2.3. Experimental Test of the Effects of Erosion Control Blankets on the Survival of Bluebunch Wheatgrass Plugs

B.J. Weddell

2.3.1. Introduction

Non-native annuals have invaded native steppe vegetation throughout the intermountain region. To date, no satisfactory method has been developed for restoring native perennial bunchgrass associations once they have been colonized by exotic species. The primary reason for this is that the removal of vegetation, even non-native vegetation, creates conditions that favor non-natives. This paradoxical situation occurs because the Eurasian annuals that have invaded possess adaptations which allow them to exploit areas of bare soil created by disturbances, whereas native species of the intermountain steppe were not exposed to frequent, large-scale disturbances during their evolution and lack adaptations to cope with such disturbances (Tisdale 1961; Mack and Thompson 1982).

This creates a frustrating predicament for land managers who wish to improve or restore native steppe that has been invaded by exotics. A variety of techniques, including herbicides, fire, and mechanical removal, have been used in attempts to minimize populations of exotic annual grasses and forbs and to promote the growth of native perennials, but so far, the long-term results of this work have been disappointing. Although it is possible to suppress the growth of exotics temporarily, generally after a few years their populations rebound (Youtie et al. 1998). One way to circumvent this problem would be to devise a restoration strategy that enhances the coverage of native species and reduces exotics without creating areas of bare soil for exotics to reinvade. Ideally, such a strategy would also maintain or restore the microbiotic crust of mosses, lichens, algae, cyanobacteria, and fungi that typically covers much of the ground between grasses and forbs in intermountain steppe communities. Inoculation with crust material enhances the rate of recovery of disturbed areas, but even with inoculation, lichens are expected to take decades to recover and mosses might not recover for centuries (Belnap 1993). During that time, exposed soil is vulnerable to colonization by exotics.

Biodegradable ground covers are often used in horticulture and restoration to control weeds and minimize erosion while transplants become established. This study examined the efficacy of biodegradable erosion control blankets in suppressing the growth of exotics around transplanted plugs of bluebunch wheatgrass at a location where native steppe vegetation has been displaced by non-native species. The establishment of seedlings in patches of moss placed on bare soil was also monitored.

2.3.2. Description of the study area

The study area is a privately-owned parcel of undeveloped land on a ridge 1.9 km northeast of Waha, in the southeast ¼ of Section 4, T. 33 N., R. 4 W. The location is surrounded by homesites. On drier locations where native vegetation persists, bluebunch wheatgrass (*Pseudoroegneria spicata* var. *spicata*) is dominant, accompanied by native grasses and forbs such as few-flowered wild oatgrass (*Danthonia unispicata*), Sandberg bluegrass (*Poa secunda*), grass-widows (*Olysinium douglasii* var. *inflatum*), cous biscuit-root (*Lomatium cous*), and narrow-leaved skullcap (*Scutellaria angustifolia*), as well as non-native annuals. On more mesic portions of the site, Idaho fescue (*Festuca idahoensis*) and common snowberry (*Symphoricarpos albus*) dominate. In some areas, however, native species have been almost completely replaced by non-native grasses and forbs. In 1998, the yellow star-thistle (*Centaurea solstitialis*) canopy intercepted over 65% of four 50-m transects in a weedy portion of the site (Weddell and Lichthardt 1998). Field morning glory (*Convolvulus arvensis*), medusahead (*Taeniatherum caput-medusae*), erect cinquefoil (*Potentilla recta*), teasel (*Dipsacus fullonum*), tall oatgrass (*Arrhenatherum elatius*), ventenata (*Ventenata dubia*), annual bromes, and piedmont bedstraw (*Cruciata pedemontana*) are prevalent.

2.3.3. Methods

In the autumn of 1999, bluebunch wheatgrass seeds were collected onsite. These were started in a greenhouse on November 30. On April 5, 2000, 48 of the resulting plugs were planted in a weedy section of the study site, after being hardened out of doors for 48 hours. The experimental design was a randomized complete block, with two blocks. Each block contained six rows of four plugs, spaced at 2.5-m intervals. Rows were 1.5-m apart. The vegetation in the blocks was heavily infested with weeds, so that virtually no native vascular plants or cryptogams remained. Half the plugs were planted in the center of two-layer, 1-m^2 coconut fiber erosion control blankets bonded with biodegradable netting (*Bon Terra*, available from Arrow Construction, Spokane, WA). This product is permeable to gases and liquids and is designed to biodegrade within 36 months. Mats were placed around the plugs on April 8, 2000, and anchored with 15-x-2.5-x-15-cm staples. Each plug was watered with 250 ml water immediately after planting and again three days later.

In addition, all vascular plants, cryptogams, and litter were removed from two 50-cm-x-70-cm test blocks. A 10-cm wide buffer was left around the block perimeter. Each of the two 30-cm-x-50-cm test areas that remained was divided into three rows, each of which contained five 10-cm-x-10-cm experimental plots. One of these received a mat of mosses (*Tortula* sp.) and lichens (*Peltigera* sp. and *Cladonia* sp.). Seven of the remaining plots received a 10-cm-x-10-cm patch of mosses (primarily *Homalothecium* sp.) gathered from the adjacent Idaho fescue/common snowberry stand, and half the plots remained bare. Recruitment of yellow star-thistle and other species in plots with and without moss was monitored on May 23 and September 17.

Survival of the bluebunch wheatgrass plugs was recorded on May 23 and October 10, 2000. Two variables—basal diameter and number of reproductive culms—were measured on

plugs that survived until October and compared for treatments and controls using analysis of variance. Values for the number of spikes were transformed using $\sqrt{Y + 0.5}$ because the data included many zeros.

2.3.4. Results and discussion

All the transplanted plugs survived until May 23. A considerable amount of pre-existing vegetation had managed to grow up through the mats as well (Figure 1). By October 10, nearly one third of the plugs had died. The proportion of bluebunch wheatgrass plugs that survived was only higher for plugs surrounded by erosion control blankets (75%) than for controls (63%). The unprotected plugs were significantly smaller ($P < 0.01$) and produced significantly fewer spikes ($P = 0.04$) than the treatment plugs (Figure 2), however.

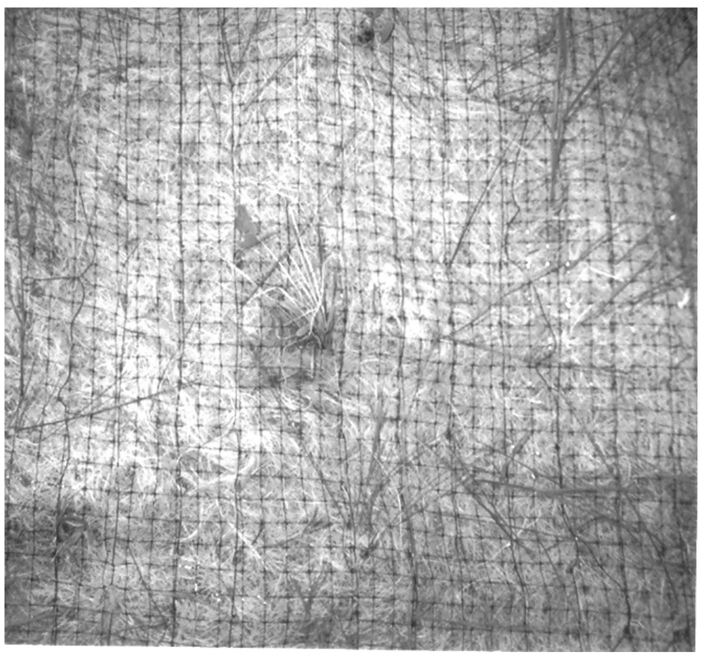

Figure 1. Biodegradable erosion control mat surrounding bluebunch wheatgrass plug 53 days after planting. Note how much of the pre-existing vegetation has penetrated the mats.

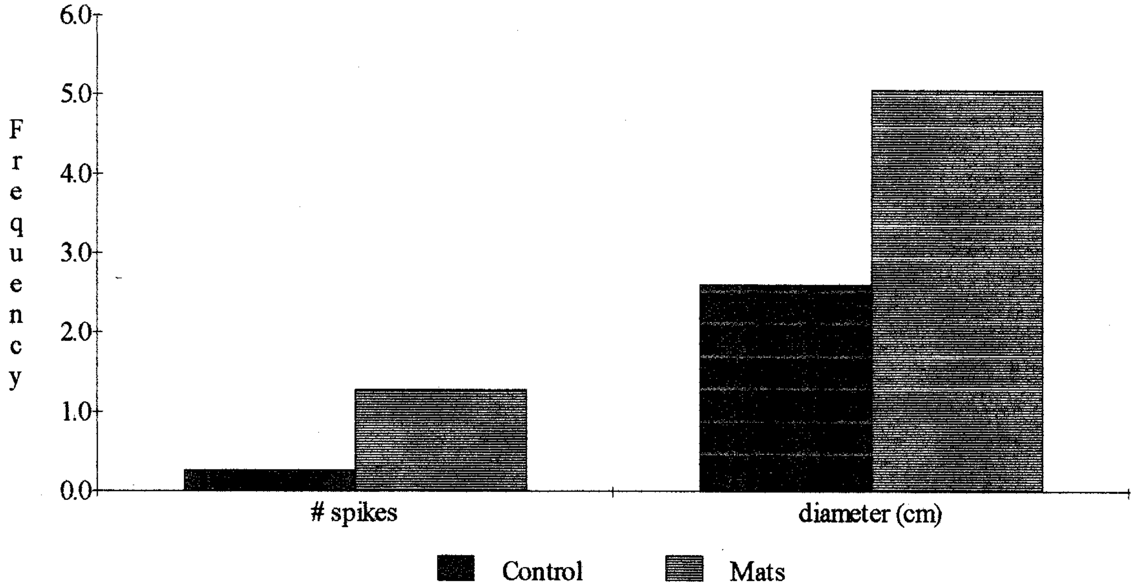

Figure 2. Comparison of number of spikes and crown diameters of bluebunch wheatgrass plugs surrounded by biodegradable mats and untreated plugs. Values are for plugs that survived until October 10.

The mosses in the crust patches were dry and appeared to be dead by August 4. Their appearance did not change after the onset of rains in September. Annuals or biennials that germinated both in the moss patches and on bare soil included yellow star-thistle, annual bromes, teasel, medusahead, ventenata, fiddleneck (*Amsinckia* sp.), thyme-leaf sandwort (*Arenaria serpyllifolia*), and Thale cress (*Arabidopsis thaliana*). All of these species except *Amsinckia* are exotics. The numbers of yellow star-thistle seedlings in the control and treatments plots were similar both in spring (15 individuals in plots with moss patches and 13 individuals in control plots) and fall (10 individuals in plots with moss patches and 11 individuals in control plots). Yellow star-thistle also germinated in plots with the moss/lichen patches.

These results suggest that biodegradable erosion control mats can enhance the establishment of native plants in areas with heavy infestations of non-native species. The fiber mats used in this experiment were not entirely successful in suppressing the vegetation they covered, however. Plastic mats would have been more effective in killing undesirable plants, but they would also have altered the soil environment appreciably. A permeable and biodegradable product was selected for this experiment to minimize such effects. Although the fiber matting probably has less dramatic effects on the soil and soil organisms than plastic, even the coconut fiber covering undoubtedly alters soil temperature. Furthermore, as it degrades, it will provide a source of carbon. The effects of these changes on soil microbiota are unknown. Other important questions need to be answered as well. It is not known whether the mats will be a barrier to the establishment of non-native seedlings, and if so how long that effect will last. And we do not known whether cryptogams will become established on the mats as they degrade.

The microbiotic crust of steppe communities affects germination and seedling establishment directly by forming a mechanical barrier to root penetration (Schlatterer and Tisdale 1969) and through allelopathic effects, and indirectly through its effects on soil-water relations and nutrient status. (See Harper and Marble 1988 for review.) Thus, it is a critical element of steppe restoration programs. However, in this study, the moss patch trials did not demonstrate any effect of patches on the recruitment of annuals. This may be because the mosses did not survive. Although the soil surface was moist when the patches were put in place, and remained moist for several more weeks, the mosses became desiccated in summer and did not revive when moisture returned. For this reason, the effects of the moss patches may not have been very different from the effects of a non-living mat.

The collection of moss patches to transplant to disturbed sites creates bare areas in the donor area. In this study, this problem was minimized by collecting mosses from rocks and from beneath clumps of dense shrubs. In addition, the spatial scale of the trials was kept small (fractions of a meter) to minimize damage to intact crust. Larger-scale trials were avoided because it was felt that these would create unacceptably large patches of bare soil in the donor areas.

There is clearly a need for restoration techniques that enhance native species and remove non-natives without thereby creating further opportunities for colonization by non-native plants. In particular, a method of restoring damaged microbiotic crusts would be a boon to restoration efforts. In situations where native vegetation has been virtually eliminated, biodegradable erosion control blankets may be useful for protecting native species until they become established. This technique is labor intensive, however, so it is not practical for large areas. On the other hand, it avoids some of the disadvantages of other approaches to controlling exotic species, such as chemical and mechanical treatments and burning, which create bare areas vulnerable to exploitation by exotics.

2.3.5. Literature cited

Belnap, J. 1993. Recovery rates of cryptobiotic crusts: Inoculant use and assessment methods. Great Basin Naturalist 53:89-95.

Harper, K.T. and J.R. Marble. 1988. A role for nonvascular plants in management of arid and semiarid rangelands. Pp. 135-169 *in* P.T. Tueller, ed., Vegetation science applications for rangeland analysis and management. Kluwer Academic Publishers, Dordrecht.

Mack, R.N., and J.N. Thompson. 1982. Evolution in steppe with few large, hooved mammals. American Naturalist 119:757-773.

Schlatterer, E.F. and E.W. Tisdale. 1969. Effects of litter of *Artemisia*, *Chrysothamnus*, and *Tortula* on germination and growth of three perennial grasses. Ecology 50:869-873.

Tisdale, E.W. 1961. Ecologic changes in the Palouse. Northwest Science 35:134-138.

Weddell, B.J. and J. Lichthardt. 1998. Identification of conservation priorities for and threats to Palouse Grassland and Canyon Grassland remnants in Idaho, Washington, cand Oregon. Idaho Bureau of Land Management, Technical Bulletin No. 98-13.

Youtie, B., J. Ponzetti, D. Salzer, and J. Soll. 1998. Controlling annual exotic grasses on relict grasslands (Oregon). Restoration and Management Notes 16:2.