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GENUS ULUCOCCUS NOVUM : A KEY FORM TO DIASPIDID EVOLUTION (HOMOPTERA : COCCOIDEA)

By SADAO TAKAGI, THO YOW PONG and KHOO SOO GHEE

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Abstract

TAKAGI, S., THO, Y.P. and KHOO, S.G. 1990. Genus *Ulucoccus* novum : A key form to diaspidid evolution (Homoptera : Coccoidea). *Ins. matsum. n. s.* 44 : 1-15, 8 figs.

Two new species of the Coccoidea occurring on bamboos in Malaysia are described and a new genus is proposed on the basis of them : *Ulucoccus gombakensis* (name-bearing species of the genus) occurring on *Gigantochloa scortechinii* in the Malay Peninsula, and *U. danumensis* on *Dinochloa scabrida* in Sabah. They are interpreted to represent an early evolutionary stage within the Diaspididae and to approximate an ancestor of the tribe Diaspidini, the subfamily Diaspidinae. Ducts are all geminate at the inner end in these species, and tri- or quadrilocular abdominal disc pores occur in *U. danumensis*. Other features noteworthy from the viewpoint of diaspidid evolution are also discussed.

Authors' addresses. TAKAGI, S. : Entomological Institute, Faculty of Agriculture, Hokkaidô University, Sapporo, 060 Japan. THO YOW PONG : Division of Environmental Sciences, Forest Research Institute of Malaysia, Kepong, Selangor, Malaysia. KHOO SOO GHEE : Department of Zoology, University of Malaya, Petaling Jaya, Kuala Lumpur, Malaysia.

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INTRODUCTION

The 2 species described in this paper undoubtedly belong to the Diaspididae, but remarkably differ from any other forms of the family known to us so far as the adult females are compared. It is the opinion adopted that they represent an early evolutionary stage within the Diaspididae. In some respects they are related to the tribe Diaspidini, the subfamily Diaspidinae, thus probably approximating an ancestor of the tribe. The 2 species are somewhat different from yet obviously related with each other, and are referred to the same genus, which will be described under the name *Ulucoccus*.

DESCRIPTION

Ulucoccus gombakensis, n. sp.

Material examined. Collected at the Gombak Field Research Centre, University of Malaya, Ulu Gombak, Selangor, Semenanjung Malaysia [Peninsular Malaysia], on *Gigantochloa scortechinii* [Bambusaceae], Oct. 2, 1986, and Nov. 27, 1988. Occurring on the undersurface of leaves. Females and preadult males covered with white and flossy wax, with exuvial cast of 1st instar remaining at anterior end of the cover. In the female the exuvial cast of the 2nd instar is broken into 2 pieces about the 1st and 2nd abdominal segments; the anterior piece is kept under the 1st instar exuvial cast, whereas the posterior is discarded. Name-bearing specimen [holotype] (adult female): deposited in the collection of the Forest Research Institute of Malaysia [FRIM], Kepong, Selangor.

Adult female (Fig. 1). Globular, somewhat longer than wide, membranous, with segmentation indistinct; pygidium not well demarcated from preceding part of body, with no marginal appendages except for small gland spines. Gland spines present on thorax and abdomen; 1-3 between anterior and posterior spiracles, 1 (or rarely 2) laterally to posterior spiracle, and 1 or 2 submarginally on 1st and 2nd abdominal segments each (rarely 3 on the 2nd); much smaller gland spines occurring singly on 3rd to 8th abdominal segments along margin. Ducts divisible into 2 groups in size, though some ducts occurring dorsally on the pygidium are intermediate; thick ducts or macroducts obviously 8-shaped at the inner end in cross section ['geminate'], occurring along margin and also dorsally in a double longitudinal submedian row on abdomen, the marginal ducts occurring singly on supposed 2nd to 7th abdominal segments; slender ducts or microducts also geminate at the inner end, occurring dorsally mainly in a double longitudinal median row through metathorax and abdomen and also submedially (within the submedian row of macroducts) on abdomen, few ventrally. Anterior spiracle with 1 or 2 trilocular disc pores, and with 2-6 slender ducts laterally. Anus located about centre of pygidium, with a slender sclerotized ring around. Antennae reduced to unsegmented tubercles, separated from each other by a space narrower than mouthparts, with 1 thick seta and 2 minute ones.

Second instar female (Fig. 2) and male (Fig. 3). Similar to adult female, differing mainly in macroducts, which occur marginally and submarginally. Microducts occurring medially and submedially on dorsum in 2nd instar female; in 2nd instar male, occurring submedially and submarginally on dorsum and medially,

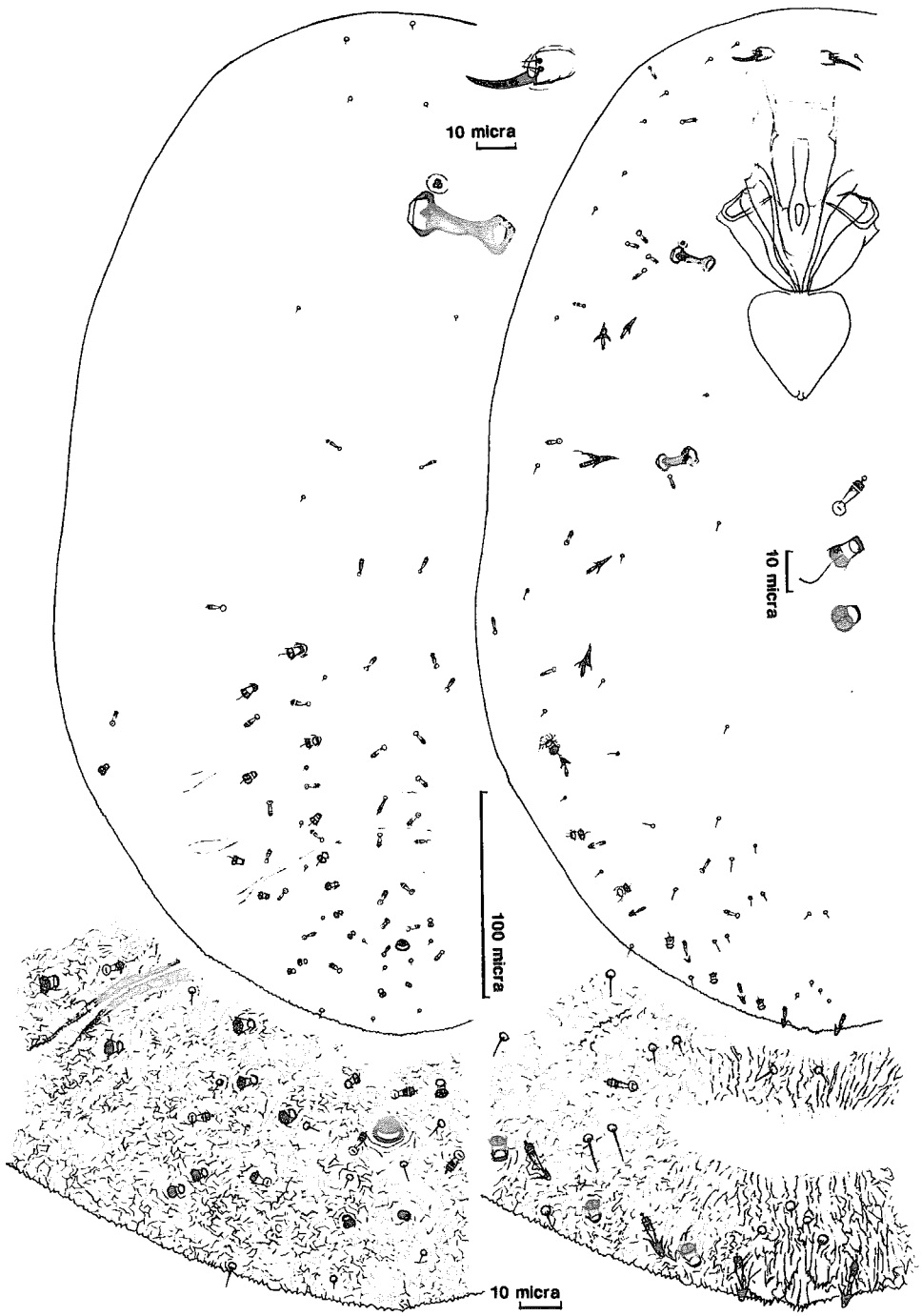

Fig. 1. *Ulucoccus gombakensis*, n. sp., adult female.

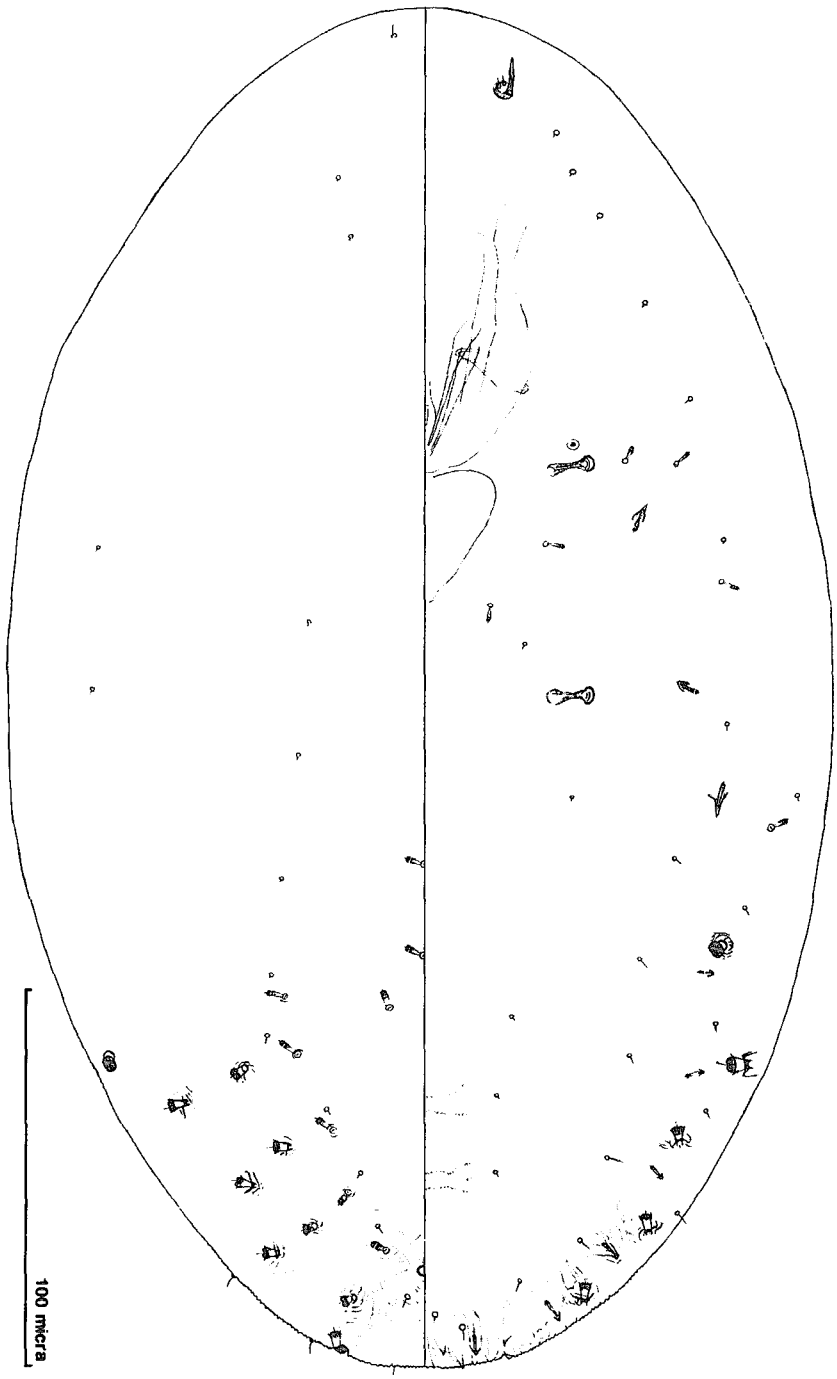

Fig. 2. *Ulucoccus gombakensis*, n. sp., 2nd instar female.

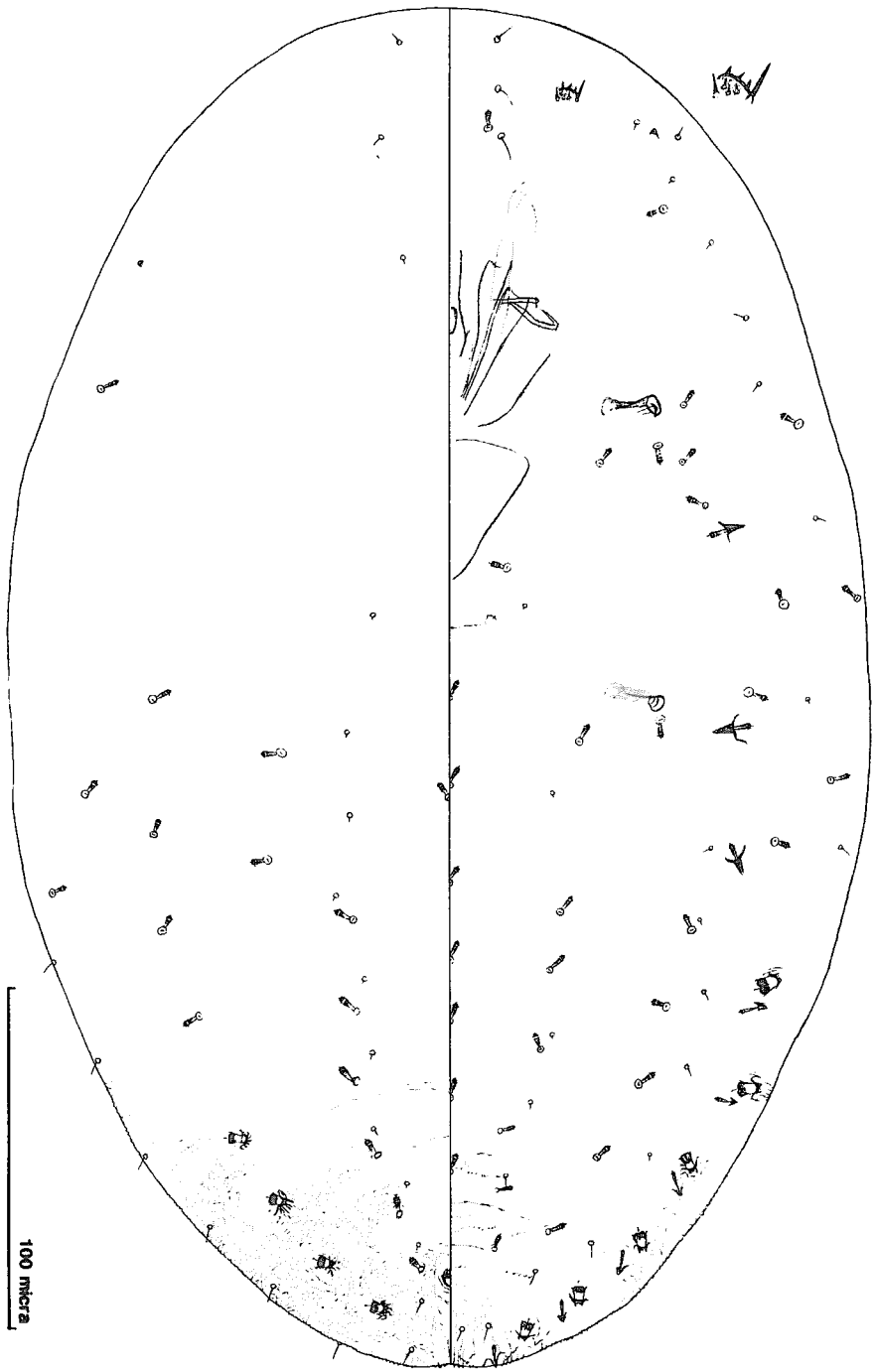

Fig. 3. *Ulucoccus gombakensis*, n. sp., 2nd instar male.

submedially and submarginally on ventrum. Gland spines all single. Anterior spiracle with no disc pore, or sometimes with 1 disc pore. Antennae with 7 or so short processes or setae in 2nd instar male.

First instar (Fig. 4). Antennae 5-segmented, terminal segment a little shorter than the preceding segments combined. Head with a pair of enlarged ducts (geminate at inner end) dorsally. Posterior end of body with a pair of small sharp processes between caudal setae, and with a pair of small, apically divided processes outside the setae. One submedian gland spine dorsally on prothorax ; 3 gland spines on thorax ventrally near margin ; 1 on about 6th abdominal segment marginally. Anterior spiracle with 1 trilocular disc pore. Eyes well developed, spherical. Legs with a distinct tibiotarsal articulation. Marginal setae elongate.

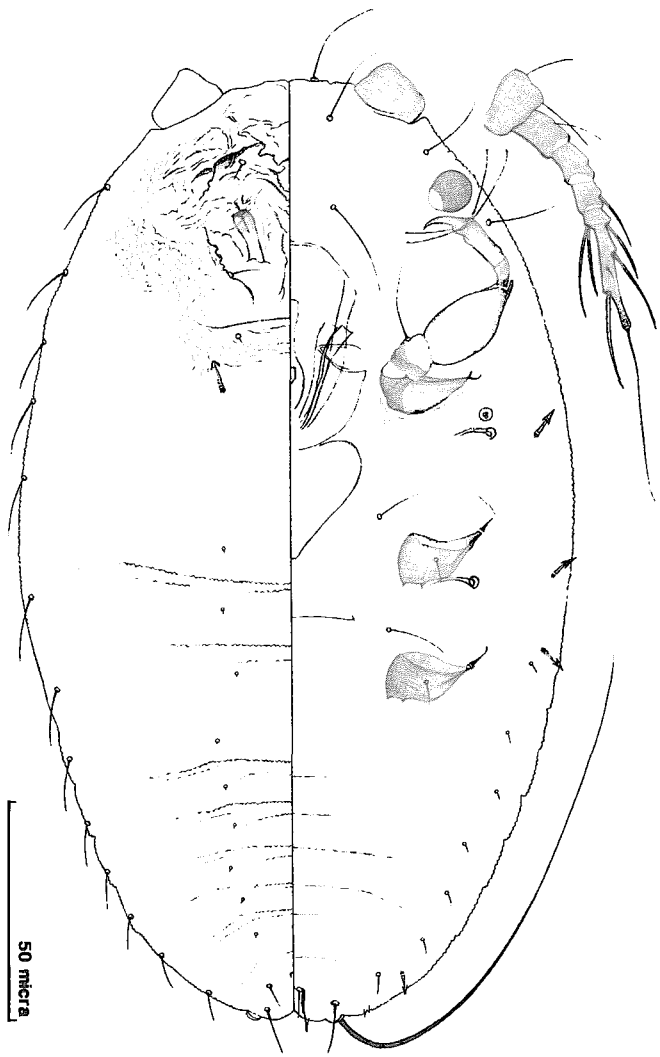

Fig. 4. *Ulucoccus gombakensis*, n. sp., 1st instar larva.

Fig. 5. *Ulucoccus danumensis*, n. sp., adult female.

Adult male (based on a few specimens in poor condition). Apterous; head, thorax and abdomen fused together to form a fusiform body, much simplified and featureless, membranous throughout. Antennae 4-segmented; 2nd segment shortest, with 1 small seta; 3rd segment with 5 or so long setae; 4th segment nearly as long as other segments combined, with 7 long setae. Legs without tibiotarsal articulation, tibiotarsus much thickened. Penis sheath longer than hind tibiotarsus.

Ulucoccus danumensis, n. sp.

Material examined. Collected at the Danum Valley Field Centre, Ulu Segama, Bahagian Tawau, Sabah, Malaysia, on *Dinochloa scabrida* [Bambusaceae], Oct. 24,

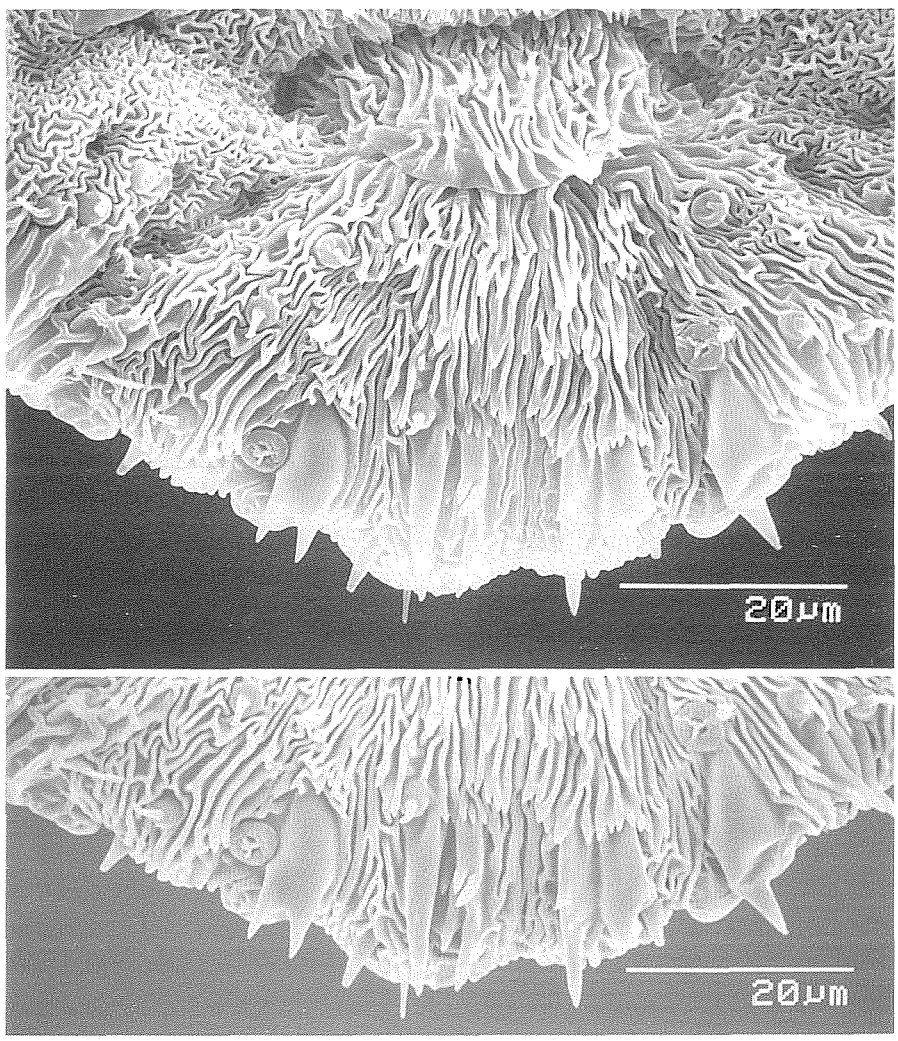

Fig. 6. *Ulucoccus danumensis*, n. sp., adult female. Pygidium in ventral view (SEM photomicrograph).

1988. Occurring on the undersurface of leaves, and secreting white flossy wax. Female with a small amount of secretion around, and with both 1st and 2nd exuvial casts (the 2nd exuvial cast is not broken into 2 pieces as in the preceding species). Name-bearer (adult female): deposited in FRIM.

Adult female (Figs. 5 and 6). Differs from the adult female of *U. gombakensis* as follows: pygidium with 3 pairs of marginal processes, which are membranous, irregular in shape, and sometimes rudimentary, the mesalmost pair (occurring on supposed 8th abdominal segment) duplex when well represented; abdomen with tri-

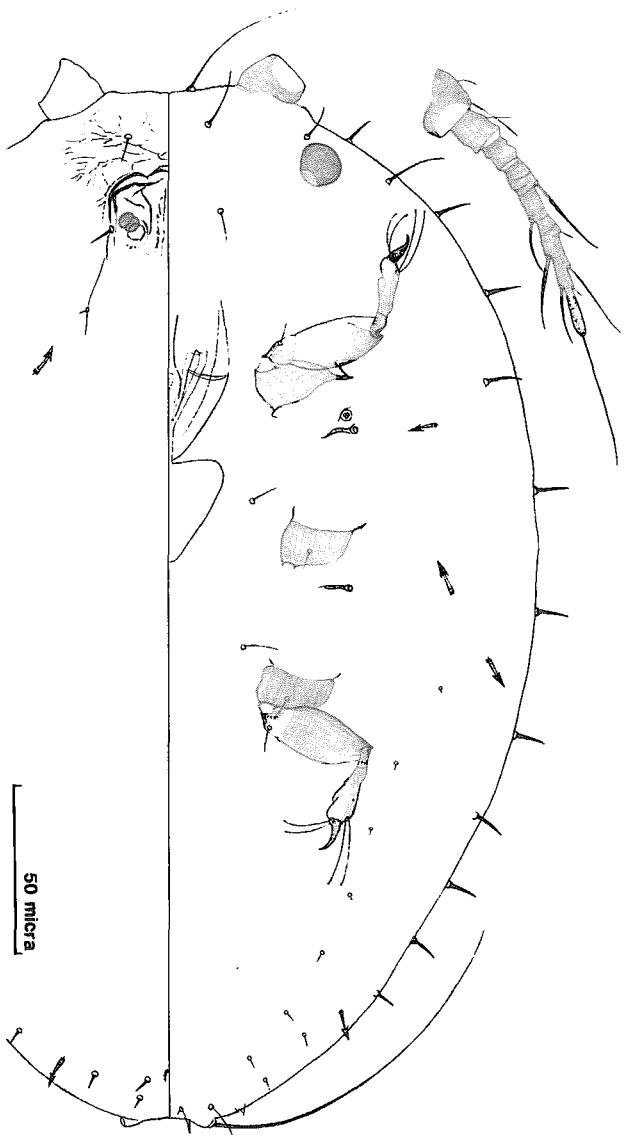

Fig. 7. *Ulucoccus danumensis*, n. sp., 1st instar larva.

or quadrilocular disc pores submarginally on ventral surface, 1 on supposed 6th and 7th abdominal segments each, or only on one of them; macroducts occurring only marginally and microducts fewer; gland spines tending to be more numerous on thorax and base of abdomen, 8-13 on one side, forming an interrupted row from beside anterior spiracle to on 3rd abdominal segment; 1 or 2 of antennal setae well developed. Anterior spiracle always with 1 disc pore.

First instar (Fig. 7) (based on a few specimens poor in condition). Differs from the 1st instar of *U. gombakensis* mainly as follows: antennae 4-segmented, terminal

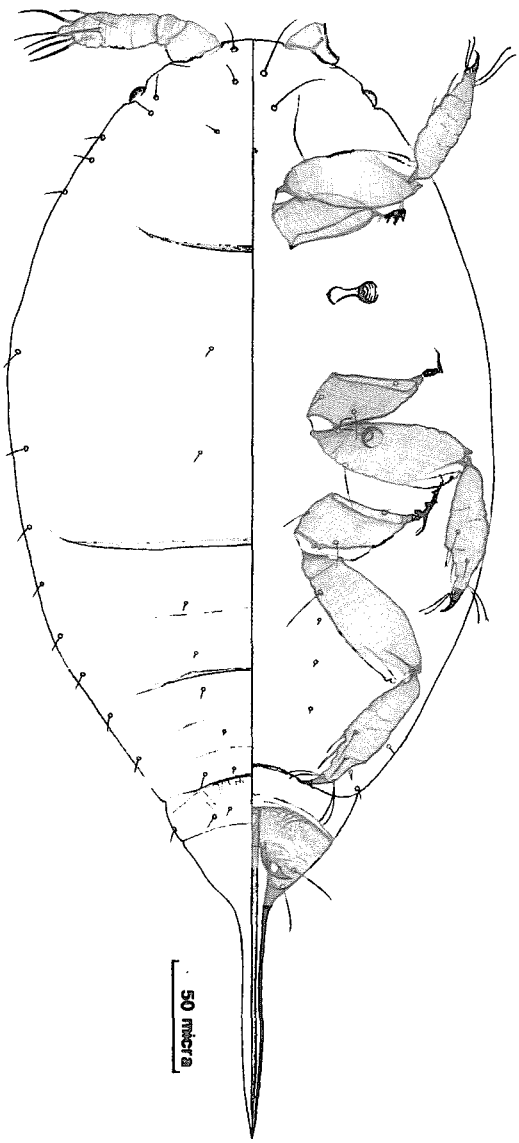

Fig. 8. *Ulucoccus danumensis*, n. sp., adult male.

segment longer than the preceding ones combined (and may correspond to the 4th and 5th segments in *U. gombakensis*); abdomen with 2 marginal gland spines on each side; marginal setae spiny.

Adult male (Fig. 8) (based on a few specimens). Apterous and similar to the adult male of *U. gombakensis* in general appearance. Antennae 3-segmented, 3rd segment with 6 long setae. Penis sheath with a pair of pointed processes ventrally on the base.

Ulucoccus, n. g.

Name-bearing species [type-species]: *Ulucoccus gombakensis*, n. sp.

U. danumensis is referred to the genus rather tentatively, though it is obviously closely related to the name-bearer. Based on the 2 species the genus *Ulucoccus* may provisionally be described as follows.

Coccoidea which are referable to the family Diaspididae because of the retention of the larval exuvial casts and the presence of ducts, gland spines and trilocular spiracular disc pores.

Adult female and second instar larvae of both sexes globular, with segmentation indistinct, and with pygidium poorly demarcated from preceding part of body; legs entirely lacking; no sclerotized marginal appendages. Ducts geminate at the inner end, abdomen with marginal ducts occurring singly. Spiracular disc pores trilocular. Abdominal disc pores, when present in adult female, tri- or quadrilocular and occurring submarginally on pygidial ventrum. Gland spines occurring submarginally on thorax and base of abdomen, and along margin on succeeding segments. Antennal tubercle unsegmented. Anus located about centre of pygidium, with a slender sclerotized ring around.

First instar larva. Antennae 4- or 5-segmented, terminal segment not annulate. A pair of enlarged ducts present on head dorsally, geminate at inner end. One submedian gland spine dorsally on prothorax; 3 gland spines on thorax and 1 or 2 on abdomen ventrally near or on margin. Posterior end of body with a pair of sharp processes between caudal setae, and with a pair of small, apically divided processes outside the setae. Marginal setae elongate or spiny. Legs with a distinct tibiotarsal articulation.

Significance of Ulucoccus in diaspidid taxonomy

The family Diaspididae is generally characterized in the adult female by the abdomen terminating in a compound segment (pygidium), by having sclerotized appendages (lobes) marginally on the pygidium and other marginal processes (pore prominences; gland spines; plates), by having tubular ducts, which are sclerotized transversely ['barred'] at the inner end, by lacking legs, by the antennae reduced to unsegmented tubercles, by forming a separate covering (test), which is composed partly of moulted larval skins (exuvial casts) and partly of secretion, etc. There have been known some diverse forms of the Coccoidea which are in some characters similar to the Diaspididae as characterized above but do not agree with the latter in other characters. They may have some relation with the Diaspididae, and have been referred to the family by authors. However, it has not been clear how they are

related to the other part of the Diaspididae thus composed. In fact, Borchsenius (1966) and others recognized the distinct family Phoenicococcidae for some of them.

The genus *Ulucoccus* is also aberrant for a diaspidid, but does not appear to be close to the Phoenicococcidae and other extraordinary forms. It has gland spines, agreeing in this respect with the tribes Diaspidini and Lepidosaphedini, the subfamily Diaspidinae. It has trilocular spiracular disc pores; this may also indicate its relation to the Diaspidinae. Moreover, the adult female and second instar of *Ulucoccus* are similar to the second instar males of many Diaspidini in the arrangement of ducts and gland spines. Their resemblance to the second instar males of some Chionaspidina is especially remarkable apart from the types of the ducts (compare *Ulucoccus*, for example, with the 2nd instar males of *Chionaspis lumbiniana* and *Narayanaspis eugeniae*, Figs. 29 and 30 in Takagi, 1985, and of *Cameronaspis* spp., Figs. 20-22 in Takagi et al., 1988). *Ulucoccus* differs from the Diaspidini in the ducts which are all geminate at the inner end in all of the adult female and larval instars, but geminate macroducts also occur in the first instar, and occasionally in other instars, of the Diaspidini and other Diaspididae. It differs also in lacking sclerotized lobes and pore prominences on the pygidial margin. In *U. danumensis*, however, 3 pairs of membranous processes occur marginally on the supposed 6th to 8th abdominal segments.

Adult males have been available for both the species, but they are apterous and, in accordance with this condition, much modified and simplified. They are almost featureless in the head and trunk, thus supplying no clue for clarifying the taxonomic relation of *Ulucoccus* with other forms of the Diaspididae.

It is the opinion adopted that *Ulucoccus* is related to the Diaspidini. On the other hand, it can be primitive in comparison with the latter in the ducts which are all geminate and in the absence of sclerotized lobes, because the barred ducts of the Diaspididae are supposed to have originated from geminate pores (which are found in the Asterolecaniidae and other families) through geminate ducts and the sclerotized pygidial lobes of the Diaspididae are also quite peculiar to the family. The resemblance of *Ulucoccus* to the 2nd instar males of Diaspidini in some characters is especially interesting, because it has been suggested (Takagi et al., 1988) that these larval forms reflect an ancestral condition of the Diaspidini.

It may safely be assumed, therefore, that *Ulucoccus* is a remnant of the ancestral stock of the Diaspidini. It may not represent an unmodified ancestor, but some features are especially interesting from the viewpoint of the evolution of the Diaspidini and also of the Diaspididae as discussed below.

1. *Ulucoccus* is covered by flossy wax. This state must represent a starting point for the evolution of the separate coverings (tests) of the Diaspidini (and also of the Diaspididae in general) (see Takagi, 1990a: this issue, p. 17).

2. This primitive genus has trilocular spiracular disc pores. This is noteworthy as discussed below.

3. In addition to the spiracular disc pores, abdominal disc pores occur in *U. danumensis*. They are tri- or quadrilocular, and are located submarginally on the supposed 6th and 7th abdominal segments. Therefore, they differ from the perivulvar disc pores occurring in other Diaspididae not only in structure (the perivulvar disc pores are quinquelocular without exception) but also in location. However,

some Leucaspidini have perivulvar disc pores, which are located about the vulva as usual, and other disc pores, which occur in the submarginal region of the abdomen. The abdominal disc pores of *U. danumensis* may have the same role as the perivulvar disc pores, and may represent a primitive structure of the latter. In that case, the perivulvar disc pores should have primarily been trilocular, thus sharing the original structure with the spiracular disc pores (see Takagi, 1990b : this issue, p. 81).

4. In *U. danumensis* there are 3 pairs of membranous marginal processes on the supposed 6th to 8th abdominal segments. They are irregular in shape and sometimes rudimentary. They may be extensions of some dermal wrinkles (Fig. 6), but appear to occur at fixed positions. They may be incipient lobes or plates.

5. *Ulucoccus* is similar to the 2nd instar males of some Diaspidini, which are quite odd when compared with the adult and 2nd instar females. Thus the genus may give a clue to the origin of those odd 2nd instar males. In this connection, the 2nd instar male and female are not much different in *Megacanthaspis*, which may represent a primitive form of the Diaspidini. This suggests that the odd 2nd instar males of the Diaspidini are secondary in appearance in the evolution of the tribe and, therefore, atavistic.

6. In the *Ulucoccus* first instar larva the marginal setae are well represented, being elongate (in *U. gombakensis*) or spiny (in *U. danumensis*). This fact may give evidence in support of the view that the elongate or spiny marginal setae in the first instar larvae of *Diaulacaspis xerospermi* and a few other forms of the Diaspidini are an atavistic manifestation (see Takagi et al., 1989).

7. In *Smilacicola* the 2nd instar is polymorphic, and is supposed to represent remote ancestors of the genus (Takagi, 1983). The 2nd instar females of 2 species of the genus agree with *Ulucoccus* in having geminate ducts only and in lacking differentiated lobes. However, they differ from the latter in some other characters and especially in lacking gland spines. *Smilacicola* belongs to the subfamily Aspidiotinae (and is related to the Parlatoriini), while *Ulucoccus* is related to the Diaspidinae (and especially to the Diaspidini). All this suggests that there was in the early history of the Diaspididae a group of forms which were commonly characterized in having geminate ducts and in lacking differentiated lobes, and which had already diversified in other characters to precede the 2 major extant subfamilies, the Diaspidinae and the Aspidiotinae.

The discovery of *Ulucoccus* is, after all, the materialization of an expectation raised by the study of larval forms of the Diaspididae. Thus the discovery and the larval study support each other. Not every character of the genus, however, could have been predicted. The presence of membranous marginal processes on the pygidium in *U. danumensis* appears inharmonious with other primitive characters. But these processes are irregular in shape and development, and may represent an incipient state of lobes or other appendages. The occurrence of tri- or quadrilocular abdominal disc pores is also surprising. Nevertheless, these pores afford a new insight into diaspidid evolution, thus supporting the view that the genus represents an early evolutionary stage in the family.

Ancestral patterns of morphological characters can persist. Ancestral forms can survive in this sense, and their host associations may also persist. The 2 species of *Ulucoccus* occur on the leaves of bamboos. Some forms supposed to be primitive

relatives of armoured scale insects (*Phoenicococcus, Colobopyga, Halimococcus, Thysanococus, Xanthophthalma*, etc.) are associated with plants of the Palmae and Pandanaceae. Is it a mere coincidence that all these insects are found on monocotyledonous plants?

Bamboos, however, harbour diverse scale insects. At the collection site of *U. gombakensis* some other armoured scales were also collected from the host plant. The question may be raised how the *Ulucoccus* species have survived on bamboo leaves, on which they may find no vacant refuge. This question may not be irrelevant, but is unanswerable in the present state of our knowledge.

ACKNOWLEDGEMENT

This is our 3rd paper based on the scale insect material collected under the project "Systematic and Ecological Surveys on Some Plant-parasitic Microarthropods in Southeast Asia". We express here our cordial thanks to the Authorities concerned of the Malaysian Government for their approval for the Japan-Malaysia joint surveys carried out in connection with the project in 1985, 1986 and 1988.

This paper contains material collected at the Danum Valley Field Centre during the surveys made in Sabah in 1988. We wish to thank the Authorities of the Sabah Government and the Sabah Foundation for permitting us to make surveys in Sabah and at the Centre. We take this opportunity to express our gratitude to the Kinabalu National Park and the Forest Research Centre (Sandakan) for the great help we received in our surveys in the Kinabalu National Park, the Kabili-Sepilok Forest Reserve and other places. We are indebted to Mr. Chey Vun Khen, Mr. Saikeh bin Lantoh and other staff members of the Entomology Division, Forest Research Centre, for their co-operation in various ways.

The host plants of the scale insects collected in Sabah were identified by the botanists of the Forest Research Centre and partly by Mr. K.M. Kochummen, Forest Research Institute of Malaysia. Without their co-operation the surveys would have never been completed.

Depositories of the scale insect material collected by the joint surveys. The material has once been brought to Japan. About a half of the mounted specimens of each species, including the name-bearer [holotype] when the species is new, will be returned to Malaysia after the completion of study on them. The other half will be deposited in the collection of the Entomological Institute, Faculty of Agriculture, Hokkaidô University, Sapporo, Japan.

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