# Interseeding Machine Development by Modification of No-Till Drills

Llewellyn L. Manske PhD
Range Scientist
North Dakota State University
Dickinson Research Extension Center

The second native grassland interseeding techniques study at the Dickinson Research Extension Center was conducted by Paul E. Nyren from 1976 to 1980. The objective was to develop and test modifications of no-till drills for interseeding native and tame grass species and legume species into native grassland. The two most important aspects of the interseeding process that were considered in the design modifications were the preparation of a suitable seedbed and the control of competition from the established vegetation without major destruction of the landscape.

The established vegetation was mixed grass prairie. The species interseeded included green needlegrass (*Stipa viridula*), crested wheatgrass (*Agropyron desertorum*), Russian wildrye (*Elymus junceus*), and Travois alfalfa (*Medicago sp.*).

The three no-till machines evaluated during this interseeding study were the John Deere 1500 Powr-Till Seeder, the Melroe 701 No-Till Drill, and the Melroe 702 3D Drill.

The John Deere Powr-Till Seeder used power-driven cutter wheels to cut through the sod and prepare a seedbed three-fourths inch to one inch wide and three-fourths inch to two and one-fourth inches deep. The fluted force-feed seed-volume metering system was ground driven. Pack wheels firmed the soil above the seed. A sprayer attachment that applied liquid herbicide in bands of variable width ahead of the cutter wheels provided sod control (Nyren et al. 1977, Nyren 1980).

Two trials were conducted with the John Deere drill. The first trial was seeded the first week of May 1976. Russian wildrye and Travois alfalfa were interseeded separately into two native grassland pasture plots. The sod control strips were 12 inches wide and treated with 0.62 lbs AI/acre of glyphosate (Nyren 1980). The second trial was seeded in early June 1977. Green needlegrass and Russian wildrye were seeded in 18-inch rows, with herbicide sod control by glyphosate at 2.0 lbs AI/acre or paraquat at 0.5 lbs AI/acre applied in band widths of 6, 8, and 12 inches, and Travois alfalfa was seeded in 24-inch rows, with herbicide sod control by glyphosate at 2.0 lbs AI/acre or paraquat at 0.5 lbs AI/acre applied in band widths of 9, 12.5, and 14 inches (Nyren et al. 1977, Nyren 1980).

Effectiveness of sod control from the herbicides was evaluated from data collected with the 10-pin point frame method, with the frames placed across the treated rows. Counts of seedlings per meter of row were conducted during the fall of the first and third growing seasons (Nyren 1980).

Neither trial with the John Deere drill was successful. The first interseeding trial was unsuccessful because of low soil moisture, inadequate growth of native plants, and lack of sod control from the herbicide (Nyren 1980). The second interseeding trial with the John Deere drill indicated that neither herbicide at any band width provided sod control (Nyren 1980). Seedling counts of interseeded grasses did not differ on any of the treatments. Seedling counts of interseeded alfalfa (table 1) differed on the plots of some treatments (Nyren 1980). The reasons for the differences in numbers of alfalfa seedlings per meter of row were not determined, but the differences were not caused by any herbicide treatment effect. The cutter wheel action stirred up a tremendous amount of dust and dirt that fell back onto the sprayed foliage and deactivated the herbicide that had been applied (Welty and Stewart 1980).

The John Deere 1500 Powr-Till Seeder did not perform satisfactorily for interseeding plants into native grassland in western North Dakota. Possible problems with seed-soil contact may have resulted from poor seedbed preparation and inadequate soil firming by lightweight pack wheels. The herbicides were an additional cost for the practice, and the herbicide treatments were ineffective at controlling the competition from established vegetation. The results from this trial indicated that for interseeding plants successfully into native grassland, chemical sod control posed more and greater obstacles than mechanical sod control.

The Melroe 701 No-Till Drill was designed with individual 2.5-inch square steel tubes attached to the lower front of the drill frame to allow the mounted tools that prepared the seedbed and controlled the sod to follow the contour of the land independently for each row. Seeding rates were regulated by non-corrosive twin neoprene sponge rollers located at the bottom of each of the two hoppers. The stock unit tools that came with the drill were a single straight coulter ahead of double disk furrow openers. Pack wheels were not standard.

Four design modifications of the mounted tools were made to adapt the Melroe 701 No-Till Drill for interseeding into grasslands. Modification #1 had two straight coulters placed side by side and set 2.25 inches apart ahead of a 12-inch cultivator sweep set to undercut the sod at a depth of 1.5 to 2 inches below the soil surface. A seeding shoe from a Planet Jr. seeder followed the cultivator sweep, and a pack wheel was mounted behind the seeding shoe. Modification #2 had a single straight coulter ahead of two half sweeps mounted on separate square steel tubes, one on each side of the seeded furrow so that sod control was achieved without soil disturbance in the seedbed. A seeding shoe from a Planet Jr. seeder followed the half sweeps, and a pack wheel was mounted behind the seeding shoe. Modification #3 had a standard double disk furrow opener assembly to cut and spread the sod ahead of a 12-inch cultivator sweep set to undercut the sod at a depth of 1.5 to 2 inches below the soil surface. Following the cultivator sweep was a seeding shoe from a Planet Jr. seeder; the seeding shoe was fitted with two iron side fins to spread the sod and leave an open furrow wider than one inch. A pack wheel was mounted behind the seeding shoe. Modification #4 had a single straight coulter ahead of a 12-inch cultivator sweep set to undercut the sod at a depth of 1.5 to 2 inches below the soil surface. Behind the cultivator sweep was a stock double disk furrow opener followed by a pack wheel (Nyren et al. 1977, Nyren 1980, Nyren et al. 1981).

One trial was conducted with the Melroe 701 No-Till Drill. Crested wheatgrass was interseeded into native grassland in October 1977 and May 1978. Three replications were interseeded with the stock machine tools and the four modification designs. Seedling counts per meter of row were conducted in the fall of 1978 (Nyren et al. 1981).

The combination of tools in modifications #1 and #2 resulted in growth of the greatest number of seedlings (table 2). Modifications #1 and #2 prepared the better seedbeds (Nyren et al. 1981). Treatments interseeded by the stock unit and modification #4 had the smallest number of seedlings (table 2). The October seeding date had a greater number of crested wheatgrass seedlings than the May seeding date for all tool combinations except modification #3 (Nyren et al. 1981).

The modifications that used pack wheels to firm the soil above the seed generally produced treatments with more seedlings than did the stock unit that had no pack wheels. Treatments interseeded by the stock unit and modification #4, which used a double disk furrow opener to deliver seed into the seedbed, had poor seedling establishment because of the uneven seed distribution that resulted from a lack of ground contact and the failure of the disks to turn evenly (Nyren et al. 1977). Treatments that undercut the sod with a 12-inch cultivator sweep achieved 75% to 90% control of the established vegetation within 2 to 3 days (Nyren et al. 1978) without turning the sod over as the old lister blade treatment did. Modifications #3 and #4 made only single cuts into the sod ahead of a 12-inch cultivator sweep and did not remove the sod from the seeded furrow. With the sod remaining in place, the sweep caused seedbed disturbance that resulted in reduced seedling emergence and fewer seedlings per meter of row. These problems were diminished by modifications #1 and #2. In modification #1, the double coulters that cut and removed a strip of sod ahead of a 12-inch cultivator sweep reduced the seedbed soil disturbance under the sweep. In modification #2, the mounting of a half sweep on each side of the seeded row eliminated the sweeps' disturbance of soil in the seedbed.

The Melroe 702 3D Drill had several improved design features over previous models. It retained individual 2.5-inch square steel tubes that were attached to the lower front of the drill frame and allowed the mounted tools that prepared the seedbed and controlled the sod to follow the contour of the land independently for each row. Seeding and fertilizer rates were regulated by non-corrosive twin neoprene rollers located at the bottom of each of the two hoppers. The stock unit tools that came with the drill were two single straight coulters placed one behind the other ahead of double disk furrow openers. Pack wheels were not standard.

The Melroe 702 stock unit was not used for interseeding. The mounted tools were modified for interseeding with three designs. Modification #5 had a single straight coulter ahead of a void slot in which a sweep, if present, would have been located. This empty slot was followed by a seeding shoe that made a one-inch furrow. Modification #6 had a double coulter ahead of a 2-inch sweep followed by a seeding shoe. Modification #7 had a double coulter ahead of a 12-

inch cultivator sweep followed by a seeding shoe (Nyren 1980).

One trial was conducted with the Melroe 702 3D Drill. Green needlegrass, Russian wildrye, and Travois alfalfa were each interseeded into native grassland in late June 1978 with each of the three modifications to the Melroe 702 drill. In addition, each plant species was interseeded with modification #7 and a low or a high rate of fertilizer was placed in the seedbed with the seed. The two fertilization rates were 50 lbs N/acre plus 20 lbs P/acre and 89 lbs N/acre plus 40 lbs P/acre. A check treatment with no interseeding and no fertilizer was used as the control (Nyren 1980).

Counts of interseeded grass seedlings per meter of row were conducted during the fall of 1978. Alfalfa seedling height was measured in 1978, and counts of alfalfa seedlings per meter of row were conducted during the fall of 1978 and 1979. Herbage biomass production data from the alfalfa interseeded treatments were collected in August 1978, 1979, and 1980. Three 12 X 40 inch frames per plot were placed across the rows and clipped. The material was separated into grassland vegetation and alfalfa, then oven dried (Nyren 1980).

Green needlegrass seedling counts (table 3) did not differ between the 2-inch sweep and the 12-inch sweep interseeding treatments and did not differ between the two fertilizer treatments (Nyren et al. 1981). The high fertilizer treatment had more seedlings per meter of row than the other treatments (table 3). The lowest seedling count was on the interseeding treatment with no sod control (Mod #5) (table 3).

Russian wildrye seedling counts (table 3) were greatest on the 2-inch sweep treatment and the 12-inch sweep with either of the two fertilizer treatments (Nyren et al. 1981). The lowest seedling count was on the interseeding treatment with no sod control (Mod #5) (table 3).

Seedling counts of the green needlegrass and Russian wildrye treatments were not conducted at the end of the second growing season, presumably because of the lack of sufficient numbers of surviving plants. The late-June seeding date may have caused a suppression in some of the early plant development. Establishing green needlegrass and Russian wildrye into native grasslands by interseeding proved to be extremely difficult. Russian wildrye did not compete well with established native plants, and the young wildrye plants declined rapidly following the seeding year.

Travois alfalfa seedlings were more vigorous than the green needlegrass and Russian wildrye seedlings (tables 3 and 4). The number of alfalfa seedlings per meter of row was significantly lower on the two fertilizer treatments than on the unfertilized treatments (Nyren et al. 1981). The height of the alfalfa seedlings was significantly greater on the two fertilizer treatments than on the unfertilized treatments (Nyren et al. 1981). The alfalfa seedlings on the no-sweep (Mod #5) treatment showed a significant decrease in height as a result of the greater competition from native plants (Nyren et al. 1981). The no-sweep (Mod #5) and the narrow-sweep (Mod #6) treatments had more seedlings per meter of row in the fall of the first growing season than did the two fertilizer treatments (table 4). Seedlings on the no-sweep and narrow-sweep treatments were smaller and less vigorous than the seedlings on the treatments with 12-inch cultivator sweeps (Nyren et al. 1978), and the greatest percent reduction in seedling numbers between the first and second growing seasons occurred on the no-sweep and narrow-sweep treatments (table 4). The smallest percent reduction in seedling numbers between the first and second growing seasons occurred on the two fertilizer treatments (table 4).

The three-year mean total herbage production on all of the interseeded treatments was lower than that on the control treatment (table 5). The average herbage biomass produced by the interseeded alfalfa ranged between 5.7% and 10.7% of the herbage biomass produced on the control treatment. The average grassland herbage biomass produced during the three growing seasons following the interseeding treatments ranged between 9.9% and 34.2% less than the grassland herbage biomass produced on the control treatment. Treatments interseeded with the combination of modification #7, which had a 12-inch cultivator sweep, and no fertilizer added, provided the greatest amount of sod control; use of this treatment resulted in the greatest reduction in grassland herbage biomass (table 5) and the greatest three-year mean alfalfa herbage production.

The problems that occurred on the treatments that had fertilizer added may have been caused more by the placement of the fertilizer directly in contact with the seed than by the practice of adding fertilizer at the time of seeding.

The purpose of the modifications to no-till drills was to directly seed into established plant communities grass or legume species that would produce greater herbage biomass than the herbage biomass produced on the same portion of the established plant community that was destroyed during the execution of the treatments.  Production from the interseeded species needed to offset the herbage loss caused by the interseeding sod control technique in order to be successful.  None of the modifications to no-till drills resulted in the interseeded species' reaching that desired level of herbage production.

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Table 1. Travois seedlings per meter of row interseeded June 1977 with the John Deere 1500 Powr-Till Seeder.

| Treatment<br>Herbicide and band width (in) | Fall<br>1977 | Fall<br>1979 |
|---|---|---|
| Check-no herbicide | | |
| 0 | 10.8 | 2.5 |
| Paraquat 0.5 lbs AI/acre | | |
| 9 | 14.6 | 2.6 |
| 12.5 | 8.9 | 3.6 |
| 14 | 6.1 | 3.2 |
| Glyphosate 2.0 lbs AI/acre | | |
| 9 | 21.6 | 4.8 |
| 12.5 | 13.3 | 2.3 |
| 14 | 12.6 | 3.6 |

Data from Nyren et al. 1981

Table 2. Crested wheatgrass seedlings per meter of row interseeded October 1977 and May 1978 with the stock unit and four modifications of the Melroe 701 drill.

| | Fall 1978 | |
|---|---|---|
| Tool Modifications | October 1977 | May 1978 |
| Stock Unit (coulter-double disk-no packer) | 2.3 | 0.4 |
| Mod #1 (double coulter-sweep-shoe-packer) | 49.3 | 17.0 |
| Mod #2 (coulter-half sweeps-shoe-packer) | 21.7 | 5.8 |
| Mod #3 (double disk-sweep-shoe & fins-packer) | 8.3 | 5.0 |
| Mod #4 (coulter-sweep-double disk-packer) | 4.3 | 0.0 |

Data from Nyren et al. 1981

Table 3. Green needlegrass and Russian wildrye seedlings per meter of row interseeded June 1978 with three modifications of the Melroe 702 drill and three fertilization rates.

| | | Fall 1978 | |
|---|---|---|---|
| Tool Modifications | Fertilization Rates (lbs/ac) | Green needlegrass | Russian wildrye |
| Mod #5 (coulter-no sweep-shoe) | 0N + 0P | 1.3 | 1.0 |
| Mod #6 (double coulter-2 in. sweep-shoe) | 0N + 0P | 1.9 | 7.6 |
| Mod #7 (double coulter-12 in. sweep-shoe) | 0N + 0P | 2.1 | 3.0 |
| Mod #7 | 50N + 20P | 2.2 | 7.5 |
| Mod #7 | 89N +40P | 4.7 | 4.5 |

Data from Nyren et al. 1981

Table 4. Travois alfalfa seedling height and seedlings per meter of row interseeded June 1978 with three modifications of the Melroe 702 drill and three fertilization rates.

| | | Fall 1978 | | Fall 1979 | |
|---|---|---|---|---|---|
| Tool Modifications | Fertilization Rates (lbs/ac) | Seedling height (in.) | Seedlings per row | Seedlings per row | Percent reduction in seedlings per row |
| Mod #5 (coulter-no sweep-shoe) | 0N + 0P | 4.0 | 35.8 | 9.7 | -72.9% |
| Mod #6 (double coulter-2 in. sweep-shoe) | 0N + 0P | 4.8 | 31.2 | 9.1 | -70.8% |
| Mod #7 (double coulter-12 in. sweep-shoe) | 0N + 0P | 5.0 | 21.3 | 7.3 | -65.7% |
| Mod #7 | 50N + 20P | 8.2 | 13.0 | 5.6 | -56.9% |
| Mod #7 | 89N +40P | 8.8 | 9.6 | 4.0 | -58.3% |

Data from Nyren 1980, Nyren et al. 1981

Table 5. Grassland and Travois herbage production (lbs/ac) on plots interseeded June 1978 with three modifications of the Melroe 702 drill and three fertilization rates.

| Tool Modifications | Fertilization Rates (lbs/ac) | 1978 Total | 1979 Grassland | 1979 Alfalfa | 1979 Total | 1980 Grassland | 1980 Alfalfa | 1980 Total | Three Year Mean Total |
|---|---|---|---|---|---|---|---|---|---|
| Mod #5 | 0N + 0P | 2604 | 1516 | 231 | 1748 | 799 | 70 | 870 | 1741 |
| Mod #6 | 0N + 0P | 2854 | 1946 | 212 | 2159 | 830 | 85 | 914 | 1976 |
| Mod #7 | 0N + 0P | 2085 | 1573 | 391 | 1964 | 665 | 76 | 741 | 1597 |
| Mod #7 | 50N + 20P | 2821 | 1854 | 286 | 2140 | 1036 | 114 | 1149 | 2037 |
| Mod #7 | 89N +40P | 2720 | 2055 | 158 | 2212 | 1144 | 91 | 1235 | 2056 |
| Control | 0N + 0P | 3597 | 1923 | 0 | 1923 | 1050 | 0 | 1050 | 2190 |

Data from Nyren 1980

## Literature Cited


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