Printed: April, 1993
Portage la Prairie
ISSN 1188-4770
Group (9f)

Research Update 699

Sod Seeding Techniques

INTRODUCTION

Best estimates indicate there are about 32 million ac (13 million ha) devoted to forage production in the prairie provinces. The productivity of this land is affected by a number of variables. Winter survival, pasture management, environmental conditions and weed and pest infestation all play a role in the successful establishment and maintenance of productive pasture and rangelands. Plants undisturbed for many years in idle pasture become root-bound, robbing each other of nutrients. Some plant species have a very short productive period.

The potential benefits of pasture renovation through sod seeding are many. In most cases a pasture's productivity can be increased by introduction of new plant species. Soil improvements can be made by including perennial legumes in a crop rotation. Overall increased forage quality and resulting economic benefits for livestock producers can be realized.

Successful establishment of productive pasture is no accident. Using conventional methods, seedbed preparation for forage crops leaves the soil highly susceptible to erosion. Small, slow growing seedlings are typical of forage species and the soil remains unprotected during the establishment year. Pasture and forage production is often reserved for marginal lands, where annual crops are less successful. Conventional seeding methods are particularly unsuitable in hilly terrain because of water erosion, in light soils because of wind erosion, in saline areas because of excessive moisture, and in stony conditions where equipment is unsuitable.

Past research has indicated that sod seeding or zero tillage pasture renovation is a feasible alternative for pasture improvement. Sod seeding requires seeding equipment that maintains the existing vegetation for erosion and moisture control, but creates and places the seed into an ideal seed bed for optimum germination and long term establishment. Some systems use mechanical methods or herbicides like glyphosate to control vegetation in conjunction with sod seeding. However, high chemical costs, limited accessibility to some pastures by spraying equipment, and the risk of weed infestation in the event of a crop failure sometimes limit their use on a large scale.

This Research Update is a summary of results encountered throughout the course of three studies conducted between 1985 and 1992. However no summary such as this can be complete without considering information from other sources, nor can it present the detailed results of a wide variety of studies representing hundreds of pages of data. As such, this Research Update should be considered a primer of fundamental principles and concepts to consider when attempting to renovate pastureland by sod seeding.

A wealth of information exists on the topics of pasture renovation, forage establishment, and sod seeding. Much of this information is available through the provincial Departments of Agriculture, and Agriculture Canada.

OBJECTIVES

Successful establishment of renovated pasture requires a combination of planning, equipment, good timing, and cooperative weather conditions. These are the same requirements necessary for successful establishment of virtually any crop. However, for successful sod seeding these variables are more critical.

Producers must first know what they want to achieve through sod seeded pasture renovation. Generally, some combination of the following are goals for most producers:

- ·soil conservation in fragile topography
- ·introduction of more productive grasses and/or legumes
- ·overall increased forage quality and quantity
- ·reduced energy inputs
- ·enhanced waterfowl habitat cover
- ·adequate nutrients to enhance weight gain of livestock
- ·soil improvements

Choosing the appropriate plant species to sow is highly dependant on the producers needs. Choosing a species of grass depends on soil type and existing vegetation species. Excessively high legume population can lead to bloat in grazing cattle and overly dense ground cover for waterfowl. Some grass species produce heavily early in the season and then stabilize, while others are easily damaged by overgrazing. An appropriate combination or selection of plant species will ensure steady growth throughout the grazing season. Protein value of mixed pasture must be a prime consideration for maximizing benefit to livestock. Some legume/grass combinations compliment each other. Alfalfa is generally much quicker to emerge than grasses and can provide too much competition for slower developing grass seedlings, making seed ratios critical. Mixed species often have difficulty remaining stable over the long term.

Pasture management is an ongoing process. Provincial Agricultural offices and Forage Councils have information that can assist you in the proper selection of forage cultivars and species.

GENERAL DISCUSSION OF RESULTS

Environmental conditions clearly play the most significant role in successful establishment of sod seeded pasture. Adequate rainfall at the right time is critical, but rainfall can only be predicted. Other variables like existing soil fertility, vegetation competition, seeding, and pest infestation can all be controlled to some degree. Sod seeding works welt in most soil types. Exceptions are noted in the "Seeding" and "Equipment" sections.

SOIL FERTILITY

Knowing the chemical composition of your soil properties is the first step in successful forage establishment. Analysis of soil samples will indicate fertilizer requirements for the plant species chosen. Some require nitrogen while others require phosphorous.

IN BRIEF

·Adequate soil fertility is necessary for successful forage establishment.
·Seed early to take advantage of existing soil moisture.
·Accurate seed placement is critical to the success of any forage crop.
·Good seed/soil contact is critical to germination.
·Minimize competition from surrounding vegetation.
·Sod seeding is only one part of a sound pasture management program.
·Success in sod seeding is the result of a delicate balancing act between soil moisture levels, soil fertility, soil types, competition from existing vegetation, pest control and diligent seeding practices.

The appropriate combination depends on the seed combination selected.

Best fertilizer responses usually occur in wetter conditions in most crops. However, pasture renovation studies conducted indicate no clear relationship between productivity, fertilizer application, and moisture levels. Soil fertility is a governing factor when considering fertilizer application. Banding fertilizer (ideally below the seed), as opposed to other methods of application offers the best return for investment.

As a general rule, nitrogen (N) promotes grass growth while phosphorous (P) stimulates legumes. Annual applications according to soil tests are beneficial. However, a balance between N and P must be achieved when fertilizing stands of mixed grass and alfalfa. Application of N can increase grass growth, shading alfalfa and reducing N fixation. Application of P at seeding time and broadcast late in the establishment year is beneficial to legumes while application of P is most beneficial to grasses when accurately placed near the seed at seeding time.

MANAGING COMPETITION

Sod seeding demonstrated clear advantages compared to conventional practices if existing growth was first suppressed. Eliminating competition from existing vegetation enhances the soil moisture levels available to seedlings. Competition can be suppressed by overgrazing in the previous season, mowing, burning, chemical application, or some combination of these.

Overgrazing: Overgrazing in the season prior to planting can help but requires diligent attention. The duration of the grazing period and stocking rates must be closely monitored. Overgrazing lowers available nitrogen, promoting legume growth while limiting grass growth. Certain grass species become less palatable to cattle later in the season, and can withstand later grazing pressure. Timing is critical. Removal of cattle followed by warm weather can then stimulate undesirable vegetation growth. Grazing sod seeded pastures in the year of establishment can be used as a competition suppression technique while new seedlings are less than 2 in (50 mm) tall. Otherwise it is discouraged.

Mowing: Mowing can be as beneficial as grazing but does not require the same level of attention. However the harvested vegetation should be removed, or the long term benefits of mowing will be reduced. Mowing favours grasses over weeds, and is ideally carried out once weeds reach a height of 6-8 in (150-200 mm) but before mature seed is produced. Mowing can inflict more damage to grass stands than normal grazing.

Burning: Burning is a useful suppression technique in some instances, but was not included as part of the studies PAMI was involved with. Producers practising burning to remove existing ground cover are facing increased public scrutiny due to air pollution. Regulations must be complied with. Controlled burns require diligent attention to prevent fire risks to buildings, fences and trees.

Burning is inexpensive, provides rapid removal of existing vegetation, and promotes several other effects, not all of which are considered beneficial. Spring burning blackens the soil surface, which in turn warms rapidly and provides an ideal environment for the early establishment of weeds. A 1983 study (White and Currie) resulted in decreased forage production on burned sites when compared to unburned sites. In addition some grass species respond better to spring burns, while others respond to late summer or early fall burning. Some grasses (eg. Kentucky Bluegrass) can be virtually eliminated by burning. Burning sometimes increases woody vegetation if pastures are subsequently under stocked.

Chemical Application: Best results were obtained through chemical suppression of existing vegetation prior to or soon after seeding. This eliminates competition for moisture at the critical seedling development stage. Chemical suppression of existing vegetation is a requirement for emergence in dry or drought conditions, but has also proven very beneficial even if adequate moisture is available.

SEEDING

Sod seeding requires different seeding equipment than conventional seeding. The seeding drill must have sufficient weight for penetration of hard soils and strong ground engaging parts for durability in untilled conditions. Also important is the trash clearance, furrow openers, seed placement, seeding rates, and soil disturbance characteristics of the seeding equipment. Most zero till drills require suppression of existing vegetation to be used successfully. Sod seeding works well in most soil types. Some packing is beneficial when seeding in light and/or dry soil conditions.

Equipment: In Manitoba the Connor Shea Coil Tyne drill (FIGURE 1) generally represented a superior seeding system when compared to other zero-till drills or conventional tillage under average conditions. A PAMI Evaluation Report (#508) on this drill is available.

FIGURE 1. Connor Shea Coulter Tyne Drill.

The Connor Shea is a three-point hitch drill designed primarily for zero till pasture renovation. It is equipped with 14 hoe openers spaced 6 in (150 mm) apart in two rows and 14 single disk cutting coulters (FIGURE 2). Seeding depth is controlled by two end wheels. At a weight of 2304 lb (1044 kg) the Connor Shea is a rugged machine for it's relatively small size. The weight was advantageous when penetrating hard soils. The heavy construction of the machine allowed it to fare well in robust topography.

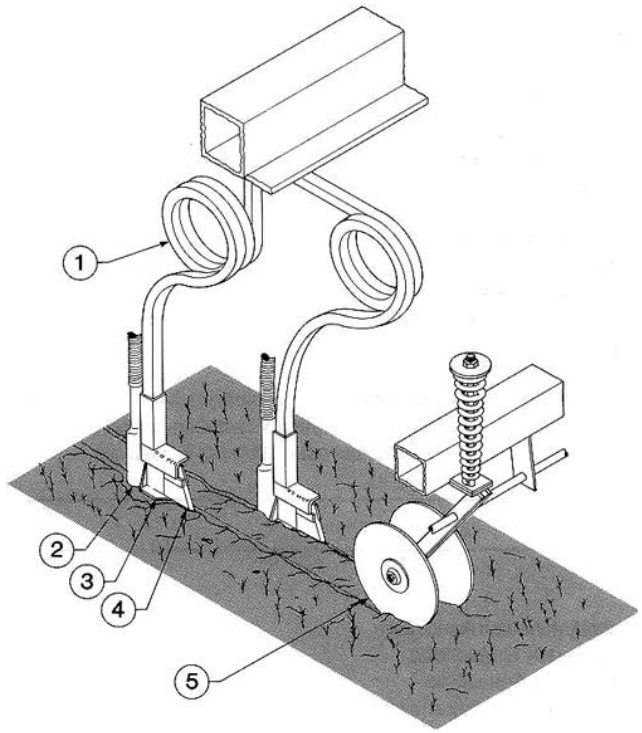

FIGURE 2. Hoe Opener: (1) Coil Tyne, (2) Seed Tube, (3) Wing, (4) Replaceable Vertical Knife, (5) Coulter.

The most unique feature of the Connor Shea drill is the Baker Point hoe. The hoe has a narrow knife edge with a winged heel that forms a soil cavity. The cavity is intended to trap moisture for the new seedling and prune existing competitive vegetation in the immediate seed zone (FIGURE 3).

Soil packing proved to be more beneficial when attempting to establish pasture in dry conditions and in light soils. Because of the

shallow seeding depths required for forage seeds, soil cover dries rapidly when left unpacked, potentially exposing seed and soil to wind erosion if early rains do not occur. A lack of soil packing around the seed provides less than ideal seed to soil contact under drought conditions. A Saskatchewan study also recommends the addition of packers to the Connor Shea when seeding in dry conditions.

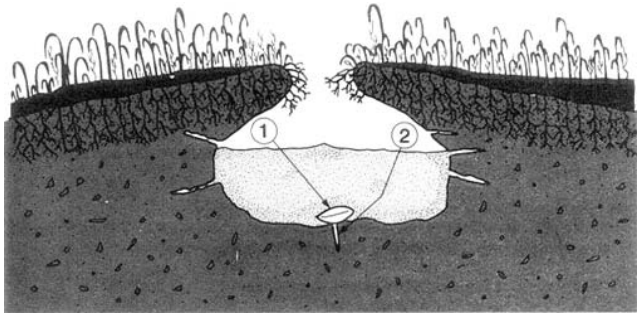

FIGURE 3. Seed Placement: (1) Seed, (2) Disk Coulter Penetration.

A comparison conducted in one study during a season of adequate rainfall (1992) appeared to indicate that packing is not always essential if appropriate levels of moisture are available. Light soil that falls into the seed cavity left by the Baker Point provided adequate soil contact in these conditions (Figure 3).

Some controversy exists over the benefits of packing. Soil packed around seed can leave an impenetrable crust after rainfall. New shoots demonstrate little ability in finding the path of least resistance when encountering obstacles. Soil type will determine the hardness of a post rainfall soil crust. Soils with higher clay content will result in harder crusts.

Seed Placement: Seed placement is critical when seeding forage crops. In general seeding depths vary between 0.25 and 1.50 in (6 and 37 mm), depending on soil type and moisture availability (TABLE 1). Seeding as early as possible takes advantage of existing soil moisture. The window of opportunity can be very small for fall seeding in some areas. Generally the soil should be dry and soil temperature below 50° C (41° F) to ensure no fall emergence.

TABLE 1. Seeding depths for forage seeds[1]

Soil Texture	Optimun Seeding Depth	
	in	mm
Clay	0.25-0.75	0.5-1.5
Loam	0.5-1.0	1.0-2.5
Sand	0.75-1.5	1.5-3.5

Seed Treatments: Studies conducted so far have indicated no real advantage for pregerminated seed, either in emergence or early plant counts. Experiments in the United States reveal that water applied in the furrow at time of seeding significantly enhances emergence. However, without further rainfall soon after emergence the benefits of this practice are questionable. The use of this technique on a large scale is not practical. Further work to study the effects of water application to a sod seeded and packed row are needed to examine the feasibility, results, and practicality of such a practice. Inoculation of legume seeds prior to planting is a technique that offers greater seedling vitality, but it is important that the seed be planted soon after inoculation if the inoculant is to remain viable.

Other Equipment: Throughout the course of research in sod seeding, PAMI has worked primarily with three different seed drills. The Connor Shea Coil Tyne Coulter Drill is the only machine designed specifically for zero-till pasture renovation (Evaluation Report 508). The Amazone NT 375 No-Till Grain Drill (Evaluation Report 421) and the Lilliston 9680 No-Till Grain Drill (Evaluation Report 420) were not designed for sod seeding, but functioned with varying degrees of success.

Many other types of drills have been used in sod seeding research and in zero till forage establishment programs. Providing they meet the seeding requirements discussed previously, any of these may be suitably employed in sod seeding.

[1]*From Manitoba Agriculture Agdex No. 120/22*

PEST INFESTATION

Grasshoppers are a commonly encountered pest causing damage to forage stands. They prefer grasses to legumes and therefore have the potential to decimate the grass species in a mixed stand. While grasshoppers played a role in many of the experimental plots studied, in most cases they were controlled by pesticide application. One study noted that the soil cavity left by the Baker Point provided a sheltered run for grasshoppers allowing them to decimate the vulnerable seedlings at emergence.

ENERGY INPUTS

Energy measurements taken during a study in 1985 showed a decided advantage to sod seeding when compared to conventional tillage. On average, 56% less energy input was required to seed equivalent areas when compared to conventional methods.

BENEFITS OF SOD SEEDING

We know that there is only a thin layer of topsoil that provides the nutrients necessary to plant growth, so soil conservation is a primary concern. Sod seeding effectively minimizes soil disturbance, leaving it less vulnerable to water and wind erosion. This is especially critical in hilly terrain, light soils, and saline conditions. Some pasture grasses only grow significantly early in the season. Sod seeding allows for the introduction of grasses and/or legumes that demonstrate even growth throughout the growing season. Overall forage quality can be enhanced, resulting in direct economic benefits to livestock producers. Reduced energy inputs when sod seeding further enhance economic benefits to producers.

Much has been learned from the studies conducted to date. This work has laid an excellent foundation for further research. Long term studies need to be conducted in order to perfect techniques that will work in drier and light soil zones.

FURTHER INFORMATION

This report is a compilation of results from an array of studies conducted on the topic. A reference list of specific studies and publications has been included on the back page of this report.

Detailed Evaluation Reports on the Connor Shea Coil Tyne Coulter Drill (Evaluation Report 508) the Amazone NT 375 No-Till Grain Drill (Evaluation Report 421) and the Lilliston 9680 No-Till Grain Drill (Evaluation Report 420) are available by calling 1-800-567-PAMI and requesting the appropriate report number. Other information available to the public can be obtained from the provincial departments of agriculture, and are listed in the reference section on the back page of this report.

GUIDELINES FOR SUCCESSFUL SOD SEEDING

- Adequate soil fertility. Have soil samples analysed for chemical composition prior to seeding, and fertilize accordingly.
- Seed early to take advantage of existing soil moisture, or wait until desirable moisture conditions exist. Fall seeding can work, but timing is important.
- Accurate seed placement is critical to success of any forage crop. Check seed depths and calibrate equipment accordingly. See TABLE 1.
- Good seed/soil contact is critical to germination. Pack soil when seeding in anything less than ideal moisture conditions.
- Depending on conditions, some form of pest control may be required.
- Minimize competition from surrounding vegetation. Mechanical removal of competition as demonstrated by the Connor Shea Drill is helpful but not sufficient in itself when seeding into dry and/or light soils. Other suppression techniques should be employed to maximize emergence and yields.
- Zero tillage as employed by sod seeding techniques, plays an important role in a sound pasture management program. Adequate moisture levels and existing vegetation suppression combine to provide excellent results in a sod seeded pasture renovation program.
- Normal moisture deficiencies alone can hinder establishment, but if combined with competition from other vegetation, lighter soils and grazing pressure, unsuccessful establishment is assured.

ACKNOWLEDGEMENTS

Prairie Farm Rehabilitation Act (PFRA)
Energy, Mines and Resources Canada
Enerdemo
Saskatchewan Agriculture Development Fund (ADF)
Saskatchewan Agriculture
University of Manitoba
Manitoba Agriculture
Ministry of Energy and Mines Manitoba

In addition we would like to thank the many pasture groups, grazing and forage groups, and individual producers who cooperated with the all of the partners who participated in the studies.

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·**ASAE Paper No. 85-1517** *-by Victor L. Hauser of United States Department of Agriculture*

·**Forage Crop Recommendations** *-Saskatchewan Agriculture, Soils and Crops Branch*

·**Drought and Saskatchewan Rangeland: A Management Guide** SRC Technical Report #179 *-by Zoheir M. Abauguendia and Robert T. Coupland of the Saskatchewan Research Council*

·**A Guide for No-Till Forage Seedings** *-by John J. Rappa of the Ontario Ministry of Agriculture and Food*

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