SHORT COMMUNICATION

Sodium in the Mineral Nutrition of *Avena sativa*

Various effects of sodium on the uptake of other nutrients, as for example phosphate (Lehr and van Wesemael), have been described in literature but little or nothing is known about its effect on the silica contents of plants. Woolley did not find any relationship between sodium and silica adsorption in tomatoes but the present authors considered it of interest to determine whether any such relationship exists in cereals, since it is known that the presence of silica can help to improve the mechanical strength of straw and that wheat exhibits an increased resistance to lodging on soils temporarily inundated by salt water.

Accordingly an experiment was carried out in which oats, the cereal most responsive to sodium salts, was cultivated in pots with different amounts of sodium and potassium. Analysis of the straw enabled a study of variations not only in the content of silica but in that of other elements, including phosphorus, in the ashes.

*Materials and experimental methods*

Oats of the “28” variety were grown in Mitscherlich pots in two experiments. The first experiments (1959), which was of an exploratory nature, will not be described here. The second and main experiment (1960) involved 6 treatments with 4 replications and was carried out on a sandy soil from the pliocene sediments of the Rome district. Its physical and chemical characteristics were: 83.4% sand, 4.2% silt, 12.4% clay, 13.0% CaCO₃, 0.09% organic C. Exchangeable K₂O and Na₂O were 39 and 23 ppm respectively. The pH was 7.8 and the available P₂O₅ 10 ppm.

Table 1 gives particulars of the mineral nutrients and treatments.

<table>
<thead>
<tr>
<th>Nutrients, ppm</th>
<th>Control</th>
<th>Na₁</th>
<th>Na₂</th>
<th>Na₃</th>
<th>Na₁K₂</th>
<th>Na₂K₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>N as (NH₄)₂SO₄</td>
<td>20</td>
<td>20</td>
<td>30</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>P as Ca₃(PO₄)₂.2H₂O</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Mg as MgSO₄.7H₂O</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>K as K₂SO₄</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>170</td>
<td>370</td>
</tr>
<tr>
<td>Na as Na₂SO₄</td>
<td>0</td>
<td>180</td>
<td>380</td>
<td>580</td>
<td>180</td>
<td>380</td>
</tr>
</tbody>
</table>

Table 1
Sowing took place in the middle of January at the rate of 15 seeds per pot and the seedlings were later thinned to five per pot. Supplementary applications of potassium and sodium attaining 200 and 100 ppm respectively were made during the season to replace losses by leaching.

The plants reached maturity in the first days of July. The straw was dried at room temperature, cut in small pieces and ground. Samples, one from each pot, were ashed at 500°C for six hours and the ash was dissolved in 0.5 N HCl; for some aliquot parts of the filtrate K and Na were determined by weight, and P colorimetrically. For silica determination the straw was oxidised with hot concentrated H₂SO₄, and the ash after evaporation was fused with Na₂CO₃ and dissolved in water. Silica was then determined by Schwartz's method, by reaction with molybdic acid in the presence of oxalic acid. Cellulose was determined by acetic acid and nitric acid, according to Bellucci's method.

Results and discussion

Table 2 gives the weight of straw and its ash and mineral contents at 100°C.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Weight of straw (g/pot)</th>
<th>Ash (g/100 g dry matter)</th>
<th>Na (g/100 g dry matter)</th>
<th>K (g/100 g dry matter)</th>
<th>P (g/100 g dry matter)</th>
<th>SiO₂ (g/100 g dry matter)</th>
<th>Ca (g/100 g dry matter)</th>
<th>Cellulose (g/100 g dry matter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>19.4</td>
<td>3.85</td>
<td>0.39</td>
<td>1.19</td>
<td>0.019</td>
<td>0.100</td>
<td>0.18</td>
<td>41.7</td>
</tr>
<tr>
<td>Na₄</td>
<td>26.2</td>
<td>6.04</td>
<td>1.69</td>
<td>1.08</td>
<td>0.046</td>
<td>0.098</td>
<td>0.12</td>
<td>36.5</td>
</tr>
<tr>
<td>Na₂</td>
<td>23.3</td>
<td>7.09</td>
<td>2.36</td>
<td>0.99</td>
<td>0.050</td>
<td>0.080</td>
<td>0.10</td>
<td>35.0</td>
</tr>
<tr>
<td>Na₃</td>
<td>21.7</td>
<td>7.21</td>
<td>2.29</td>
<td>1.07</td>
<td>0.126</td>
<td>0.063</td>
<td>0.09</td>
<td>34.1</td>
</tr>
<tr>
<td>Na₄K₁</td>
<td>19.9</td>
<td>7.59</td>
<td>1.11</td>
<td>3.13</td>
<td>0.125</td>
<td>0.062</td>
<td>0.10</td>
<td>32.5</td>
</tr>
<tr>
<td>Na₄K₂</td>
<td>19.4</td>
<td>8.19</td>
<td>1.19</td>
<td>3.49</td>
<td>0.129</td>
<td>0.066</td>
<td>0.08</td>
<td>35.6</td>
</tr>
<tr>
<td>LSD (5%)</td>
<td>—</td>
<td>0.70</td>
<td>0.80</td>
<td>0.36</td>
<td>0.013</td>
<td>0.034</td>
<td>0.016</td>
<td>3.5</td>
</tr>
<tr>
<td>LSD (1%)</td>
<td>—</td>
<td>0.97</td>
<td>1.11</td>
<td>0.50</td>
<td>0.018</td>
<td>0.047</td>
<td>0.022</td>
<td>4.9</td>
</tr>
</tbody>
</table>

With sodium alone the ash content of the straw was much higher than in the control, but with sodium and potassium together the difference was much less or disappeared entirely. The potassium content increased considerably – from 1.19 to 3.49 per cent of dry matter – with potassium application, and that of sodium even more so – from 0.39 per cent to 2.36 per cent of dry matter – with sodium application. The application of potassium, along with sodium considerably reduced the adsorption of sodium. The application of sodium alone did not reduce the adsorption of potassium.

Contrary to expectation after observation of the mechanical resistance of straw, the silica content was greatly reduced by the application of sodium, especially in association of potassium; the differences are significant in treatments Na₃, Na₄K₁ and Na₄K₂.

The experiment confirmed the conclusion of the preceding year, that the application of sodium increased the phosphorus content of oat straw. At the lower rates of sodium the phosphorus content rose from 0.019 to 0.046–0.050 per cent, and at the high rate of 580 ppm Na it reached 0.126 per cent.