Table 1. Nodulation, nitrogen content and yield of chickpea as influenced by rhizobia.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Pusa 261 nodule</th>
<th>Nodule</th>
<th>Pusa 256 yield (g/pot)</th>
<th>N content (mg/pot)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Fresh wt (mg/plant)</td>
<td>Number</td>
<td>Fresh wt.</td>
</tr>
<tr>
<td>No-inoculation</td>
<td>12</td>
<td>293</td>
<td>22</td>
<td>338</td>
</tr>
<tr>
<td>Cicer-Rhizobium</td>
<td>10</td>
<td>222</td>
<td>43</td>
<td>503</td>
</tr>
<tr>
<td>B. japonicum</td>
<td>5</td>
<td>37</td>
<td>31</td>
<td>532</td>
</tr>
<tr>
<td>R. leguminosarum</td>
<td>16</td>
<td>296</td>
<td>22</td>
<td>406</td>
</tr>
<tr>
<td>Green gram-Rhizobium</td>
<td>13</td>
<td>164</td>
<td>19</td>
<td>307</td>
</tr>
<tr>
<td>C.D. 0.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CV%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average of three replicates. *Average number of nodules per plant.

Table 2. Biomass production in soybean isolines.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Grain (g/pot)</th>
<th>Shoot</th>
<th>Root</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 kg N ha⁻¹</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-nod, uninoculated</td>
<td>2.1</td>
<td>15.6</td>
<td>5.6</td>
</tr>
<tr>
<td>Non-nod, inoculated</td>
<td>4.1</td>
<td>13.8</td>
<td>5.5</td>
</tr>
<tr>
<td>20 kg N ha⁻¹</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-nod, uninoculated</td>
<td>3.1</td>
<td>27.0</td>
<td>6.6</td>
</tr>
<tr>
<td>Non-nod, inoculated</td>
<td>4.8</td>
<td>19.7</td>
<td>4.8</td>
</tr>
</tbody>
</table>

Average of three replicates.

A strain of *Bradyrhizobium japonicum* unable to invade and produce nodules on the non-nod type of soybean was found to influence plant growth. Reduction in shoot and root weight in nodulating isolate may be ascribed to competition between host and *Rhizobium* for photosynthates.

Symbiotic association between legumes and *Rhizobium* implies invasion, nodule formation and fixation of atmospheric N, however the role played by the latter in absence of nodules, in providing N and enhancing yield of plants, is not fully understood. Competition and synergistic effects amongst strains in mixed cultures of rhizobia, *Rhizobium* and *Azotobacter/Azospirillum* have been observed.

Instances of successes and failures of inoculation with strains of *Rhizobium* occupying between 30 and 75% of nodules have been reported. Decrease in ¹⁵N content of plants—an indicator of possible N₂ fixation in Clark-63, a non-nodulating isolate of soybean inoculated with strain SB 113 of *B. japonicum* was observed (Raverkar, personal communication).

In general, most of the native soil rhizobia are ineffective and are known to compete with inoculated strain causing delay and/or reduction in nodulation. Beneficial effects of seed inoculation with different rhizobia to wheat, where no nodules are formed, have also been observed even under field conditions.

Favourable effects of heterologous rhizobia on yield of chickpea and, that of homologous *B. japonicum* on non-nodulating soybean observed in these experiments, thus point out possibility of beneficial effects of rhizobia on leguminous plants in absence of nodulation.


31 July 1989

**Cytoplastic polyhedrosis virus infecting redpalm weevil of coconut**

P. B. Gopinadhan, N. Mohandas and K. P. Vasudevan Nair
Department of Entomology, College of Agriculture, Vellayani 695 522 India

A highly potent cytoplastic polyhedrosis virus (CPV) has been detected for the first time in Kerala in stages of the redpalm weevil, *Rhynchophorus ferrugineus* F., which infests coconut. It infects all the life stages of the pest, including the adult. Infection in the late grubs stage resulted in malformed adults and suppressed the insect population drastically. The midgut of infected insects was enlarged and filled with thousands of polyhedral inclusion bodies (PIBs) visible under a light microscope. Electron microscopic studies revealed characteristics surface projections of viral bodies characteristic of CPV.

**INVESTIGATION ON a disease prevalent among the life stages**
of the red palm weevil, *Rhynocophorus ferrugineus* F. in Trivandrum district (Kerala), led to the detection of a cytoplasmic polyhedrosis virus (CPV).

The diseased grubs collected from the field were much smaller and yellowish in appearance compared to the white translucent healthy ones. In early stages of the disease the grubs showed retarded development, less movement and feeding. In due course the head of the infected grubs became enlarged and a marked constriction appeared at the anterior abdominal region. The hindgut was getting completely extroverted and the grubs became moribund. The cadaver was shrunken, leathery and yellow in appearance. The integument was remarkably tough and shiny (Figure 1, a–h).

The last instar grubs inoculated in laboratory resulted in the emergence of deformed adults which died in 10 to 15 days while the normal adults had a life span of 60 to 118 days. Microscopic examination of the body fluid of such adults revealed thousands of polyhedral inclusion bodies (PIBs). The infected adults laid very limited number of viable eggs, and the young grubs emerging from those eggs succumbed to disease and died within a day or two. Nelson’s made similar observations in CPV-infected lepidopterans.

On dissection of the diseased specimen the midgut region was seen opaque enlarged and milky white in colour and the tissues at the two ends were weakened. The midgut breaks off at the weakened portion even by very slight touch. Wilson and Ramsoka also found such a phenomenon in variegated cutworms infected by CPV. Smears of the

---

*Figure 1. CPV-infected *R. ferrugineus*. a–c (× 2), Leathery extrverted grubs; d, e (× 1), healthy grubs; f, g (× 1.5), diseased pupae, crickled, malformed wings; h (× 2), healthy pupa.*
midgut content showed thousands of PIBs under light microscope. The PIBs were varied in size and took Giemsa stain. Under the electron microscope, the PIBs had a hexagonal and pitted appearance and the virions were seen located near the surface. The virus particles were spherical and possessed surface projections typical of other cytoplasmic polyhedrosis virus (Figure 2, a–f). Similar characters of PIBs and virions were recorded from CPV-infected Spodoptera frugiperda and Anoplonyx destructor.

Pathogenicity tests of the CPV isolated from the diseased grubs on second stage grubs of the host was carried out by
feeding fresh slices of coconut petiole dipped in semipurified PIIBs suspension. The treated grubs were reared individually in widemouthed glass bottles provided with untreated petioles. The behaviour of the infected grubs and the development of disease symptoms in the laboratory were similar to those observed in field. The mortality commenced from the fourth day, (with 100% mortality in 10 days) while the grubs in control emerged as adults. This is the first investigation report on a viral disease (CPV) of red palm weevil recorded.


ACKNOWLEDGEMENTS. We thank Dr R. V. Rammoohan and Dr Lakshmanarayanan, Department of Physics, GKV, UAS, Bangalore and Dr Y. Rammoohan and Smt Hemavathy, Electron Microscopic Laboratory, NIMHANS, Bangalore for their help in obtaining electron micrographs of PIIBs and cross-sections of PIIBs with viroids.

15 April 1989

BOOK REVIEWS


Vegetable drugs play a dominant role in Ayurveda and there exist numerous folk traditions of local health care in tribal as well as other rural areas. Many of these local traditional herbal remedies need to be revitalized and evaluated in the light of indigenous health sciences like Ayurveda, Siddha and Unani in order to achieve the national goal of 'Health for all by 2000 AD'.

The present publication is the outcome of two surveys conducted during 1975-80 and aims at fulfilling such an objective. The book provides an account of the herbal potential of the chain of islands, along with relevant information on the local tribes, their socio-hygienic aspects, general vegetation, and as many as 42 herbal remedies following ethnobotanical studies. Of the 306 plant species collected from the islands 223 species are reported to have medicinal properties and 141 species are found to be useful in the Ayurvedic system of medicine. The book also provides useful information on 80 Ayurvedic drugs selected out of the actual collections made by the authors and another 29 on the basis of earlier reports. The information includes the accepted botanical source, Andaman and Nicobar source, therapeutic properties, important Ayurvedic preparations, and the major diseases in which the preparations can be used. Twenty black-and-white colour photographs of medicinal plants and tribal are provided, the production of which could have been better. Botanical names in the enumeration of Ayurvedic drugs should have been in italics or bold face. Illustrations of important medicinal plants would have added to the utility of the book. Considering the enormous biodiversity and medico-botanical potential of the islands, the study could have been much more exhaustive. Although the production and get-up of the book is satisfactory, the size and price of the book may not be liked by all users.

On the whole, the book is a successful venture, useful to workers in the field of Ayurveda and various allied disciplines on the one hand and ethnomedicinals on the other.

R. RAGHAVENDRA RAO
Botanical Survey of India
Dehra Dun.


This is a comprehensive book dealing with sampling and analytical techniques for a wide array of water, soil and air environments. It is a useful manual for individuals and laboratories engaged in the field of environmental investigations, including those concerned with ecology, pollution, agriculture, fisheries, water supply, sanitation, and health and hygiene. The book also contains at the end appendices containing equivalents, conversion factors, national standards, etc.

The book will prove to be still more useful if a list of suppliers, with addresses, of instruments mentioned in the book is also included in the appendix. Also it is necessary to include simple methods, where available, instead of those involving expensive instruments. For instance, on page 108, bacterial colonies are recommended to be counted by a Quebec colony counter. For those who cannot afford this counter, manual counting is an acceptable procedure.

The only criticism I have of the book is its high cost which would discourage individuals from purchasing it.

T. RAMAKRISHNAN
Indian Institute of Science
Bangalore 560 012