st year
Standard Double toolbar 4 shanks spaced 3 foot 4-inch twisted chisel	11.47a	0.63c	0.24c	0.26c	0.42c	0.39c
Double toolbar 4 shanks spaced 3 foot 3-inch twisted chisel	13.85a	0.74bc	0.21c	0.31c	0.38c	0.40c
% of standard	120.8	117.5	87.5	119.2	90.5	102.6
Double toolbar 2 shanks spaced 10 foot 4-inch twisted chisel	14.12a	1.33bc	0.67bc	0.87b	0.88b	0.94b
% of standard	123.1	211.1	279.2	334.6	209.5	241.0
Double toolbar 2 shanks spaced 10 foot 3-inch twisted chisel	14.88a	1.77b	0.83b	0.80b	0.50bc	0.98abc
% of standard	129.7	281.0	345.8	307.7	119.1	251.3
Triple toolbar 2 shanks spaced 10 foot 3-inch twisted chisel 12-inch sweep	29.72a	6.87a	3.23a	2.37a	1.90a	3.59a
% of standard	259.1	1090.5	1345.8	911.5	452.4	920.5

Means in the same column and followed by the same letter are not significantly different ($P<0.05$).

Fig. 1. Triple-toolbar interseeding machine.

Fig. 2. Interseeding tools: double straight coulters, 3-inch twisted chisel plow shovel, and 12- inch cultivator sweep with tip removed.

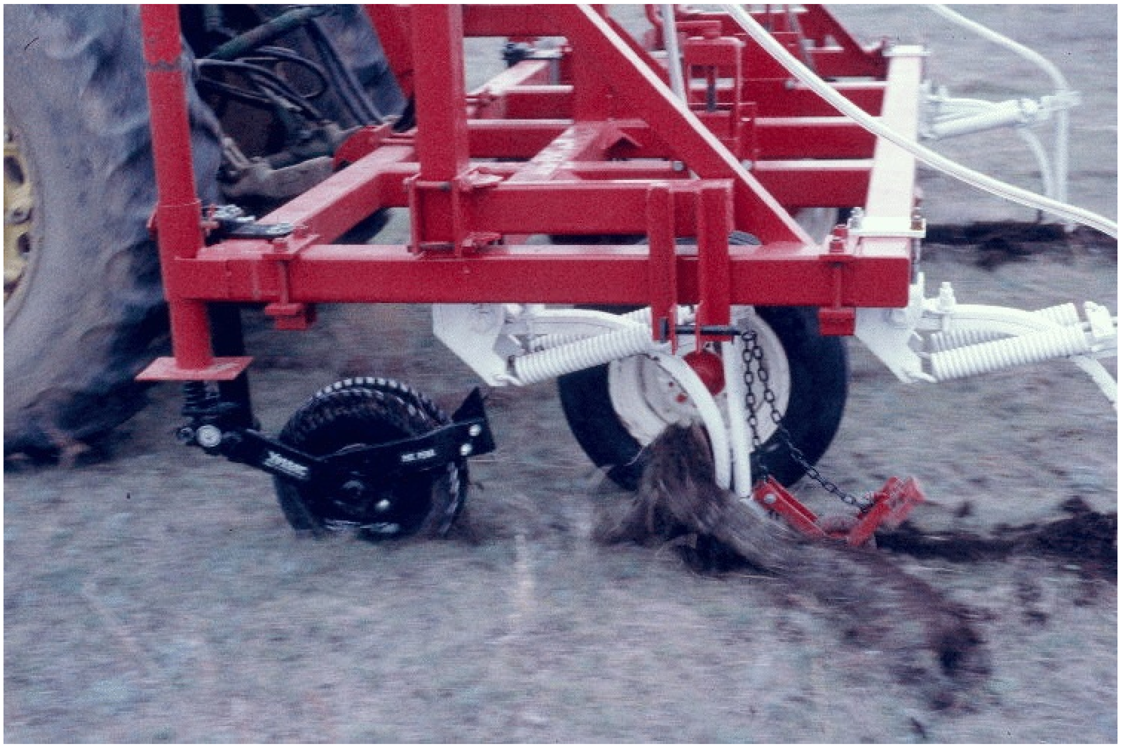

Fig. 3. Interseeding alfalfa into grassland with triple-toolbar machine.

Fig. 4. Three-inch clean furrow row produced by triple-toolbar interseeding machine.

Triple-toolbar interseeding machine with double straight coulters, three-inch twisted chisel plow shovel, and twelve-inch cultivator sweep with tip removed.

Literature Cited

Chisholm, T.S., F.R. Vigil, T.M. Klosterman, and G. Orcutt. circa 1980. Interseeding and plans for SDSU's new machine for better pasture production. South Dakota State University Agricultural Experiment Station. B 680. Brookings, SD. 14p.

WIND JAMMER,
a portable wind screen: its fabrication and use

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Report DREC 04-1057

The Wind Jammer is a portable protective screen designed to reduce the impact from wind during rangeland data collection.

Rangeland research projects usually sample data during scheduled successional measurement periods (e.g. herbage biomass production collected biweekly). The measurement periods, of necessity, are inflexible to the presence of wind, which is an inherent condition on rangeland. Consequently, the technical crew performing routine data collection is usually working under the hardship of being fully exposed to the elements, which can cause increased levels of physical exertion. This wind fatigue can be prevented by screening crew members and their immediate work station with the Wind Jammer.

The Wind Jammer (figure 1) has a simple design and is easy to fabricate. Two one-yard square aluminum frames are held together at a flexible joint by a piano hinge (figure 2). Hemmed canvas covers are lashed to each frame by a nylon rope threaded through grommets in the canvas cover and matching drilled holes in the frame (figure 2). Bellows-style sample bag pockets are sewn onto the inside of the canvas cover (figures 3 and 4). Three soil pins, used to stake the Wind Jammer to the ground, move up and down through holes in two mounted guides and the bottom angle of the frame. The guides are made of aluminum angle sections and have cut notches that securely latch the soil pin handle in the up or down position (figures 5 and 6).

When the Wind Jammer is being transported between sample collection sites, the soil pins are latched in the up position and the two frame halves are folded together. When the Wind Jammer is in use (figure 1), the two frame halves are opened into a “V” shape with the center pointing into the wind (figure 2). The work station on the leeward side (figure 3) is protected from the wind. The sample bag pockets (figure 4) allow convenient access to sample bags and prevent collected samples from being blown across the prairie. The three soil pins are pushed into the ground to provide stability and to prevent movement of the Wind Jammer in windy conditions (figures 5 and 6).

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Table 1. Materials for one Wind Jammer.

Quantity	Description and Use
8	Aluminum angle for two 1-yard square frames with ends mitered at 45°. 36 inches long, 1 X 1 inch angle, ⅛ inch thick.
6	Aluminum angle for mounted guides of three soil pins with ⅜ inch hole and notch. 1 inch long, 1 X 1 inch angle, ⅛ inch thick.
3	Steel rod for soil pins (threaded at top end and 1 inch point at bottom end). 12 inches long, ⅜ inch diameter.
3	Steel rod for soil pin handle (threaded at one end). 3 inches long, ⅜ inch diameter.
1	Piano hinge with bolt and nut fasteners used to connect the two 1-yard square frames. 30 inches long, 1.5 inches total width.
2	Solid braided nylon rope for lashing canvas cover to frames. 156 inches long, ¼ inch diameter.
2	Canvas for a hemmed cover on the 1-yard square frames. 36 X 36 inches, 18 oz. weight, choice of colors.
6	Canvas for sample bag pockets (3 pockets on each of the two 1-yard square canvas covers). 10 inches high, 8 inches wide plus a 2 inch bellows on each side, 18 oz. weight, color of canvas cover.
32	Grommets in canvas cover for lashing to the 1-yard square frames, 16 grommets per canvas cover, placed four per side with one in each corner. ⅓ inch diameter hole.
6	Acorn nuts for capping the threaded ends of the three soil pins and soil pin handles. ⅜ inch.

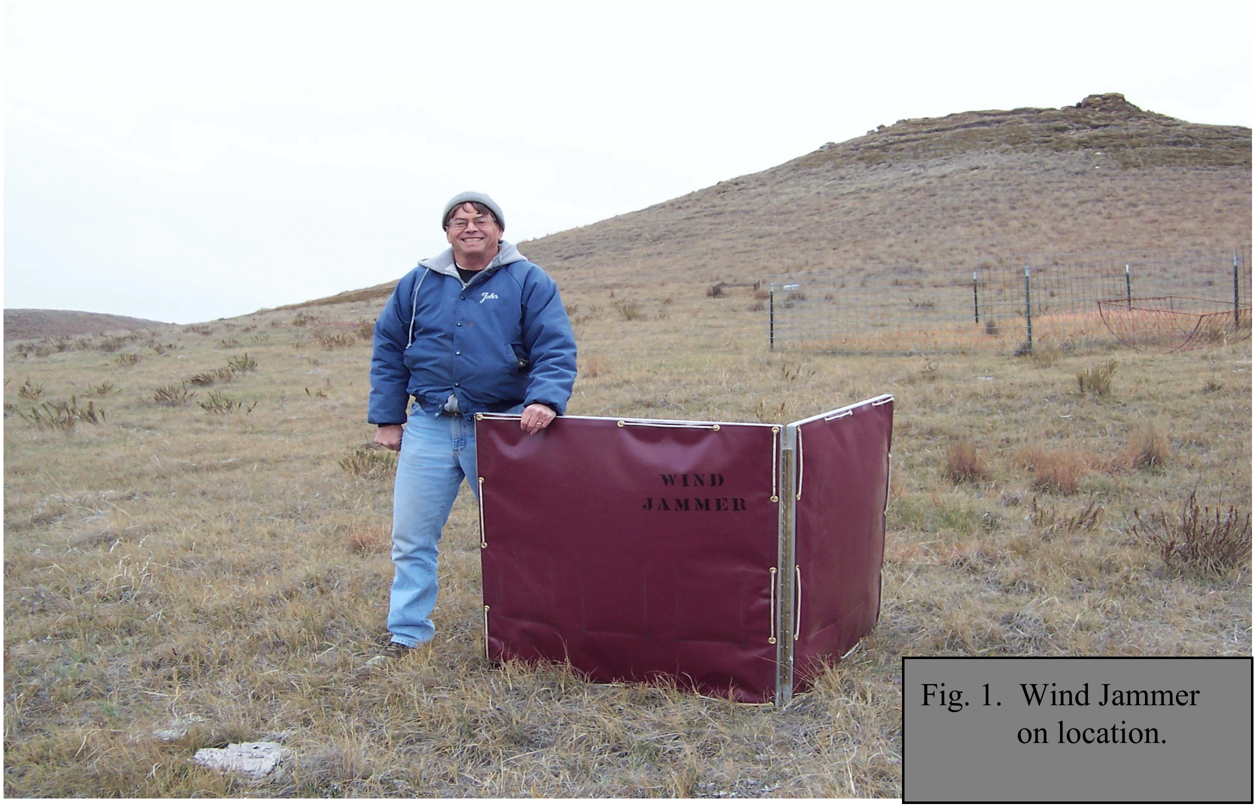

Fig. 1. Wind Jammer on location.

Fig. 2. Wind Jammer windward view.

Fig. 3. Wind Jammer leeward view.

Fig. 4. Wind Jammer sample bag pockets.

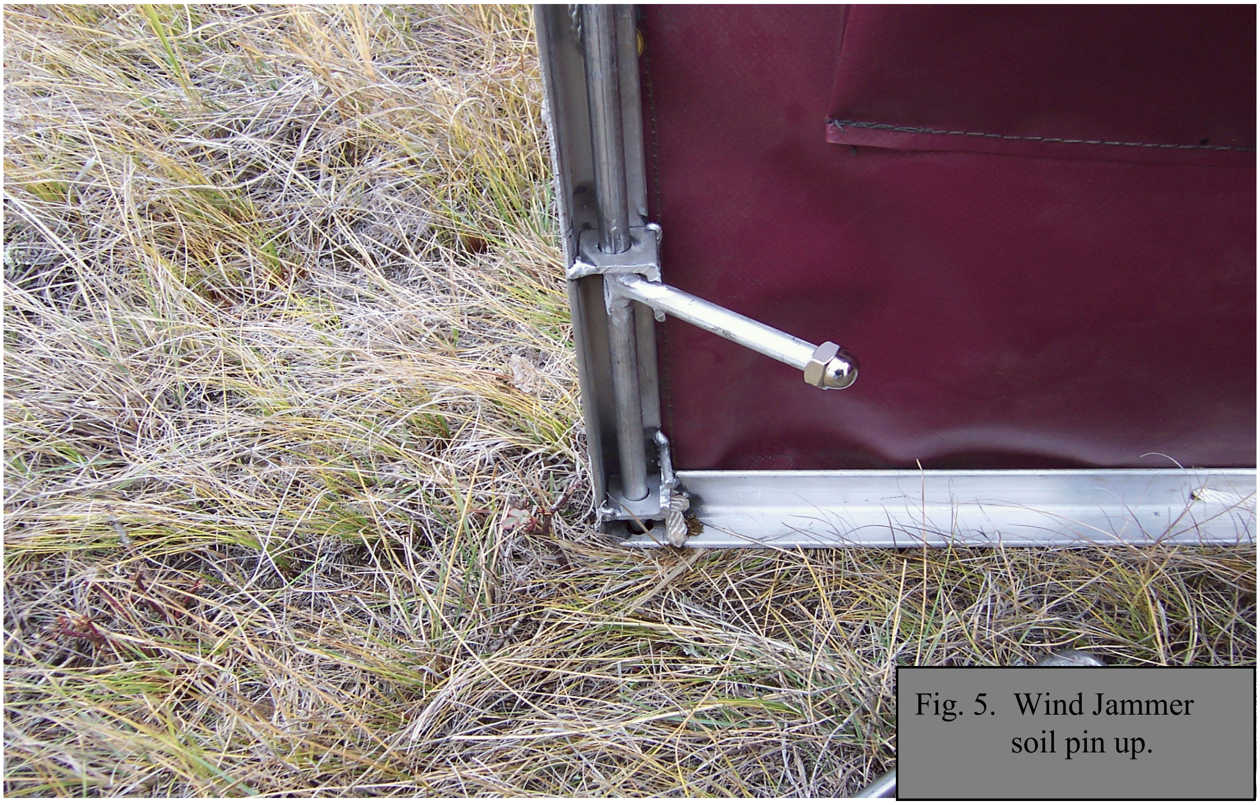

Fig. 5. Wind Jammer soil pin up.

Fig. 6. Wind Jammer soil pin down.