Technical Note: Field measurement of etiolated growth of rhizomatous grasses

PATRICK E. REECE, JAMES T. NICHOLS, JOE E. BRUMMER, AND RUSSELL K. ENGEL

Abstract

Defoliation effects on grasses have been quantified with measurements of etiolated growth since the 1960's, however, field techniques for measuring etiolated growth of rhizomatous grasses with dispersed tillers have not been reported. Tents constructed with landscape fabric were used in a field study of 2 species of rhizomatous grass. When manufactured, the woven polypropylene fabric is needle punched for air and water permeability. Light that may pass through perforations has no measurable effect on etiolated growth as indicated by a test of single and double layers of fabric. Tents can be sized to shade borders around interior sample areas to prevent translocation from outside tillers to harvested tillers. Landscape fabric tents are light weight and reusable and eliminate breakage, water vapor, and storage problems associated with other covers.

Key Words: initial-spring growth, total-organic-reserve index, Calamovilfa longifolia, Andropogon hallii

Etiolated growth of grasses has been used to quantify the effects of grazing history, grazing date and frequency, fertilizer application, clipping date, stubble height, competitive stress from weeds, and to determine tolerance to herbicides (Peterson 1962, Raese and Decker 1966, Bryan and McMurphy 1968, Matches 1969, Young and Evans 1978, Reece et al. 1988, Reece et al. 1996). Mean tiller weight of etiolated initial spring growth is a valid index of total organic reserves when environmental and physiological limitations do not occur (Busso et al. 1990). However, translocation of assimilates among distant tillers of rhizomatous species may confound measurements (Rogan and Smith 1974). Movement of assimilates from uncovered to covered tillers can be stopped by severing rhizomes around the perimeter of covers or by shading additional area around sample quadrats. Severing rhizomes is labor intensive and also cuts shallow roots. Material and/or labor costs for framed or rigid types of covers increase measurably when the shaded area increases. Our objective was to evaluate the utility and cost of tents constructed of landscape fabric.

Materials and Methods

Studies of etiolated initial-spring growth of prairie sandreed [Calamovilfa longifolia (Hook.) Scribn.] and sand bluestem (Andropogon hallii Hack.) were conducted in the field at the University of Nebraska, Gundmundsen Sandhills Laboratory, near Whitman, Nebraska. Soils were Valentine fine sands (mixed, mesic, Typic Ustipsamments). About 75% of the vegetation con-
sisted of prairie sandreed, sand bluestem, little bluestem (Andropogon scoparius Michx.), and switchgrass (Panicum virgatum L.). The vegetation is described in more detail by Reece et al. (1996).

Landscape fabric, Pro5 Weed Barrier\(^1\) was used to construct tents. This material is an ultra-violet stabilized, woven and needle punched polypropylene fabric which allows air and water movement but is 99.8\% opaque. Nixon (1993) reported an average distance of less than 15 cm between prairie sandreed tillers on the same rhizome. Consequently, 1.0 \( \times \) 1.0 m tents were designed to cover an area about 90 \( \times \) 90 cm. This provided a 20-cm wide shaded border around an interior 0.25 \( \text{m}^2 \) sample area to minimize translocation of assimilates. Tents were suspended with polyvinyl chloride (PVC) frames and anchored with 26-cm long, 4-mm diameter wire landscape staples.

Thirty, 0.25 \( \text{m}^2 \) sample areas with residual stubble of both study species were selected in each of 2 pastures with different grazing histories, rested versus heavy summer grazing during 1988–1989. In each pasture, 10 sample areas were randomly assigned to each cover treatment: (1) uncovered, (2) single layer tent or, (3) double layer tent. Tents were installed in early April before initial-spring growth had begun. Residual stubble of prairie sandreed and sand bluestem was cut to a height of 5 cm on the same day that sample areas were covered. Etiolated growth was examined at 1-week intervals under 6 randomly selected tents. Growth was initially rapid and declined through time. When visual evidence of growth did not occur for 2 weeks, tillers were counted and clipped at ground level from uncovered and covered 0.25 \( \text{m}^2 \) quadrats on 6 June 1990, oven dried at 60°C for 48 hours and weighed to estimate dry matter yield. Data were analyzed with the General Linear Models Procedure (SAS 1982). Means were separated with the least-squares means procedure within SAS (Searle et al. 1980).

Results and Discussion

Etiolated initial-spring growth was not limited physiologically by availability of active meristematic tissue in either species. Uncovered areas produced about 45\% more prairie sandreed tillers and about 55\% more sand bluestem tillers compared to covered areas (Table 1). Similar differences between covered and uncovered plants occurred with blue grama (Bouteloua gracilis (H.B.K.) Lag.) and needleandthread (Stipa comata Trin. & Rupr.) initial-spring growth in western Nebraska (Reece et al. 1988). There were no measurable differences in the effect of single compared to double layers of landscape fabric on mean tiller weight, total herbage, or tiller density of etiolated growth for either species (Table 1).

Organic reserves from all plant parts, including roots, may be used for etiolated growth (Raese and Decker 1966, Ogden and Loomis 1972, Busco 1988). Based on the results of this study, tents used by Reece et al. (1996) consisted of a single layer of landscape fabric with a double folded 5 cm wide hem and grommets at each corner. Tents were stretched evenly over two 2.5 \( \times \) 5.0 \( \times \) 30.0 cm wood stakes, placed at the inside center of a 0.25 \( \text{m}^2 \) frame and driven to a remaining height of 15 cm, by securing the grommeted corners with wire landscape staples (Fig. 1). Additional staples were pushed through the hem to fit each side securely to the soil surface to exclude all light. Wood stakes were less expensive and required less labor compared to PVC frames used in 1990. The fabric was cut, hemmed and grommets installed for about $1.50 per tent at a tent and awning shop. Total labor and material cost per unit was about $5.00.

Table 1. Effect of cover treatment on mean tiller weight, total herbage and tiller density of initial-spring etiolated growth for prairie sandreed and sand bluestem at the Gudmundsen Sandhills Laboratory near Whitman, Nebr.

<table>
<thead>
<tr>
<th>Cover Treatments</th>
<th>Weight/Tiller (mg)</th>
<th>Total Herbage (g m(^{-2}))</th>
<th>Tiller Density (no m(^{-2}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prairie Sandreed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uncovered</td>
<td>131a</td>
<td>12a</td>
<td>89a</td>
</tr>
<tr>
<td>Single Layer</td>
<td>74b</td>
<td>5b</td>
<td>60b</td>
</tr>
<tr>
<td>Double Layer</td>
<td>83b</td>
<td>5b</td>
<td>64ab</td>
</tr>
<tr>
<td>Sand Bluestem</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uncovered</td>
<td>137a</td>
<td>23a</td>
<td>173a</td>
</tr>
<tr>
<td>Single Layer</td>
<td>49b</td>
<td>6b</td>
<td>119b</td>
</tr>
<tr>
<td>Double Layer</td>
<td>54b</td>
<td>5b</td>
<td>106b</td>
</tr>
</tbody>
</table>

\( ^1\)Data for single and double layer treatments are for etiolated growth.

\( ^2\)Within columns and species, means with different lower case letters are significantly different, P≤0.05.

![Fig. 1. Placement of 0.25 \( \text{m}^2 \) frame and wooden stakes for installation of shade tents constructed of a single layer of landscape fabric.](image-url)

---

\(^1\)DeWitt Company, Inc., Hwy 61 South, Sikeston, Mo. 63801.
Literature Cited


