Effect of Water Stress on Yield and Water Use of Corn for Silage Grown in a Semiarid Environment of Wyoming

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Introduction
Corn is the primary source of both silage and biofuel in the U.S. and many parts of the world. Corn-for-silage production faces many challenges in arid and semiarid environments. In these regions, adequate water along with proper irrigation techniques are required to achieve outstanding yields of corn for silage. Corn is very susceptible to limited water during early and late vegetative stages and during early reproductive stages of development. Further, water stress occurring during periods of high temperatures may cause significant reductions in shoot growth, leaf area, and yield depending on the intensity and duration.

Objectives
The objective of the study was to determine the effect of water stress on yield of corn for silage grown under on-surface drip irrigation.

Materials and Methods
A field experiment was conducted at the Powell Research and Extension Center (PREC) during the 2014 and 2015 growing seasons. The study area is characterized by a semiarid climate with an average temperature of 66°F and cumulative precipitation of 3.2 inches during the growing season. The experiment was set in a randomized complete block design with three replications under an on-surface drip-irrigated field. The treatments consisted of four irrigation strategies: 100% crop evapotranspiration (100ETc [full irrigation], which was equivalent to 12 inches of water applied during the growing season), 80ETc, 60ETc, and limited water (full water from planting to the V9 stage of development, no water from V9 to R3, and then full water through the rest of the growing season. V9 is the stage at which the leaf collar of the ninth leaf appears, while R3 corresponds to the milk stage.) Harvested plants were oven-dried at 140°F for 72 hours, and then the dry matter yield was measured. Data were analyzed using the statistical software SAS.

Results and Discussion
Dry matter yield decreased with increased water stress, with no significant difference between 60ETc and limited water treatments (Table 1). The significant yield decrease in the stressed silage corn as compared to the full irrigation treatment could have been due to an insufficient supply of carbohydrates, which limits a plant’s ability to grow and develop ‘normally’. The water stress for a period of 35 days (limited water) was sufficient to cause a 40% reduction in yield (Table 1). The substantial loss in dry matter yield occurred at the late vegetative and early reproductive stages. Farmers may want to avoid water stress during these critical periods for profitable production of corn for silage.

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Table 1. Dry matter yield, water use of corn for silage, and water reduction (%) relative to 100ETc (full irrigation) at PREC in 2014 and 2015. The values are averaged over the two years.

<table>
<thead>
<tr>
<th>Irrigation</th>
<th>Dry matter yield (lb/ac)</th>
<th>% yield reduction</th>
<th>Water use (inches)</th>
<th>% water reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>100ETc</td>
<td>17,397a</td>
<td>0</td>
<td>11.9a</td>
<td>0</td>
</tr>
<tr>
<td>80ETc</td>
<td>14,159b</td>
<td>19</td>
<td>10.0b</td>
<td>16</td>
</tr>
<tr>
<td>60ETc</td>
<td>10,831c</td>
<td>38</td>
<td>8.1c</td>
<td>32</td>
</tr>
<tr>
<td>Limited water</td>
<td>10,447c</td>
<td>40</td>
<td>7.9d</td>
<td>34</td>
</tr>
</tbody>
</table>

Within column, means followed by different letters are significantly different based on the least significant difference (0.05).

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