TABLE I
Oxalic acid content of Pusa Giant Napier grass and its parents

<table>
<thead>
<tr>
<th>Crop</th>
<th>Moisture (%)</th>
<th>Oxalic acid (%)</th>
<th>Water-soluble</th>
<th>Total</th>
<th>Water-soluble oxalate as percent of total oxalic acid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(on moisture-free basis)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Pusa Giant Napier</td>
<td>77</td>
<td>2-38 ± 0-062</td>
<td>3-04 ± 0-0282</td>
<td>76-6</td>
<td></td>
</tr>
<tr>
<td>&quot;Tender&quot;*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Pusa Giant Napier</td>
<td>76-4</td>
<td>2-17 ± 0-040</td>
<td>2-42 ± 0-0919</td>
<td>89-6</td>
<td></td>
</tr>
<tr>
<td>&quot;Medium&quot;†</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Pusa Giant Napier</td>
<td>65-0</td>
<td>0-25 ± 0-0071</td>
<td>1-32 ± 0-0636</td>
<td>18-9</td>
<td></td>
</tr>
<tr>
<td>&quot;Ripe&quot;‡</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Napier grass sample 1</td>
<td>69-0</td>
<td>2-61 ± 0-0258</td>
<td>3-31 ± 0-0636</td>
<td>78-8</td>
<td></td>
</tr>
<tr>
<td>&quot;Medium&quot;*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Napier grass sample 2</td>
<td>71-0</td>
<td>2-44 ± 0-0647</td>
<td>3-57 ± 0-0636</td>
<td>68-3</td>
<td></td>
</tr>
<tr>
<td>&quot;Medium&quot;*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Bajra sample 1</td>
<td>75-5</td>
<td>1-35 ± 0-023</td>
<td>2-295 ± 0-0183</td>
<td>58-8</td>
<td></td>
</tr>
<tr>
<td>&quot;Medium&quot;*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Bajra sample 2</td>
<td>72-3</td>
<td>0-34 ± 0-0087</td>
<td>1-54 ± 0-0282</td>
<td>22-07</td>
<td></td>
</tr>
<tr>
<td>&quot;Medium&quot;*</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

* One month old. † Two months old. ‡ Twelve months old.

(see Talapatra et al.5). On the basis of the results of chemical analysis, it could safely be concluded that the levels of oxalate present in PGN are quite low to produce deleterious effects of any kind on the health of the ingesting animals even when fed large quantities of the grass. The only evidence available, in support of the conclusion drawn, is that no report of abnormality of any kind, caused by ingesting this grass among animals, has so far been reported from any part of the country. However, final confirmation can only be done by carrying out carefully planned animal feeding and metabolic experiments.

The water-soluble fraction both in PGN (medium, tender) and Napier grass samples constitutes over 70% of the total oxalate present. In Bajra, however, it is much lower. Considering the values of total and water-soluble oxalate and the water-soluble fraction as percent of the total oxalate, it appears that the oxalate level in PGN is derived mainly from the Napier grass parent. Such a situation may be expected in view of the fact that the PGN is an allotriploid hybrid involving two genomes from the Napier grass parent and one from the Bajra parent.

The age of the PGN appears to exercise a profound influence on its oxalate status. There is a sharp fall both in the water-soluble and total oxalate content from the tender (one month old) to the ripe (about 12 month) PGN plants so much so that the water-soluble oxalate content of the ripe plants has become quite negligible. It should, thus, be possible to have plants of even lower oxalate content than those of PGN (medium age) depending on their age.

These and other investigations are now in progress.

The authors are grateful to Dr. M. S. Swamianathan, Head of the Division of Botany of this Institute, for his keen interest and encouragement and to Shri K. C. Sikka, Assistant Biochemist, and (Miss) S. Singh, Senior Research Assistant, Botany Division, for technical assistance during the course of these investigations.


SODIUM CHLORIDE TOLERANCE BY AZOTOBACTER CHROOCOCUM

Azotobacter has been known to be resistant to the action of high concentration of salts. As early as 1907, Keutner observed that marine Azotobacter could grow and fix nitrogen in 8% sodium chloride solution. Such reports on salt tolerance by Azotobacter are not wanting in literature.12-13 Inhibitory effects of salinity on nitrogen fixation by Azotobacter have been found by a few workers.4-9,11 However, we are not aware of the critical levels of a typical salt such as sodium chloride on
nitrogen-fixing ability of the bacterium. With this objective, the effect of increasing concentration of sodium chloride on nitrogen fixation by four strains of Azotobacter chroococcum was studied and the results are reported hereunder.

Jensen's liquid medium was used as substrate for growing the organism and the 0.05% sodium chloride contained in it was taken as the control. Twenty-five ml. aliquots of the sterilized medium in triplicate were inoculated separately with four strains of A. chroococcum from Delhi, Samalkot, Cuttack and U.S.S.R. The concentrations of NaCl tried were 0.05% (control), 0.10%, 0.20%, 0.30%, 0.50%, 0.80%, 1.00%, 1.50%, 2.00%, 2.50%, 3.00% and 5.00%. The cultures were incubated at 32°C for 14 days at the end of which nitrogen was estimated by micro-Kjeldahl method. It was evident from the results (Table I) that there was gradual decrease in the amount of nitrogen fixed by all the strains as the concentration of sodium chloride increased; significant decrease in nitrogen fixation occurred at 0.8% NaCl in Cuttack strain, at 0.5% in Samalkot strain, at 0.2% of the salt in Delhi and U.S.S.R. strains. However, maximum limit of tolerance to the salt varied with the strains, the Delhi and Samalkot strains tolerated up to 3.0% sodium chloride while the U.S.S.R. and Cuttack ones did so up to 2.50%. In the control series, where 0.05% of sodium chloride was present in the substrate, the Cuttack strain of A. chroococcum fixed maximum amount of nitrogen. However, a 50% fall in the nitrogen-fixing activities of different strains occurred at varying doses of the salt depending on the strain used. In the Delhi strain, the 50% fall in the amount of nitrogen fixed took place at 1.5% level of sodium chloride, while such a decrease occurred at 1.0% in U.S.S.R. strain, at 2.5% in Samalkot strain and at 2.0% in the Cuttack strain. These results appear important in selecting strains for use in saline soils of India for maximising nitrogen content of soils through non-symbiotic nitrogen fixation. The concentration of salts in Indian soils sometime goes up to 1.5%. From the laboratory results obtained on salt tolerance by A. chroococcum, it is obvious that the Samalkot and Cuttack strains have possible potentialities for introduction into our saline soils since the strains retain a capacity to fix 60-80% of nitrogen even under 1.5% concentration of sodium chloride.

The authors are grateful to Mr. A. G. Kavitkar for help in the statistical analysis of the data.

Division of Microbiology, V. ISWARAN.
Indian Agricultural Research Institute, W. V. B. SUNDARA RAO.
New Delhi, October 15, 1965.

Table I
Nitrogen fixation by A. chroococcum in relation to increasing concentrations of NaCl (Average of three replicates in mg/g. sucrose oxidised)

<table>
<thead>
<tr>
<th>% NaCl</th>
<th>Delhi strain</th>
<th>U.S.S.R. strain</th>
<th>Samalkot strain</th>
<th>Cuttack strain</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-05</td>
<td>11-39</td>
<td>14-15</td>
<td>18-61</td>
<td>17-36</td>
</tr>
<tr>
<td>0-10</td>
<td>12-13</td>
<td>14-00</td>
<td>16-24</td>
<td>17-28</td>
</tr>
<tr>
<td>0-20</td>
<td>8-52</td>
<td>11-22</td>
<td>15-96</td>
<td>16-05</td>
</tr>
<tr>
<td>0-30</td>
<td>7-28</td>
<td>7-13</td>
<td>16-05</td>
<td>15-68</td>
</tr>
<tr>
<td>0-50</td>
<td>7-28</td>
<td>7-28</td>
<td>14-00</td>
<td>14-52</td>
</tr>
<tr>
<td>0-80</td>
<td>6-85</td>
<td>6-57</td>
<td>14-00</td>
<td>13-81</td>
</tr>
<tr>
<td>1-00</td>
<td>6-35</td>
<td>7-06</td>
<td>14-19</td>
<td>11-94</td>
</tr>
<tr>
<td>1-50</td>
<td>5-79</td>
<td>6-91</td>
<td>13-65</td>
<td>11-76</td>
</tr>
<tr>
<td>2-00</td>
<td>5-00</td>
<td>5-23</td>
<td>11-57</td>
<td>8-96</td>
</tr>
<tr>
<td>2-50</td>
<td>5-00</td>
<td>5-24</td>
<td>8-06</td>
<td>5-23</td>
</tr>
<tr>
<td>3-00</td>
<td>5-23</td>
<td>Nil</td>
<td>5-23</td>
<td>Nil</td>
</tr>
<tr>
<td>5-00</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>C.D at 1%</td>
<td>C.D at 1%</td>
<td>C.D at 1%</td>
<td>C.D at 1%</td>
<td>C.D at 1%</td>
</tr>
<tr>
<td>1-16</td>
<td>0-85</td>
<td>1-35</td>
<td>3-06</td>
<td></td>
</tr>
</tbody>
</table>

5. — and Jones, L. W., Ibid., 1941, 52, 359.

GREEN GARNET FROM THE BANDITE SERIES, BANDIHALLI, TUMKUR DISTRICT, MYSORE STATE

The garnet (uvarovite)-diopside-granulite occurring near the village Bandihalli (Lat. 12° 47'; Long. 77° 1'), Tumkur District, Mysore State, was given the name Bandite and the suite of metamorphic rocks associated with this granulite, the Bandite series, by Jayaram (1926). The green garnet found in the Bandite was identified as uvarovite by Jayaram, probably on account of its emerald green colour. Though no detailed mineralogical work has been done on this garnet, to confirm Jayaram's identification, in all subsequent literature on these rocks, the green...