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Prairie Grass Establishment Study

1989

1998 Annual Report

Prepared for:

Fernald Environmental Management Project
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Abstract:

The Fluor Daniel Fernald Prairie Grass Establishment Study measured performance on a series of experimental plots to evaluate soil amendment and mulch combinations, seed bed preparation and seeding methods for establishing prairie grass. Low organic content of the disturbed areas was augmented and lack of cover were addressed by combinations of **a)** one of four kinds of soil amendments or none **b)** one of two types of mulch or none and **c)** a cover crop of oats or none were applied to designated test plots. This original ***five by three by two*** design gave 30 combinations in triplicate, for a total of 90 plots. The report describes plot preparation that included soil amendment, planting, mulching, management and evaluation. Because seed tubes of the seed drill became plugged during planting, oats essentially were not planted, in effect reducing the design to 15 combinations replicated six-fold for a total of 90 plots. At intervals after planting, germination success and cover of the seeded grasses and prevalence of weeds were measured. Because the measurements during the first season are tedious, detailed results were collected for only a representative plot of each combination. At the end of the season the status of each plot was described and an overall analysis of what was learned was carried out. These results can be used to make recommendations for future studies. Because prairie grass takes several years to become established, the results of this first year will need to be supplemented by the results from surveys made on subsequent years.

Purpose:

The Prairie Grass Establishment Study is designed to identify methods for establishing and managing prairie vegetation on sites that have had top soil removed as part of remediation at the Fernald project site. Native prairie grasses studied included Canada Wild Rye (*Elymus canadensis*); Little Bluestem (*Schizachrium scoparius*); Big Bluestem (*Andropogon gerardii*); Indian Grass (*Sorghastrum nutans*);) and Side Oats Grama (*Bouteloua curtipendula*).

Site:

The planting site is a section of land approximately 530' long and 54' wide, located some 20' east of the access road adjacent to the On-Site Disposal Facility. The area consisted of two 530' rows of separate plots, 22' wide by 20' long separated by a 10' access road for equipment accessability. The layout was for a ***five by three by two*** design, giving 30 combinations in triplicate, for a total of 90 plots.

Rationale and Design:

Removing contaminated soil also removes organic matter and leaves a seed bed that likely will need amendments that enrich the organic matter content and treatments that provide cover to moderate temperature and evaporation. Because establishment of prairie grasses is slow, and much more so in the disturbed soil, post-planting management is critical. These considerations had a major influence on the design of the experiment.

To augment the low organic content of the disturbed areas and counter the lack of cover, combinations applied to the designated test plots consisted of: **a)** one of five kinds of soil amendment treatments– composted sewage, manure, 2 inches or 4 inches of top soil and none **b)** one of three types of mulch treatments– straw, wood chips or none and **c)** two cover crop treatments– oats or none. This original ***five by three by two*** design gave 30 combinations in triplicate, for a total of 90 plots. Because the seed tubes of the seed drill became plugged during planting the oat cover crop was not successfully planted, in effect reducing the design to 15 combinations replicated six-fold for a total of 90 plots. The original plot layout for Spring 1998 is shown in **Figure 1** **(Appendix)**.

Site Preparation and Planting:

Each row of plots was tilled using a three-point hitch tiller pulled by a 45 horsepower tractor to rid the area of vegetation and loosen the soil. Manure and composted sludge were incorporated by the tiller in the designated plots at this time. After tilling was completed, the 2" soil cap, 4" soil cap and wood chip mulch were applied to the designated plots. Following these preparations, the seed mix was planted at a rate of 15 lbs pure live seed/ acre using a Truax seed drill. The seed mix consisted of **Canada wild rye** (*Elymus canadensis)*; **little bluestem** (*Schizacrium scoparius*); **big bluestem** (*Andropogon gerardii*); **Indian grass** (*Sorghastrum nutans*); and **side oats grama grass** (*Bouteloua curtipendula*). The **oats** (*Avena sativa*) were to be planted on the inner half of the test plots but the oats clogged the seed tube of the planter and went unnoticed, so none were actually planted. Straw mulch was then applied to the appropriate plots and annual rye grass was sown to provide the 3' spacers between each plot.

Record of Activities:

Planning of the experimental design and protocol occurred prior to May 5th, when preparation of the planting area began. Monitoring of the plots continued until September 20. The timing of activities is shown in the list of **Table 1** **(Appendix)**.

Results:

The plots were monitored throughout the season to determine the germination rate in response to the various combinations of treatments. Sampling quadrats were put in place for use in evaluating counting the proportion of the ground that was covered by the seeded grass and by weeds for each mulch/amendment combination. Also, the grass species present in each plot was recorded.

The specific evaluation of the plots was reported by means of the photos and in text of the monthly reports. The tabular reports for June and August are contained in **Table 2** **(Appendix)**. The summary that follows is organized by topics to summarize the status of the plots during August, essentially the end of the 1998 growing season.

Amendments

No amendment: Prairie grass coverage was 5 to 25% with no mulch and wood chips; 0 to 5% with straw.

Manure: Prairie grass coverage was 25 to 50% with no mulch (best plot overall), 5 to 25% with wood chips and 0 to 5% with straw.

Compost: Prairie grass coverage was 5 to 25% with no mulch and wood chips and 0 to 5% with straw.

2 inches of Top Soil: Prairie grass coverage was 0 to 5% with no mulch , wood chips and straw.

4 inches of Top Soil: Prairie grass coverage was 0 to 5% with no mulch , wood chips and straw.

Mulch

No mulch: Prairie grass coverage was 25 to 50% with manure, 5 to 25% with no amendment and with compost and 0 to 5% with 2 and 4 inches of top soil.

Wood chips: Prairie grass coverage was 5 to 25% with manure, no amendment and compost; 0 to 5% with 2 and 4 inches of top soil.

Straw: Prairie grass coverage was 0 to 5% with all catagories.

In summary, ***straw and both topsoil applications*** were detrimental, likely because of the high weed seed content. The ***layer of wood chips was too thick***, causing them to cover the seeds and affecting viability. On the positive side, they will likely retarded weed growth if grasses are present. It seems likely that ***oats*** would have suppressed weed growth and enhanced grass germination. These latter two points need to be tested.

Analysis of the Project as of October 1998:

The evaluation that follows analyzes the status of the various plots and summarizes what was learned as a result of the study as of the end of the growing season.

Summary of Successes and Problems Observed during Site Preparation and Planting-

- The marking of the area and tilling were well done.
- The spreading of the amendments was not as uniform as it should have been, leading to unevenness in the quality of the plot. This probably resulted in patchy nutrient content and patchy establishment and growth of the grasses.
- A major issue is the availability of the contractor work crew within the window of opportunity. In restoration work, as in farming the weather conditions, soil moisture, time of season, plant stage and the like come together to present a "window of opportunity". If an operation such as seeding, tilling or mowing is not done in this window, it may mean that the activity cannot be done for a long time, perhaps not until the following year. Sometimes, in desperation, the activity is done at the wrong time and this can lead to failure. For example, because of missed window, seeding may be done so late in the season that rains are not sufficient and the seeds do not germinate well. Somehow priority needs to be given to certain tasks... obviously not all tasks.

• Once an operation is begun, workers and equipment are needed on a timely basis to complete tasks so that those who advise or supervise are free to oversee operations. For example, when planting the Truax needs to be monitored by someone familiar with its operation. Failure to do this resulted in the clogging of the oats delivery tube going unnoticed. No one was available to do this needed task because we were unexpectedly short-handed at the last minute.

• The delays in getting the tilling started resulted in tilling without allowing a period of rain to produce a firm seed bed As a result the seed bed was not firm enough and the prairie grass seeds may have been buried too deeply. The wheel discs moving through the loose soil can pile the soil too deeply.

• Making a second seeding pass tends to bury the seeds especially when soil is loose. When oats were planted by a second pass after the prairie grass was planted buries the first planted seeds too deeply.

• The method of mowing needs to be reviewed. The equipment took a toll on the plot indicator signs, and disrupted the soil in some places. This problem needs to be addressed since mowing is a key means of weed control, especially important as the plots get older.

What has been learned–

• Respect windows of opportunity. Work out plans to have contractor workers available

• Make sure the seedbed is firm. Also, do not seed into newly applied wood chips. They must have time to settle and become firm or they will shift and bury the grass seed.

• Monitor the Truax throughout the period of planting to make sure that seeds are falling freely and steadily into the wheel disc.

• Even with amendments the establishment and growth of prairie is slow and so the first year evaluation has its limits in predicting success. Three weeks after planting, an attempt was made to identify percent cover of prairie grasses only. Later it was obvious that the majority of the grasses so identified in June were actually non-prairie grasses such as *Setaria* (foxtail). The August data represent actual success rate for prairie grass establishment.

• A cover crop such as oats is beneficial to provide shade to cool the soil and reduce evaporation of water.

• The wood chip mulch seems to control weed competition well and, if the chips are applied a number of months ahead of time the can age and be partly buried so they do not shift during seeding by the Truax drill.

• Mowing can cause a lot of damage if it is not done suitably.

APPENDIX

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Table 1. Activities

Activity	Date
Delineation of planting strips prior to tilling Two rows, 530' long and 22' wide with a 10' space between were marked off with flags (See **Figure 1** plot map)	May 5
Tilling of planting strips and blending of prairie seed mix The 22' wide rows were tilled the entire length, with a 10' untilled spacer between. Tilling was repeated several times to loosen soil and completely bury the original growth. Approximately 36 lbs pure live seed was blended by combining Canada wild rye (7 lbs), side oats grama (2 lbs), little bluestem (7.6 lbs), big bluestem (12 lbs), Indian grass (7.6 lbs) and stored for later use.	May 12
Placement of hubs to delineate test plots Hubs with the plot indicator code were placed to indicate which mulch and amendment is to be used on the plot. (See Plot Indicator Legends on **Figure 1.**)	May 15, 18, 19, 20
Amendments delivered The top soil, manure were delivered by an agricultural company (Alvis Sand and Gravel) as well as the straw. The composted sewage sludge was supplied by the Hamilton Waste Water Treatment Plant.	May 19, 20, 21
Amendments applied and tilled The amendments above mentioned were spread upon the specified plots and tilled into the soil	May 27, 28
Yard compost delivered, applied and tilled/ Wood chips applied and spread Yard compost was delivered to the site and applied to a secondary area that had tilled. The yard compost was then tilled into the soil. The wood chips supplied from on-site were applied to the specified plots and spread with rakes.	May 29

Prairie grass seed and oats applied with seed drill and additional straw bales were delivered — June 1

The prairie mix was applied with the seed drill over the plot rows. The remaining prairie seed was then removed from the seed drill and the oats were spread upon the outside 11' of the plot rows. The plot rows were now divided into four 11' rows, 2 with oats and two without oats. (See **Figure 1.** plot map)

Additional straw bales were delivered to the site by Alvis Sand and Gravel upon the realization that addition straw was necessary for proper coverage of the specified plots.

Application of straw to specified plots — June 1, 2, 3

The straw was applied manually to specified plots.

Application of annual rye grass (filter strips) — June 3, 4

Annual rye grass seed was applied to 3' spacers between plots

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Table 1 (continued). Activities Log

Activity	Progress Report	Date
Geiger - Fernald visit		January 27
Geiger - Fernald visit		March 12
Geiger - Fernald visit		April 9
Delineation of planting strips prior to tilling	May	May 5
Tilling of planting strips/ mixing of prairie seeds/ Geiger - Fernald visit	May	May 12
Placement of Hubs to delineate test plots	May	May 15, 18-20
Amendments delivered	May	May 19-21
Amendments applied and tilled	May	May 27-28
Yard compost delivered, applied and tilled/ woodchips applied and spread/ Geiger - Fernald visit	May	May 29
Prairie grass seed and oats applied with seed drill/ additional straw bales delivered/ Geiger - Fernald visit	May	June 1
Application of Straw to specified plots	May	June 1-3
Application of annual rye grass (filter strips)	May	June 3-4
Geiger - Fernald visit		June 25
Undisturbed growth	June	June 5 - July 2
Measurement of prairie grass coverage/ Counting of prairie grass stems and forbs within quadrat (Brannen data)	June	July 2
Prairie Grass Identification Photographs	July	July 21
Geiger - Fernald Visit		July 23
Data Collection Missing - Brannen unable to visit site	July	August 5-16
Measurement of prairie grass coverage/ Counting of prairie grass stems and forbs within quadrat (Brannen data)	August	August 16, 28
Geiger - Fernald visit		August 25
Measurement of prairie grass coverage on non-quadrat plots/ identification of grasses on non-quadrat plots (Brannen data)	September	September 9
Geiger - Fernald visit	September 10	
Mowing of plots	September	September 16
Identification of prairie grass additions	September	September 16, 20
Geiger - Fernald visit		October 16

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Table 2. Data: Fifteen Representative Plots

QC = Quadrat Count
PG = Prairie Grasses
NPG = Non-Prairie Grasses

Plot	June Data [1]	August Data
No Amendment		
No Mulch (NN: 43)	5-25% coverage by PG QC: 8 PG/ 1/2 forbs	5-25% coverage by PG 50-75% coverage by NPG QC: 3 PG/ 6 NPG/ 2 forbs
Woodchips (WN: 45)	0-5% coverage by PG QC: 6 PG	5-25% coverage by PG 50-75% coverage by NPG QC: 6 PG
Straw (StN:44)	95-100% coverage by PG QC: 108 PG/ 2 forbs	0-5% coverage by PG 75-95% coverage by NPG QC: 36 NPG
Manure		
No Mulch (NM:19)	5-25% coverage by PG QC: 12 PG	25-50% coverage by PG 25-50% coverage by NPG QC: 8 PG **Best Plot**
Woodchips (WM:42)	0-5% coverage by PG (1/2 PG) QC: 1 PG	5-25% coverage by PG 5-25% coverage by NPG QC: 21 forbs
Straw (StM:41)	95-100% coverage by PG QC: 98 PG/ 4 forbs	0-5% coverage by PG 50-75% coverage by NPG 5 PG/ 34 NPG
Compost		
No Mulch (NC:34)	5-25% coverage by PG QC: 16 PG/ 6 forbs	5-25% coverage by PG 25-50% coverage by NPG QC: 5 PG/ 11 NPG/ 5 forbs
Wood chips (WC:6)	0-5% coverage (weeds) QC: 1 PG	5-25% coverage by PG 50-75% coverage by NPG QC: 3 PG

[1] Three weeks after planting, an attempt was made to identify percent cover of prairie grasses only. Later it was obvious that the majority of the grasses so identified in June were actually non-prairie grasses such as *Setaria* (foxtail). The August data represent actual success rate for prairie grass establishment.

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Straw (StC:26)	95-100% coverage by PG QC: 110 PG/ 2 forbs	0-5% coverage by PG 5-25% coverage by NPG QC: 11 PG/ 2 forbs
2 in. Topsoil		
No Mulch (N2:1)	0-5% coverage (1/2 PG) QC: 22 PG/ 19 forbs	0-5% coverage by PG 75-95% coverage by NPG QC: 2 PG/ 19 NPG/ 18 forbs
Woodchips (W2:3)	0-5% coverage (weeds) QC: 1 PG	0-5% coverage by PG 50-75% coverage by NPG QC: 4 PG
Straw (St2:23)	75-95% coverage by PG QC: 65 PG/ 2 forbs	0-5% coverage by PG 95-100% coverage by NPG QC: 8 forbs
4 in. Topsoil		
No Mulch (N4:37)	75-95% coverage (1/2 PG) QC: 18 PG/ 13 forbs	0-5% coverage by PG 50-75% coverage by NPG QC: 2 PG/ 12 forbs
Woodchips (W4:30)	0-5% coverage (1/2 PG) QC: 0 PG	0-5% coverage by PG 5-25% coverage by NPG QC: 0 PG
Straw (St4:14)	95-100% coverage (3/4 PG) QC: 92 PG/ 3 forbs	0-5% coverage by PG 75-95% coverage by NPG QC: 53 NPG/ 2 forbs

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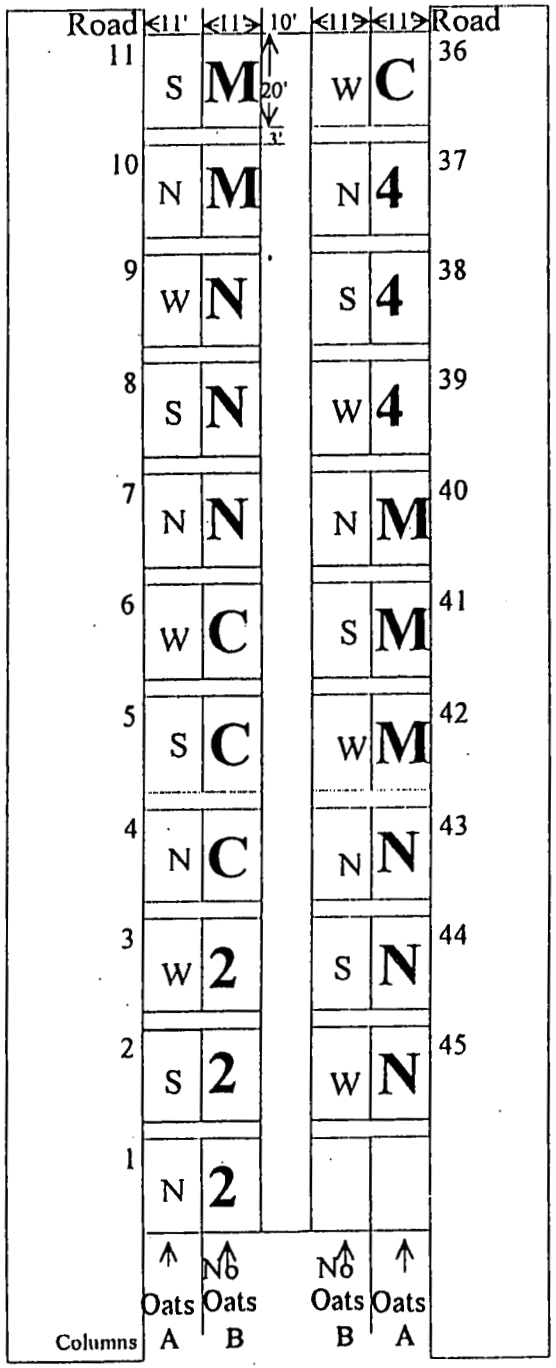
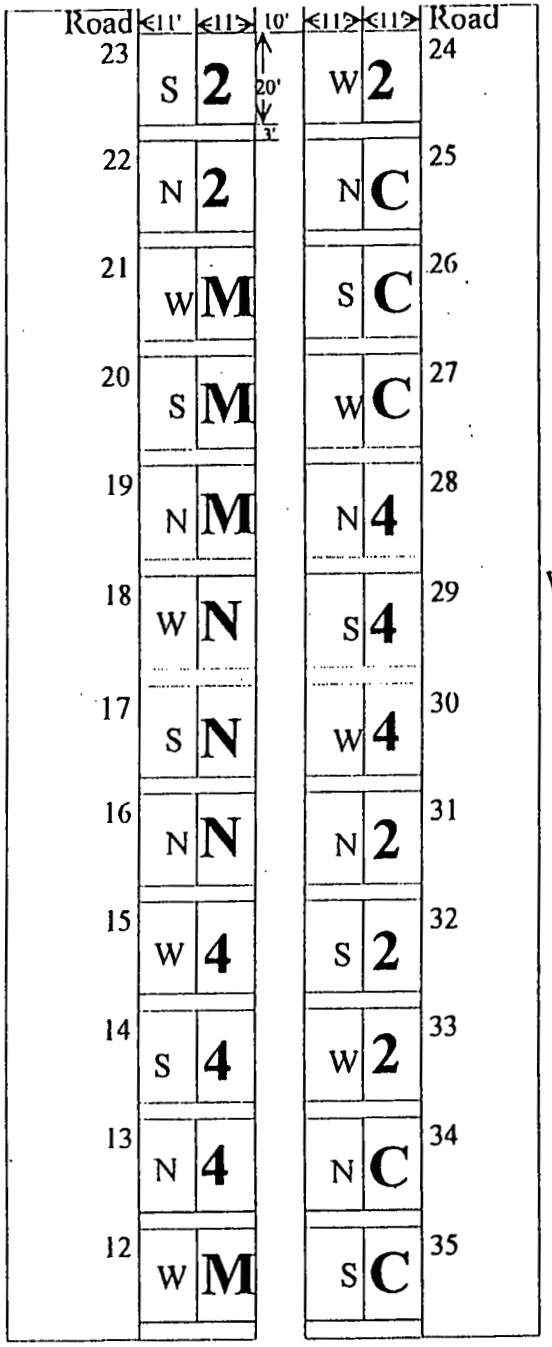
Figure 1 1989



Southern End

Northern End



Spring 1998

Legend

Amendments

- 2 — 2" soil cap
- 4 — 4" soil cap
- M — Manure incorp
- C — Sewage incorp
- N — None

Mulch

N - none

S - straw

W - woodchips