determination will be necessary in determining the dry weight yield.

The final experiment involved the use of dried, mature grain sorghum. The data, although limited, indicated a semilogarithmic behavior. However, they did not match the data of the wooden rods. Many additional experiments are necessary to determine the effect of moisture and to observe the characteristics of different types of materials. It is hoped that most common pasture materials will yield similar data.

All experimentation and calibration on this device has been suspended pending the construction of a new commercially built model with various modifications and improvements. The recording device will be a portable battery operated scaler with a rechargeable battery. The lowest source and detector will be located as near the ground as possible. The entire device will be capable of disassembly and will be easily transported in a compact storage container.

**BENTGRASS (Agrostis Spp.) VARIETAL TOLERANCE TO ICE COVER INJURY**

James B. Beard

A PREVIOUS study showed that hardened Toronto creeping bentgrass (*A. palustris* Huds.) had a high tolerance to injury from 3 types of ice covers when held in a $-4^\circ$ C. cold chamber for 90 days. Field studies showed no significant kill of Toronto after 51 days coverage under a 2-inch ice sheet. Toronto, the bentgrass variety utilized in these two studies, is known to be adapted to the more northern states. The question of whether other bentgrass varieties are similarly tolerant of extended periods of ice coverage is of concern.

Five creeping bentgrass varieties, 'Toronto' (C-15), 'Cohansey' (C-7), 'Washington' (C-50), 'Penncross', and 'Seaside', plus the 'Astoria' variety of colonial bentgrass (*A. tenella* Sibth.), were included in this experiment. The six varieties had been maintained under irrigated turf conditions at a 3/4-inch cutting height for 2 years. Eight pounds of nitrogen per 1,000 square feet per year had been applied in 4 applications prior to September 5. Soil tests showed the pH, phosphorous, and potassium levels to be adequate.

The grasses were permitted to harden naturally in the field. On December 3, 1963, sod plugs 4 inches in diameter and 2 inches thick were collected and placed in waxcoated cartons of the same diameter. The soil temperature at the time of sampling was near $0^\circ$ C. at the 2-inch depth.

Immediately after sampling, the cartons were flooded and frozen, resulting in an ice layer over the soil between $1/2$ and $3/4$ inch thick. Subsequently, all varieties were held at $-4^\circ$ C. in an unlighted freezing chamber having mechan-

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1 Contribution from the Department of Crop Science, Michigan Agricultural Experiment Station, East Lansing, Paper No. 3350. This work partially supported by a grant from the Michigan Turfgrass Foundation. Received for publication Jan. 28, 1965.

2 Assistant Professor, Department of Crop Science, Michigan State University, East Lansing, Michigan.


4 Beard, J. B. Effects of ice covers in the field on two perennial grasses. Crop Science 3:139-140, 1965.

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**Table 1. Percent survival of 6 field-hardened bentgrass varieties after being flooded, frozen, and held at $-4^\circ$ C. for intervals up to 120 days.**

<table>
<thead>
<tr>
<th>Bentgrass variety</th>
<th>Days under ice cover</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Cohansey</td>
<td>100</td>
</tr>
<tr>
<td>Toronto</td>
<td>100</td>
</tr>
<tr>
<td>Penncross</td>
<td>100</td>
</tr>
<tr>
<td>Washington</td>
<td>100</td>
</tr>
<tr>
<td>Seaside</td>
<td>100</td>
</tr>
<tr>
<td>Astoria</td>
<td>100</td>
</tr>
</tbody>
</table>

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**Figure 1. Survival of Cohansey (left) and Astoria (right) bentgrass varieties after being flooded, frozen, and held at $-4^\circ$ C. for 120 days.**

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The flood and freeze treatment was designed to simulate conditions of a heavy rain with accompanying flooding and immediate freezing. Shown in Table 1 is the survival of the six bentgrass varieties. Cohansey, Toronto, and Penncross creeping bentgrasses survived 100% after 120 days of ice coverage. Washington and Seaside survived completely through 60 days coverage with 95 and 85% survival, respectively, after 120 days. Five percent kill, as rated in these studies, would not be observable under field conditions. Injury to Astoria occurred with ice coverage of 60 days or more. Astoria showed the most injury with 30% survival after 120 days.

This study was conducted for 120 days while the previously reported study was 90 days in duration. No kill of Toronto resulted from the additional 30 days of ice coverage.

Bentgrass varietal variation in tolerance to extended periods of ice coverage is illustrated in Figure 1. The five creeping bentgrass varieties were more tolerant of ice covers than the colonial bentgrass, Astoria. The more homogeneous vegetative bentgrasses, Cohansey and Toronto, tended to tolerate ice covers better than the more heterogeneous seeded bentgrasses. As a group, the bentgrasses were quite tolerant of extended ice coverage.