EVALUATION OF GRASS ESTABLISHMENT, DEVELOPMENT AND SURVIVAL UNDER SOD-SEEDING CONDITIONS IN THE DRY SUBHUMID PRAIRIES

by

Suzanne M. Gobin

A thesis
Submitted to the Faculty of Graduate Studies
in Partial Fulfilment of the Requirements
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Abstract

Evaluation of Grass Establishment, Development and Survival Under Sod-Seeding Conditions in the Dry Subhumid Prairies

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In order to increase the nesting potential of pastures and rangelands, increases in the proportion of high quality dense nesting cover (DNC) grasses in the sward are required. Sod-seeding is a system where seeds are placed into an undisturbed pasture or rangeland sod, and this system may be an effective way to establish DNC grasses, especially on fragile soils where pre-seeding tillage is not desirable. Different management practises will affect the degree of success achieved with sod-seeded grass stands. It is not known at the present time if all candidate DNC grass species respond similarly to sod-seeding.

The objectives of this study were 1) to evaluate different sod-suppression techniques for the establishment of tall wheatgrass [Thinopyrum ponticum (Podp.) Barkw. & D.R. Dewey] under two types of resident vegetation and 2) to compare the relative response of switchgrass (Panicum virgatum L.), green needlegrass (Stipa viridula Trin.), tall wheatgrass, and northern wheatgrass [Elymus lanceolatus (Scribner & J.G. Smith) Gould] to seedbed preparation techniques. Field studies were conducted in 1991 and 1992 at

Portage La Prairie and Gladstone, MB and a controlled environment study was conducted in 1992. Grass seedling emergence, development and survival were monitored throughout the growing season, and in some cases, the following season as well. Environmental measurements and competition from the resident vegetation were measured.

Results of the first experiment indicated that under conditions of intense competition from rhizomatous resident vegetation, such as with bromegrass (Bromus inermis L.) and Poa species at Gladstone, chemical suppression of the resident vegetation was critical for successful establishment, development and survival of tall wheatgrass plants. At Portage, satisfactory population establishment and survival were achieved without any suppression of the resident vegetation; however, greater morphological development of the plants, both in the first and second season, occurred when chemical suppression was used.

Results of the second experiment indicated that suppression of the resident vegetation increased plant density, development and survival of all four sod-seeded grasses over the untreated control. The tall and northern wheatgrasses were the most conducive to sod-seeding, and the switchgrass and green needlegrass the most difficult grasses to establish successfully.

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1.0 INTRODUCTION

Many practises used in agriculture over the years have resulted in declines in waterfowl populations. Wetlands, sloughs and potholes have been drained to increase land available for crops. For many waterfowl species, upland nesting sites are as important as wetlands. However, upland areas have been seeded to annual crops, which, for the most part, do not provide high quality nesting cover (Prairie Habitat Joint Venture, 1989). The loss of original habitat suitable for nesting waterfowl has been implicated as a major cause for declining waterfowl populations in the Prairies between 1970 and 1990, from approximately 20 million to 10 million ducks (Prairie Habitat Joint Venture, 1989).

While upland pastures and rangelands provide some potential nesting sites, intensive grazing practises and high stocking rates (continuous grazing at higher than recommended stocking rates) have led to changes in the botanical composition of pastures. Tall, native species have been replaced by invader species such as smooth bromegrass (*Bromus inermis* L.) and Kentucky bluegrass (*Poa pratensis* L.) (Waller and Schmidt, 1983). These do not grow as tall and thus provide only poor quality nesting cover.

In order to increase the nesting potential of pastures and rangelands, increases in the proportion of high quality dense nesting cover (DNC) grasses in the sward are required.

Successful nesting occurs with stands of tall, dense cover; in fact, waterfowl seem to prefer this type of cover (Duebbert and Lokemoen, 1976; Duebbert et al., 1981; Higgins, 1977; Kirsch et al., 1978). Providing the tallest and most dense vegetation possible has been recommended as the goal of pasture management for DNC (Kirsch et al., 1978). However, since different waterfowl prefer different grasses and different sward heights, a mix of several grasses, differing in height, would be preferable. There are a number of different grasses that could be used for establishing DNC. Tall wheatgrass [Thinopyrum ponticum (Podp.) Barkw. & D.R. Dewey] is an introduced grass with excellent potential for tall DNC. In addition to providing DNC, re-establishing native grasses into existing pastures may allow producers to develop a multiple-land use system, in which late-season grazing could occur after the nesting period was over (that is, after mid-July).

Sod-seeding may be an effective way to establish DNC. It is less expensive and maintains ground cover during the establishment period (compared to tillage). Several factors can affect the successful establishment of plants that have been sod-seeded. The species, cultivar, method of seeding, soil fertility, competition from resident vegetation, occurrence of diseases and pests, and weather will all influence establishment and survival (Bryan, 1985). It is not known at the present time if all candidate DNC grass species respond similarly to sod-seeding.

Sod-seeding native grasses does present certain challenges. Environmental conditions, such as temperature, soil moisture, precipitation and type of resident vegetation, greatly affect sod-seeded grass establishment, development and survival. Stand failures often occur because of competition from the resident vegetation. Different management practises will affect the degree of success achieved with sod-seeded grass stands. Suppression of the resident vegetation has been recognized as an important component of sod-seeding management systems.

This study was conducted to determine the feasibility of establishing stands of dense nesting cover (DNC) through sod-seeding. The objectives were 1) to evaluate different sod-suppression techniques for the establishment of tall wheatgrass under two types of resident vegetation and 2) to compare the relative response of different perennial grass species to seedbed preparation techniques.

2.0 LITERATURE REVIEW

2.1 Sod-Seeding

Sod-seeding refers to a practise where a crop is seeded into vegetation in pastures and rangelands, with only partial disturbance of the resident vegetation (Hervey, 1960). Since no preseeding tillage occurs, seeding equipment for sod-seeding must be able to effectively penetrate the surface residue and the soil without plugging, and create seed grooves that are even in depth to provide good seed placement (adequate seed to soil contact) with adequate cover to prevent the seed from drying out (Baker, 1973). Reducing competition for light, soil, nutrients and water by the resident vegetation greatly increases the establishment of sod-seeded plants.

There are several advantages to sod-seeding compared to the more traditional method involving pre-seeding cultivation. Sod-seeding is well suited to fragile land where erosion, stones or salinity make cultivation difficult or impossible (Harris, 1990; Marshall and Naylor, 1984a; Sprague, 1960). Because less soil disturbance occurs in the sod-seeding system compared to cultivation, the soil is less prone to wind and water erosion (Bowes and Zentner, 1992; Bryan et al., 1984; Hervey, 1960). Sod-seeding also requires less time, labour and energy than conventional seedbed preparation, making it less expensive (Bowes and Zentner, 1992; Rogers et al., 1983; Waddington and Bowren 1976). Although some fragile lands that may once have been broken will slowly revert back to native vegetation, sod-seeding is a much quicker method of revegetation than the process of natural succession (Hart et al., 1985; Hervey, 1960).

Establishing stands of dense-nesting cover for waterfowl nesting requires a high level of management for several years. This not only requires intensive labour, but also means fields are out of production for several years. Duebbert et al. (1981) report that fields containing quackgrass [Agropyron repens (L.) Beauv.], smooth bromegrass, Canada thistle [Cirsium arvense (L.) Scop.], leafy spurge (Euphorbia podperae L.) or perennial weeds require combinations of herbicides and intensive cultivation for one or more years for proper control prior to grass establishment. Intensive cultivation, however, can be detrimental to the soil. Herbicides can be as effective as tillage in controlling weeds and would reduce some of these negative requirements associated with establishing DNC in a conventional manner.

Despite the potential advantage of sod-seeding over conventional establishment techniques, establishment can still be variable (Hervey, 1960). For example, while establishment of big bluestem (Andropogon gerardii Vitman), indiangrass [Sorghastrum nutans (L.) Nash], and switchgrass (Panicum virgatum L.) was superior under sod-seeding compared with conventional seeding into a Kentucky bluegrass, blue grama [Bouteloua gracilis (H.B.K.) Lag. ex Steud.], western wheatgrass [Pascopyrum smithii Rydb. (Love)] and buffalograss [Buchole dactyloides (Nutt.) Englem.] sod, establishment of side-oats grama [Bouteloua curtipendula (Michx.) Torr.] was unaffected by establishment method (Hart et al., 1985). Superior establishment of certain grasses under sod-seeding was attributed to better seed-to-soil contact (Hart et al., 1985). Emergence of Italian ryegrass (Lolium multiflorum) and perennial ryegrass (Lolium perenne L.) was greater in sod-seeded plots (Squires and Elliott, 1975). Hervey (1960) attempted to seed tall wheatgrass, by sod-seeding and by conventional methods, into a sand dropseed (Sporobolus cryptandrus)/forb sod, and found poor survival resulted in all cases. The author attributed this to inadequate soil surface cover that led to erosion (Hervey, 1960). Comparable establishment of sod-seeded bromegrass, Russian wild ryegrass [Psathyrostachys juncea (Fischer) Nevski] and alfalfa (Medicago sativa L.) was found between sod-seeded and rotovated plots (Waddington and Bowren, 1976). The rotovated plots suppressed the sward of dandelion (Taraxacum officinale L.), alfalfa, alsike clover (Trifolium hybridum L.), creeping red fescue (Festuca rubra L.), bromegrass and crested wheatgrass [Agropyron cristatum (L.) Gaertner] to a greater degree than herbicides, but produced a looser seedbed and allowed for dandelion re-infestation (Waddington and Bowren, 1976).

Poorer establishment of sod-seeded perennial ryegrass, sand bluestem [Andropogon gerardii var. paucipilus (Nash) Fern.], switchgrass, smooth bromegrass and intermediate wheatgrass [Thinopyrum intermedium (Host) Barkw. & D.R. Dewey] as compared to conventional seedbed preparation has been reported in studies on sites consisting mainly of bunchgrasses (King et al., 1989; Marshall and Naylor, 1984a). Poor establishment was attributed to possible herbicide residues and leachates from the plant residue (Marshall and Naylor, 1984a), low precipitation and competition for moisture, poorer seed-to-soil contact and increased weed competition (King et al., 1989), and the physical impedance of the trash layer (King et al., 1989; Marshall and Naylor, 1984a).

Roth et al. (1985) reported higher alfalfa yields in the year of establishment and in the following year when sod-seeded after chemical suppression of the resident vegetation using either glyphosate or paraquat as compared to conventional seeding methods. In contrast, Hart et al. (1985) found that although big bluestem, indiangrass and switchgrass had greater establishment under sod-seeding as compared to discing, total vegetative yields (including the Kentucky bluegrass, blue grama, western wheatgrass and buffalograss resident vegetation) and seeded species yields were not different between treatments after four years. This led the authors to conclude that the advantage of sod-seeding was a more rapid rate of establishment (Hart et al., 1985). Conventional seedings took longer to establish, but did eventually produce comparable dry matter yields (Hart et al., 1985).

Management practises will influence the success of sod-seeded grass establishment. Careful selection of the grass species and seeding equipment used and the application of pesticides will affect stand establishment. The competition from the resident vegetation should be reduced or eliminated (Bryan et al., 1984). In fact, Panciera and Jung (1984) concluded that factors such as the cultivar, planting date and weed control affect the successful establishment of switchgrass more than tillage.

2.2 Dense Nesting Cover Assessment

Nesting cover quality of a sward can be assessed using a Robel pole (Robel et al., 1970). The Robel pole consists of a pole that is marked every 5 to 10 cm. The height at which 100% visual obstruction occurs is measured; that is, the height at which the pole is no longer visible. Robel pole measurements give an accurate estimation of the density (as well as the height) of a stand and are a useful measure of the nesting potential of a sward (Duebbert et al., 1981; Robel et al., 1970).

Height measurements alone as an estimate of the DNC potential of a stand are not adequate, as other features such as foliar density are not taken into consideration (Jones, 1968). Robel pole measurements have been correlated to the density and weight of vegetation present (Robel et al., 1970).

2.3 Grass Species Characteristics

Yields of native grasses are generally less than those of introduced grasses (Kilcher and Looman, 1983; Knowles, 1987; Lawrence and Ratzlaff, 1989). However, native grasses should be considered for nesting cover as they do not break down under the winter snowpack (Duebbert et al., 1981; Frank and Woehler, 1969) and they increase the biodiversity and quality of nesting cover. There is limited information available on growth and development of native grasses, and in many previous experiments, only total dry matter yields have been recorded.

2.3.1 Tall Wheatgrass

Tall wheatgrass [Thinopyrum ponticum (Podp.) Barkw. & D.R. Dewey] is an introduced, cool-season bunchgrass that has good saline and flooding tolerance (Duebbert et al., 1981; Harris, 1990). It is drought tolerant, even in the seedling stage (Frischknecht, 1951). It also is very winter-hardy, as it did not suffer from winter injury when evaluated in