elevation in free amino acids has a functional relevance to meet the energy demands[8] and is also involved in the osmotic balance[9]. AAT and A1AT aminotransferase activities of gill tissue increased significantly indicating the occurrence of greater energy demands under toxic stress. The decrease in the ammonia content in the gill suggests the excretion of ammonia from this tissue by way of diffusion or its possible utilization for amino acid synthesis via glutamine as evident from increased levels of glutamine. The decreased levels of ammonia with increased urea content suggest the stepped-up conversion of toxic ammonia to less toxic urea. Hypoproteinemia and other indicators of toxic stress revealed in this study have been earlier reported with other pesticides[10,11].

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IMPACT OF THE PRESENCE OF PARASITES ON THE POPULATION OF RESIDENT ENDOSYMBIOTES IN BROWN PLANTHOPPER, *NILAPARVATA LUGENS* STAL. (DELPHACIDAE: HOMOPTERA)

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Brown planthopper (BPH), *Nilaparvata lugens* (Stal.) was found to be parasitized by several parasites at various stages of its development. Some of the parasites frequently observed were an egg parasitoid, *Anagrus optabilis*, Perkins (Mymaridae)[1], a Dryinid, *Haplogonatopus? orientalis*[2] and a mite belonging to the family Trombidiidae occurring on nymphs and adults[3] and finally an unclassified Elenchid (unpublished observation by the authors) occurring as an internal parasite in BPH.

Generally the presence of a parasite would make the host weak, disrupt the normal functioning of the reproductive system and death in extreme cases. In BPH the presence of yeast-like symbiote at adequate number is an important aspect in fulfilling the nutritional requirements of the host insect as seen in the cases of other rice planthoppers[4].

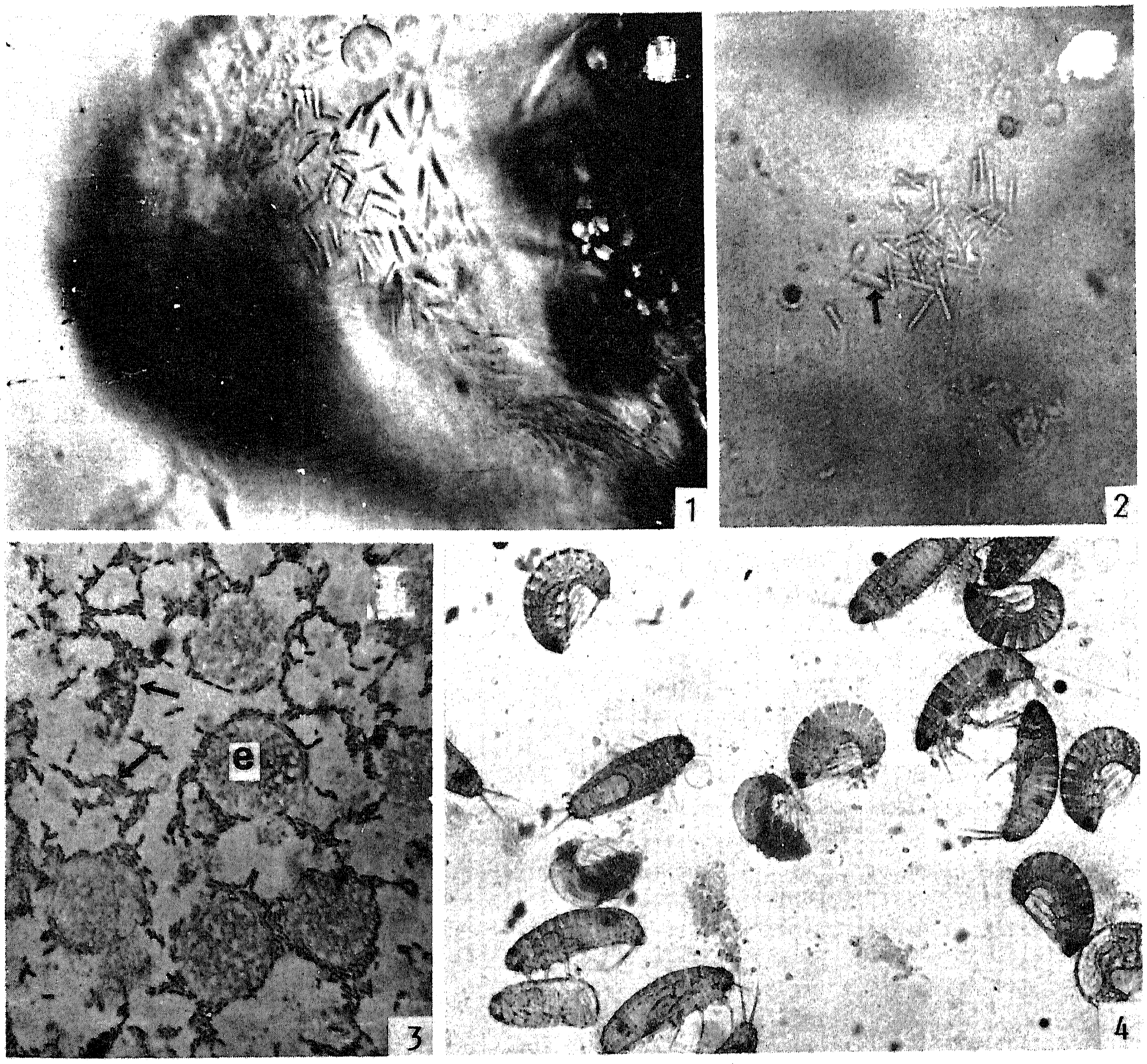
This paper attempts to study the effect of such presence of parasites on the population of symbiote in BPH.

The parasitized eggs, nymphs and adults of BPH were collected from the insectary and rice fields. In eggs parasitized by *A. optabilis*, the number of symbiote was counted in the individual egg. Comparison was made with healthy eggs of BPH following the method described earlier[5]. The different stages of the mymarid were recognized based on available descriptions[6].

In the nymphs and adults parasitized by the dryinid, mite and elenchid the symbiote number was counted after separating the parasite from the host. As the availability of parasitized host was inadequate, the method described by Noda[7] for counting symbiote was slightly modified. Individual insects were squashed in 1 ml of 0.8% saline without preweighing and counts made in all the 9 large squares of the improved Neubauer double ruling haemocytometer chamber of 9 mm^2 area for increasing the accuracy. Comparison of this method with Noda's procedure suggested a negligible difference in symbiote number.

In the case of BPH eggs parasitized by the mymarid, the number of symbiote decreased with the growth of the parasite. When the parasitoid larva was in late first instar, early and late second instars the number of symbiote was 496.7, 643.8 and 23.6 per egg respectively. But a normal one-day-old egg recorded 463.7 symbiotes while a developed embryo about to hatch recorded 1865.6 per egg. In the later stages of infection several rod-like structures about 18–20 μm length were seen floating in the egg fluid (figures 1 and 2). Their number was about 638.7 per egg. However, during the late pupal stages of the parasitoid these structures disappeared. Similar structures were present in mymarid-infected eggs of another delphacid, *Sogatella furcifera* (Horvath) (unpublished observation). The nature of these structures is not known. These could be some metabolic product for utilization by the parasite.

When the second instar larva of mymarid, which actually feeds on yolk spheres, became active a considerable reduction in symbiote population was observed. However, the alimentary tract of the second instar mymarid showed a few symbiotes inside. So the parasitoid, in all probability, may not be consuming the symbiotes as such.



Figures 1–4. 1. Rod-like structures visible through the chorion of BPH egg parasitized by *A. optabilis* (×500); **2.** A normal yeast-like symbiote (indicated by arrow) seen among rod-like structures (×500); **3.** Smear of abdominal contents of BPH parasitized by an elenchid. (e)–immature eggs of elenchid. Arrows indicate symbiotes (×100); **4.** Triungulinids of elenchid from parasitized BPH. Symbiotes were few at this stage (×100).

There was direct relationship between the symbiote number and the maturity of elenchid female inside the host. The presence of an elenchid female carrying immature eggs (figure 3) reduced the symbiote number in a brachypterous female BPH to 14.7×10^4, while a normal adult recorded 37.3×10^4 symbiotes. When the triungulinids (figure 4) were about to be released into the host system the number of symbiote was only about 0.52×10^4 per adult female. As the elenchids obtain their nourishment by diffusion through the integument the heavy reduction in symbiote might not be due to direct feeding by the parasite but could be due to the disturbance of host-symbiote equilibrium.

In a parallel study Buchner[8] reported that among certain leafhoppers parasitized by *Pipunculus* sp. (Diptera) the development of ovaries was often completely suppressed or retarded leading to lack of infection mounds in mycetomes.

When working with BPH, Chen *et al*[9] observed that after the final moulting the density of symbiote in males was gradually reduced to 8.4×10^4 while the same was found to be increasing in females to a level of 44.2×10^4 per insect. Explaining many such situations Buchner[8] suggested that sex-related development and multiplication of symbiote depend largely on the specific biochemical constituent of the sexes and often related for the purpose of transmission in females. In the present study the pattern of reduction of symbiotes in female BPH parasitized by elenchid was similar to that normally observed in healthy male BPH. Stylopization in the parasitized adults of leaf and planthoppers creates a situation where the sex of the insect goes undefined[10]. Thus, in view of such influences dependent upon sex, it could be suggested that in the case of BPH the gonads could be influencing a control over symbiote multiplication through hormones.

The adult females parasitized by dryinid recorded about 22.3×10^4 symbiotes which is about 30% less than the normal number in the healthy insects. The reduction is understandable when considering the fact that the dryinid is supposed to feed directly on the internal tissues of BPH. However, interestingly enough, very few symbiotes were observed in the intestine of the parasite.

The trombidiid mite had the least effect on symbiote. The parasitic mite when reared along with the newly emerged females, in test tubes, did not survive for more than 5–7 days. After a week of confinement with the mites the female BPH recorded about 32.9×10^4 symbiotes which is almost equal to the number observed in healthy insects.

Though an apparent reduction was associated with most of the parasites it needs further investigations to understand the basis for such a reduction.

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IN VITRO REGENERATION FROM LEAF EXPLANTS OF *LADEBOURIA HYACINTHIANA*, ROTH. (*SCILLA INDICA*, BAK.)

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In vitro regeneration has been investigated in several liliaceous species[1-9] *Ledebouria hyacinthiana*, a monsoon perennial is a commercial substitute of Indian squill[10]. The present investigation was aimed at establishing a method for rapid *in vitro* multiplication of a high yielding triploid cytotype collected from Radhanagari range of the Western Ghats of Maharashtra maintained in green-house through cultivation of bulbils regularly produced at leaf tips.

Leaf explants from basal, middle and tip parts of mature leaves, surface-sterilized in 1% mercuric chloride were cultured in both solid as well as liquid