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**EFFECT OF SULPHUR ON BACTERIAL NODULATION OF GROUNDNUT ROOTS**

The fixation of elemental nitrogen by the symbiotic nodule bacteria needs no emphasis. It has long been recognized that certain crops such as clovers, alfalfa, peas and other legumes improve the soil in some way, making it possible to get higher yields of cereals after these crops. Lyon and Bizzell in a ten-year experiment at Ithaka, New York, found that the amounts of nitrogen fixed in pounds per acre per year were 251, 168 and 105 by nodule bacteria of alfalfa, sweet clover and soyabean, respectively.

The nodulation in legumes was stimulated by fertilizing the soil with sulphur and its compounds as was observed by several workers. Tacheuchi reported that higher dose of sulphur and its compounds gave a decreasing effect upon the number of nodules.

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**Groundnut plants (Arachis hypogaea L.)**

T, 32 were raised in washed silica sand in pots. The plants were supplied with complete nutrient solution, the formula for nutrient solution is given in Table I (Tisdale et al.) and distilled water for irrigation. All the pots received 5 ppm iron tartarate, 2 ppm manganese chloride, 3 ppm boric acid and 1-4 ppm molybdic acid. pH of the final solution was adjusted to 6-5 by adding N/10 NaOH. Nutrient solution was added at the rate of 250 c.c. per pot on alternate days. At periodical intervals, the whole plant was pulled off with the help of distilled water running through rubber tube in the root zone, taking precautions not to injure the root nodules. The nodules were then separated and counted.

**TABLE I**

Composition of nutrient solution and compound of sulphur used

<table>
<thead>
<tr>
<th>Doses</th>
<th>Gm. of salt per litre of water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treat.</td>
<td>S ppm</td>
</tr>
<tr>
<td>0.515</td>
<td>0 0.505</td>
</tr>
<tr>
<td>0.515</td>
<td>3 0.505</td>
</tr>
<tr>
<td>0.515</td>
<td>9 0.505</td>
</tr>
<tr>
<td>0.515</td>
<td>27 0.505</td>
</tr>
<tr>
<td>0.515</td>
<td>81 0.505</td>
</tr>
</tbody>
</table>

An observation of the data in Table II reveals that number of nodules per plant at the time of harvest increased from 9-3 to 121-3 with the enhancement of sulphur concentration from 0 to 9 ppm in the nutrient solution. Further increase in sulphur concentration up to 81 ppm showed a corresponding decrease in the number of nodules per plant. The treatments showed significant difference and treatments S3 and S4 were of equal effect.

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**TABLE II**

Effect of sulphur concentrations on the number of nodules per plant of groundnut

<table>
<thead>
<tr>
<th>S. Treatment</th>
<th>Doses of S ppm</th>
<th>Age of crop in days</th>
<th>Mean</th>
<th>Index</th>
<th>Weight of root at 150 days per plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>S0</td>
<td>0</td>
<td>20</td>
<td>1-8</td>
<td>3-3</td>
<td>4-7</td>
</tr>
<tr>
<td>S1</td>
<td>3</td>
<td>0</td>
<td>5-0</td>
<td>26-0</td>
<td>29-3</td>
</tr>
<tr>
<td>S2</td>
<td>9</td>
<td>0</td>
<td>5-0</td>
<td>26-0</td>
<td>29-3</td>
</tr>
<tr>
<td>S3</td>
<td>27</td>
<td>0</td>
<td>5-0</td>
<td>26-0</td>
<td>29-3</td>
</tr>
<tr>
<td>S4</td>
<td>81</td>
<td>0</td>
<td>5-0</td>
<td>26-0</td>
<td>29-3</td>
</tr>
</tbody>
</table>

Mean 2.4 12.8 34.8 45.3 55.6 67.7 74.0 0.867
C.D. 2.4 12.8 34.8 45.3 55.6 67.7 74.0 18.60 0.867
The reduction in nodulation due to sulphur deficiency corroborates with the findings of Gaw and Soong,7 Ivanoff8 and Bledsoe and Harris.6 This decrease may be attributed to the deficiency of sulphur, which is a nutrient element, and restricted supply of sulphur-containing plant proteins which are essential for the multiplication and growth of symbiotic bacteria. The decrease in root size may be a factor for the reduction in nodulation, but the effect of deficiency appears to be more marked on nodulation as compared to size (weight) of roots.

The decrease in number of nodules in treatments with 27 and 81 ppm of S may be due to inhibitory effect of sulphate at higher concentrations. A similar effect was also observed by Tacheki.9

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SEXUAL DIMORPHISM IN THE GAR FISH, XENENTODON CANCILA

Day1 describing Belone cancila (Xenentodon cancila) states, “There is a variety at Hardwar and in Central Provinces, having a hump along the first part of its back, sometimes continued as an elevated ridge as far as the origin of the dorsal fin”. In the present study, several hundred specimens were examined from the collections made at Bhopal, Jabalpur, Shivrampuri, Gwalior, Dehradun, Muzaffarnagar, Allahabad and the local lakes (Ramgarh and Mahesra) and the rivers (Rapti and Rohin). A good percentage of them was with humped back (Fig. 1) as mentioned above. The hump is darker in colour than the adjoining body

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