CARBOHYDRATE RESERVES OF RANGE PLANTS

The knowledge of carbohydrate reserves in plants is very useful in planning seasons of grazing use for allotment management plans. This knowledge is helpful in propagating desirable species and can also be used to help control some less desirable plants.

The attached graphs may help you plan seasons of grazing use to take advantage of the carbohydrate reserve pattern of the plants listed. This information is not intended to replace data gathered locally but might be of some use in the meantime.

More information on the use of this material may be obtained from two publications by the Utah Agricultural Experiment Station - Logan, Utah:

1. Carbohydrate Reserves in Plants, Utah Resources Series 31, June, 1966

Sonchus arvensis
Wash. County, Minn.
Oct. 1932.

S. A. C. Army notes for method of analysis.

Percent carbohydrates in the pots:

- Total sugar
- Acid insoluble sugar
- Acid soluble sugar
- Starch
- Water
- Reducing sugar
Senecio integerrimus
Geranium fremontii
Logan, Utah

Ref. County Dr. Unpublished M.S. Dissertation, Utah State University.
Milligrams of total available carbohydrates in glucose units in plant roots
Agropyron inerme and Stipa Lettermannii
Logan, Utah
Convolvulus arvensis
Hays, Kansas
Ref: Fraizer, J. C., Plant Physiol. 18:167-174 1943

Analyses were made following the methods of Locene's and Shull in determining reducing and total sugars and the Morgan-Walker method for starch-dextrin fractions.

% Carbohydrates on dry-weight basis of the roots

- Total sugars
- Starch and dextrin
- Reducing sugars
-readily available carbohydrates
Water-soluble carbohydrates were determined by cold-water extraction and antirone polar development (Sullivan 1951)
The diagram shows the analysis of carbohydrates in plant foods. Convallaria majalis was used for analysis. The Hunson-Walker method was employed by boiling alcohols. The graph illustrates the percentage of carbohydrates in plant foods, with different lines representing total sugars, starch (including dextrin), and readily available carbohydrates (total sugars and starches). The method used was Collaborative Agr. Expt. Sta., Nat. Agr. Leaflet No. 661 (1944).
Carraria draba
Colorado Expt. Sta.
Water soluble carbohydrates were determined by cold-water extraction and cathode color development (Sullivan, 1951).

<table>
<thead>
<tr>
<th>Species</th>
<th>Date</th>
</tr>
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<tbody>
<tr>
<td>Agropyron nitidum</td>
<td></td>
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<tr>
<td>Agropyron inermis</td>
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<tr>
<td>Bromus, Oregon</td>
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<tr>
<td>Buffalograss, Grassy</td>
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[Graph showing water soluble carbohydrates (% glucose equivalent to oven-dry weight) for different species over a range of 0 to 16% on the y-axis and 0 to 10 on the x-axis.]

Siberian wheatgrass
Bare-dune wheatgrass
Crested wheatgrass
Sibirian wheatgrass
Crested wheatgrass, P-27

<table>
<thead>
<tr>
<th>Test (percent) of roots of grazed and ungrazed plants</th>
</tr>
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<tbody>
<tr>
<td>10</td>
</tr>
<tr>
<td>Grazed mountain brome</td>
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<tr>
<td>Grazed (moderately) glaucescent wheatgrass</td>
</tr>
</tbody>
</table>

Bromus carinatus & Agropyron trachycaulum

Canyon, Utah

Taraxacum kok-saghyz
Kingston, Ontario
% of Carbohydrates reserves in roots
Circium arvense
Wash. County, Minn.

See note from article by A. C. Army for methods of analysis.
Agropyron repens
Fargo, N. Dakota

Agropyron repens
Wash. Co., Minn.

<table>
<thead>
<tr>
<th>% Carbohydrates in the roots</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
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</thead>
<tbody>
<tr>
<td>Bladdcellulose</td>
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<tr>
<td>Dissolved and Soluble Starch</td>
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<tr>
<td>Total Sugar</td>
<td></td>
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<tr>
<td>Reducing sugars</td>
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<tr>
<td>True Starch</td>
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</table>
Method of analysis closely followed the procedures outlined in "Official Methods" (1945). This was a control - no clipping.

| % Carbohydrates in the culm bases and underground portions to 4 inch depth |
|-----------------------------|------------------|------------------|
| Hemicellulose                | Total Available Carbohydrates (sucrose and starch and reducing sugars) |
| Sucrose                     | Starch           | Reducing Sugar   |

<table>
<thead>
<tr>
<th>25</th>
<th>20</th>
<th>15</th>
<th>10</th>
<th>5</th>
<th>0</th>
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</tbody>
</table>

Agropyron Smithii
Fort Hays Kansas
Ref: Kenninger, F. E., M.S. Thesis Fort Hays, Kansas State College, 1953.
Continuation of Agropyron smithii

- Moderately clipped - clipped at 3 week intervals, at 2 inch stubble height

% Carbohydrates in culm bases and underground portions to a 4 inch depth:

- Hemicellulose
- Total available carbohydrates (sucrose and starch and reducing sugars)
- Sucrose
- Starch
- Reducing sugars
Continuation of Agropyron smithii

Heavily clipped - clipped every 2 weeks to a 3 inch stubble height

% Carbohydrates in culm bases and underground portions to a 4 inch depth.

- Echeninocellulose
- Total available carbohydrates (sucrose and starch and reducing sugars)
- Sucrose
- Starch
- Reducing sugar
% Carbohydrates in the culin bases and underground portions to a 4 in. depth.
Continuation of
Andropogon gerardi

Moderately clipped = clipped at 3 week intervals to a
3 inch stubble height.

Graph showing:
- Hemicellulose
- Total available carbohydrates (sucrose and starch and reducing sugars)
- Sugars
- Starch
- Reducing sugar

Carbohydrates in the culm bases and underground portions to a 4 inch depth.
Continuation of Andropogon gerardi

Heavily clipped - clipped every 2 weeks to a 1 inch stubble height.

% Carbohydrates in the main bases and underground portions to a 4 inch depth.

- Hemicellulose
- Total available carbohydrates (sucrose and starch and reducing sugars)
  - Sucrose
  - Starch
  - Reducing sugar
Carbohydrates in the culm bases and underground portions to a 1/2 inch depth.
Continuation of
Bouteloua gracilis and
Buchloe dactyloides

Moderately clipped - clipped at 3 week intervals to a 2 inch stubble height.
% Carbohydrates in the culm bases and underground portions to a 4 inch depth.

Continuation of Table and Contribution of Carbohydrates and Sugars in the Roots

Buchloe dactyloides
Poa pratensis
Columbia, Missouri
Available carbohydrates by Walkman Method

Aristida stricta and Quercus incana
Western Florida

Duf. Woods, F. W. and others, Ecology
No. 292-295 (1954)
Sorghum halepense - Johnsongrass

Stoneville, Mississippi 1959-60

J.R. Poole et al., C. G. Wenda 9(4):
563-568 (1961)

% Carbohydrate content of roots (dry wt.)

Total carbohydrate (Anthrone method)

Glucose (reducing sugars) determined by the modified Somogyi method using Somogyi's copper reagent (and Nelson's chromogen reagent)
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Reference:</td>
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<tr>
<td>&quot;Solidago rigida&quot;</td>
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<tr>
<td>&quot;Vernonia baldwin&quot;</td>
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<tr>
<td>&quot;Verlunia Stricta&quot;</td>
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<tr>
<td>Trochypogon plumosus</td>
<td>Tristachya hinida</td>
<td>Digitaria tricholinae</td>
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<tr>
<td></td>
<td>Johannesburg, S.</td>
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<td></td>
<td>Africa</td>
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</tbody>
</table>

% Composition of roots - expressed as % of combustible dry matter

<table>
<thead>
<tr>
<th>%</th>
<th>Starch</th>
<th>Total</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
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<td></td>
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</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Starch</td>
<td>Total</td>
<td>Other</td>
</tr>
<tr>
<td>0</td>
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</tbody>
</table>

Starch did contain a few long-starch particles.
Total available carbohydrates were extracted by using 2N K₂SO₄. An aliquot was analyzed by the Shafter and Somogyi. Given results carbohydrates as the Wehmann Method.

Radiata native
Eutrema pratense
Lolus corniculatus
Medicago, Wisconsin

Art: Smith, N., Crop Science 1:275-284 (1962)

M. alfalfa
Red clover
Birdsfoot Trefoil

% Carbohydrates in plant roots

Apr 1 May 1 June 1 July 1 Aug 1 Sept 1 Oct 1 Nov 1