Results and Discussion

The complexes are yellow in colour soluble in DMF and DMSO and have 1:1 stoichiometry. Conductivity measurement indicates that the complexes are non-electrolytes.

Infrared spectra.—The medium intensity broad ligand band at 3250 cm\(^{-1}\) assignable to the intramolecular hydrogen bonded OH, existing between OH and OCH\(_3\) group, is retained in the complexes also. This non-shifting of the OH band indicates the non-involvement of OH in the complex formation. Another support for this conclusion is sought in the stretching frequency due to phenolic CO. The strong band at 1290 cm\(^{-1}\) due to phenolic ν CO vibration is retained in the complexes without an alteration. Involvement of OH group in the complex formation should have shifted the ν CO to the higher frequency. The strong ligand band at 1629 cm\(^{-1}\) due to ν C≡N\(^4\) appears at 1650 cm\(^{-1}\), 1635 cm\(^{-1}\) and 1608 cm\(^{-1}\) respectively in Zn (II), Cd (II) and Hg (II) complexes. This shift may be due to the coordination through the nitrogen atom of the azomethine group. The asymmetric ν COC vibration of the ligand at 1300 cm\(^{-1}\) remains inert to the complex formation, indicating non-involvement of OCH\(_3\) group of the ligand in the coordination to the metal.

The involvement of both OH and OCH\(_3\) groups in the bond formation would have impelled on the ligand quadridentate behavior of the type observed in the bis-(salicylidene) benzidide but our spectral observations show only the involvement of C≡N groups in the coordinate bond formation, hence the bidentate behavior. In the 500 cm\(^{-1}\) to 400 cm\(^{-1}\) region, the medium to strong intensity bands, which are not present in the ligand, are assigned to the ν (M–N) vibrations in view of the previous assignments.

All these spectral observations, taken together with the analytical and conductance data, suggest that in all these complexes, the metal ions exhibit coordination number four and ligand shows bidentate behavior, coordinating through only C≡N groups.

Thanks are due to Shri K. Subramanya, Department of C.I.S.L., Indian Institute of Science, Bangalore, for the i.r. spectra.


**EFFECT OF RHIZOBIUM, AZOTOBACTER AND BEIJERINKIA INOCULATION ON CICER ARIETINUM VAR. TYPE-I**

Formation of nodules on the legume and the degree of nodulation are dependent on the strain of *Rhizobium* species. Therefore, a field investigation was undertaken to assess the efficiency of two strains of *Rhizobium* sps. of *Cicer arietinum*, *Azotobacter chroococcum* and *Beijerinkia indica* strains were also included in the study.

**Material and Methods**

A field experiment (randomized block design) with 9 treatments (Table I) replicated four times

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**Table I**

*Showing average weight of nodules, grain yield and seed protein of Bengal gram from a field experiment*

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Wt. of dried nodule (g/ha)</th>
<th>Grain yield (kg/ha)</th>
<th>Seed protein (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>77</td>
<td>16·35</td>
<td>21·00</td>
</tr>
<tr>
<td><em>Rh.</em> sps. H(_{45})</td>
<td>146(^*)</td>
<td>20·19</td>
<td>21·70</td>
</tr>
<tr>
<td><em>Rh.</em> sps. H(_{44})</td>
<td>78</td>
<td>17·52</td>
<td>20·72</td>
</tr>
<tr>
<td><em>Beij. indica</em> J(_3)</td>
<td>103</td>
<td>15·98</td>
<td>21·35</td>
</tr>
<tr>
<td><em>A. chroococcum</em> B(_4)</td>
<td>77</td>
<td>17·33</td>
<td>21·17</td>
</tr>
<tr>
<td><em>Rh.</em> sps. H(_{44}) + <em>Beij. indica</em> J(_3)</td>
<td>84</td>
<td>15·18</td>
<td>20·65</td>
</tr>
<tr>
<td><em>Rh.</em> sps. H(_{44}) + <em>A. chroococcum</em> B(_4)</td>
<td>203(^*)</td>
<td>23·74(^*)</td>
<td>21·87</td>
</tr>
<tr>
<td><em>Rh.</em> sps. H(_{45}) + <em>Beij. indica</em> J(_3)</td>
<td>106</td>
<td>20·89</td>
<td>21·17</td>
</tr>
<tr>
<td><em>Rh.</em> sps. H(_{45}) + <em>A. chroococcum</em> B(_4)</td>
<td>80</td>
<td>15·12</td>
<td>21·17</td>
</tr>
<tr>
<td>CD</td>
<td>66</td>
<td>5·19</td>
<td>NS</td>
</tr>
</tbody>
</table>

---

was carried out in the alluvial soil of Agricultural Farm of Banaras Hindu University. The soil pH
and organic matter content were 7.5 and 0.36% respectively. The plot size was 5 x 2 sq. m. The field was basal dressed with urea and superphosphate @ 20 kg N and 21.8 kg P/ha respectively.

Azotobacter chroococcum B₄ was isolated from B.H.U. farm soil. Strains H₄₄ and H₄₅ of gram Rhizobium and I₃ of Beijerinckia indica were obtained from I.M.A.U. culture collection, Jabalpur. Rhizobium was grown on yeast extract mannitol agar medium slants. Azotobacter and Beijerinckia were grown on Burk's medium. After an incubation period of 10 days the bacterial growth from a slant was dislodged into 100 ml sterile water for single culture treatment, but for mixed culture treatment, bacterial growth of Rhizobium and Azotobacter, or Rhizobium and Beijerinckia from two different slants was transferred to the same amount of liquid.

For seed treatment, 2 ml culture suspension and 5 ml sticker solution (2.5% sugar + 1% gum acacia) were added to 40 g seeds in a beaker and thoroughly shaken. Bacterial treatment was done just before sowing and seeds of gram (Cicer arietinum) var. type-1 were sown @ 40 kg/ha. After 73 days of sowing, the plants were uprooted for nodule study. At harvest the grain yield was recorded and subsequently crude protein of seeds was determined.

Results and Discussion

Data on grain yield, nodule weight, and per cent crude protein of seeds are given in Table I. Gram Rhizobium H₄₄ caused significant increase in the nodular mass, and an increase of 23% in the grain yield which was statistically insignificant. But the same strain along with A. chroococcum B₄ increased the nodule weight as well as grain yield significantly over the uninoculated control. The grain yield was increased by 45%. The protein content of the seeds was not affected by bacterial inoculation.

A. chroococcum B₄ being an isolate from the same locality might have established itself when used as seed inoculant in comparison to the Beij. indica I₃ which was an isolate from medium black soil of Jabalpur (Sanoria, unpublished work). The beneficial effect of Azotobacter to Rhizobium and the plant might be attributed to the synthesis of growth promoting substances (Jones and Greaves, 1943; Gebhardt and Kovalchuk, 1958). Moreover growth substance like β-indole acetic acid, possibly concerned in the nodulation process (Alexander, 1961) has been reported to be synthesized by Azotobacter (Smaly, 1954; Vancura and Macura, 1960). No information is available regarding the production of growth substances by Beijerinckia. Possibly Beijerinckia which produces abundant slime, excretes little of the growth substances. Both the strains H₄₄ and H₄₅ were reported to be effective under the medium black soil of Jabalpur (Sanoria and Dube, 1972) but in the Indo-gangetic alluvial soil of Varanasi only H₄₄ is found to be effective. Local strain B₄ is found to exert synergistic effect on H₄₄.

We are grateful to Dr. Sant Singh, the Head of the Department, for providing the necessary facilities.

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Agricultural Chemistry, C. L. Sanoria.
Banaras Hindu University.
Varanasi, July 26, 1975.


RHYTHMIC VARIATIONS IN THE PHOSPHORYLASE ACTIVITY IN THE SCORPION HETEROMETRUS FULVIPES (Koch)

Diurnal rhythms in various activities like locomotion, poison secretion, nervous secretion, rate of heart beat, cholinesterase activity in the heart muscle, spontaneous electrical activity in the ventral nerve cord and segmental nerves, have been reported to occur in the scorpion Heterometrus fulvipes. Similar rhythms have also been shown to occur in the levels of metabolites like blood glucose and hepatopancreatic glycogen in the same species. Carbohydrate distribution and synthesis were studied in different tissues of scorpion. The present report concerns the study of phosphorylase activity in the pedipalpal muscle and hepatopancreas of the scorpion H. fulvipes as a function of time of the day. The pattern of activity of this enzyme which plays a vital role in glycogen breakdown should reveal the pattern of utilization of carbohydrate energy sources for various activities during the course of a 24 h period.

The details of collection, maintenance of scorpions and sampling of tissues were described earlier. The activities of phosphorylase 'a' (active) and 'ab' (total) have been estimated in the absence and