



DIVERSITY AND DIAGNOSTICS OF STERNORRHYNCHAN INSECT PESTS INFESTING ARECANUT

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ABSTRACT

Investigations were carried out in major arecanut growing districts of Karnataka during 2019-2020 to know the species composition of sternorrhynchan pests viz., mealybugs, scales and aphids. A total of 14 species of sternorrhynchan sucking insect pests were recorded in the arecanut growing districts. These belong to five families viz., Coccidae Stephens, Diaspididae Maskell, Pseudococcidae (Heymons) and Aphididae (Buckton). Among these, Coccidae was the species rich. *Prococcus acutissimus* (Green) was the most predominant species followed by *Pseudococcus longispinus* (Targioni Tozzetti), *Ceroplastes* sp. nr. *rusci* (L.), *Chrysomphalus aonidum* (L.), *Parasaissetia nigra* (Neitner), *Coccus viridis* (Green), *Coccus hesperidum* L., *Pseudaulacaspis cockerelli* (Cooley), *Pinnaspis aspidistrae* (Signoret), *Lepidosaphes gloveri* (Packard), *Ferrisia virgata* (Cockerell), *Dysmicoccus brevipes* (Cockerell) and *Cerataphis lataniae* (Boisduval). Diagnostics of these with descriptions of taxonomic characters and a key to genera is also provided herein.

Key words: Arecanut, aphids, Karnataka, mealybugs, scales, taxonomic key

Arecanut palm, *Areca catechu* L. is one of the important commercial plantation crops in India. The economic produce of the arecanut fruit is called betel nut or supari, which is used in various social and religious ceremonies in India. Arecanut is having some medicinal uses against leukoderma, leprosy, cough, fits, worms, anemia and obesity. The cultivation is concentrated in the southwestern and northeastern region up to an elevation of 1000m above mean sea level. In the world, arecanut palm cultivation is majorly restricted to south Asian countries like India, Pakistan, Sri Lanka, Malaysia, Philippines and Japan. In India, arecanut is extensively grown in different states like Karnataka, Kerala, Assam and West Bengal. The contribution of arecanut in total area of cultivation and production from Karnataka, Kerala and Assam accounted is around 83% (Ramappa, 2013). Among the districts of the Karnataka state, Shivamogga stands first in both area (21.06%) and production (21.30%) followed by Davanagere, Dakshina Kannada, Tumkur, Chikkamagaluru and Chitradurga. These districts together account 83.63% of the total area and 82.10% of the total production in the state (Anon, 2018).

Arecanut is infested by many species of insect and non-insect pests in its young and old stage. These pests attack nuts, inflorescence, causing direct losses

to leaves, stem, nuts and roots, causing indirect losses (Daniel and Kumar, 1976). Among these, root grub *Leucopholis lepidophora* Blanchard (Scarabaeidae: Coleoptera), spindle bug *Carvalhoia arecae* Miller and China (Miridae: Heteroptera), inflorescence caterpillar *Tirathaba mundella* Walker (Pyralidae: Lepidoptera) and mite *Raoiella indica* Hirst (Acarina: Tenuipalpidae) are important in causing economic damage (Nair and Menon, 1963; Kalleshwaraswamy et al., 2015). Sucking pests are less explored and taxonomically well known among the insect pests of arecanut. Scales, mealybugs and aphids are important with possibilities of becoming severe pests. These insects suck the sap from the leaves, inflorescence and nuts and reduce the photosynthetic rate. In case of severe infestation, it interferes pollination, affect normal growth and yield (Ramappa, 2013). To understand the diversity of these sternorrhynchan insect pests infesting arecanut in Karnataka, a study was undertaken. Their diagnostics is also provided giving morphological descriptions and a key for easy identification.

MATERIALS AND METHODS

Study conducted to know the species composition of coccids and aphids in different arecanut growing districts included surveys of arecanut plantations in

the four agroclimatic zones of Karnataka, viz., coastal zone, central dry zone, southern transition zone and hilly zones. In each of these, 20 selected gardens covering different talukas were surveyed at monthly intervals. In each garden, presence or absence of the pest was recorded, and live insects collected with a fine camel hair brush were immersed in 70% ethyl alcohol. The infested plant samples were brought to the laboratory in polythene bags (16x 22 cm) or in a small plastic container. These samples were kept under cool condition and sorted out using a compound microscope (Carl Zeiss). The specimens were preserved in vials (5 ml) containing 70% ethyl alcohol, with representative samples subjected to permanent slide mounting. Sirisena et al. (2013) was followed with little modification for these and slides of scales, mealybugs and aphids were prepared. Identification of the specimens was made from these- mealybugs were identified up to species level by using taxonomic keys as given by Williams (2004) for scales key by Zimmerman (1948) and for aphids (Joshi, 2005). The observation on the presence of these pests was made on the plant parts like stem, roots, inflorescence, nuts and leaflets. A list of species of sternorrhynchan insect pests, their identification characters and distribution were recorded. Live aphid and coccid photos were captured using Vivo 11 Pro mobile mounted on Olympus BX 51 microscope and microphotographs of slide mounted females and their important diagnostic characters were captured with a Nikon DS-Vi1 camera mounted on this microscope. All the figures were generated using Adobe Photoshop CS2. Diagnostic characters of each species have been given as legends in all the figures. Live and mounted female

photographs of *C. sp. nr. rusci* could not be included, as the specimens were damaged and could not be processed properly; also the live photographs of *A. destructor* as sound specimens suitable for good photographs were not available.

RESULTS AND DISCUSSION

In the present study, 14 species of sternorrhynchan insect pests were observed from major arecanut growing zones of Karnataka viz., southern transitional zone (14), hilly zone (5), coastal zone (3) and central dry zone (3) (Table 1). These included one species of aphid (Aphididae), three species of mealybugs (Pseudococcidae), five species each of soft scales (Coccidae) and armoured scales (Diaspididae). They belong to four families viz., Coccidae [*Ceroplastes sp. nr. rusci* L., *Parasaissetia nigra* (Neitner), *Prococcus acutissimus* (Green), *Coccus viridis* (Green), *Coccus hesperidum* L.]; Diaspididae [*Chrysomphalus aonidum* (L.), *Pseudaulacaspis cockerelli* (Cooley), *Pinnaspis aspidistrae* (Signoret), *Lepidosaphes gloverii* (Packard), *Aspidiotus destructor* Signoret]; Pseudococcidae (*Ferrisia virgata* (Cockerell) *Pseudococcus longispinus* (Targioni Tozzetti), *Dysmicoccus brevipes* (Cockerell); and Aphididae (*Cerataphis lataniae* (Boisduval).

Diversity and incidence: Among all the four zones, the highest number of insect species was recorded in the southern transitional zone (14) followed by the hilly zone (5), coastal zone (3) and central dry zone (3). Among the scales, five species each of soft scales and armoured scales were recorded in four different zones selected for the study. *P. acutissimus* was

Table 1. Species composition of sternorrhynchan insect pests in arecanut

Sl. No.	Species	Coastal zone	Central dry zone	Southern transition zone	Hilly zone
1	<i>Coccus viridis</i> (Green)	-	-	+	-
2	<i>Prococcus acutissimus</i> (Green)	+	+	+	+
3	<i>Ceroplastes sp. nr. rusci</i> (L.)	+	-	+	+
4	<i>Parasaissetia nigra</i> (Neitner)	-	-	+	-
5	<i>Coccus hesperidum</i> (L.)	-	-	+	-
6	<i>Chrysomphalus aonidum</i> (L.)	-	-	+	+
7	<i>Lepidosaphes gloverii</i> (Packard)	-	-	+	+
8	<i>Pseudaulacaspis cockerelli</i> (Cooley)	-	-	+	-
9	<i>Pinnaspis aspidistrae</i> (Signoret)	-	-	+	-
10	<i>Aspidiotus destructor</i> Signoret,	-	-	+	-
11	<i>Pseudococcus longispinus</i> (Targioni Tozzetti)	+	+	+	+
12	<i>Ferrisia virgata</i> (Cockerell)	-	-	+	-
13	<i>Dysmicoccus brevipes</i> (Cockerell)	-	-	+	-
14	<i>Cerataphis lataniae</i> (Boisduval)	-	-	+	-
Total		3	3	14	5

+ = Present; - = Absent

distributed in all the four zones surveyed. This was followed by *C. sp.nr. rusci* was distributed in all the four zones except the central dry zone. The remaining three species of soft scales recorded were *P. nigra*, *C. viridis* and *C. hesperidum*. Among armoured scales, *C. aonidum* and *L. gloverii* were distributed only in the southern transitional zone and hilly zone. Whereas, the other three species of diaspidids were *P. cockerelli*, *P. aspidistrae* and *A. destructor* were recorded only in the southern transitional zone. Among the three species of mealybugs, *P. longispinus* was the most predominant species of mealybugs distributed in all the four zones surveyed. While the other two species of mealybugs namely, *F. virgata* and *D. brevipes* were distributed only in the southern transitional zone. One species of aphid, *C. lataniae* was recorded in southern transitional zone (Table 1; Fig. 1).

Diagnostic keys: The surveys have documented 14 species of sternorrhynchan insect pests. The diagnostic keys for these are given below with relevant illustrations.

Key to the families

1. Siphunculi and cauda present.....
 Aphididae (Buckton) (Fig. 2)
 Siphunculi and cauda absent.....2
2. Labium three segmented, anal plate and anal cleft absent, ostiole present, cerarii present and



Fig. 1. Aphids and coccids occurring on arecanut- Aphididae A. *Cerataphis lataniae*; Pseudococcidae B. *Dysmicoccus brevipes*, C. *Ferrisia virgata*, D. *Pseudococcus longispinus*; Coccidae E. *Coccus hesperidum*, F. *Coccus viridis*, G. *Parasaissetia nigra*, H. *Prococcus acutissimus*; Diaspididae I. *Chrysomphalus aonidum*, J. *Lepidosaphes gloverii*, K. *Pinnaspis aspidistrae*, L. *Pseudaulacaspis cockerelli*

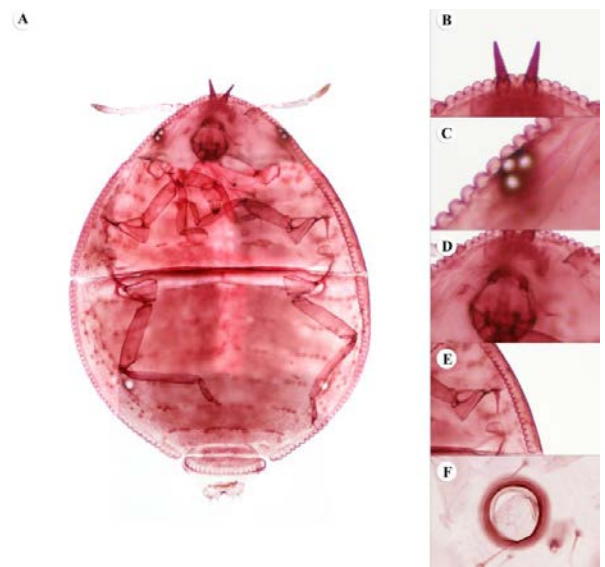


Fig. 2. Diagnostic characters of *Cerataphis lataniae* (Boisduval): A. Dorsoventrally flattened, almost circular body, B. Head with a pair of forwardly directed frontal horns, C. Eyes three faceted, D. Underside of head without dagger-like hairs but with only fine hairs, E. Crenulate body margin due to a continuous row of wax glands, F. Pore like siphunculus

- legs present.....Pseudococcidae (Heymons) (Fig. 3)
 Labium one segmented, anal cleft and anal plates may present or absent, cerarii absent, legs may be present or absent.....3
3. Anal plate and anal cleft absent, pygidium present, legs absent.....Diaspididae Maskell (Fig. 10)
 Anal plate and anal cleft present, pygidium absent, legs present.....Coccidae Stephens (Fig. 6)

Key to the genera

Pseudococcidae

1. Cerarii 1 to 3 pairs, circulus always present.....
Ferrisia (Cockerell) (Fig. 4)
 Cerarii more than three pairs, Circulus may present or absent.....2
2. Body mainly oval, number of cerarii is 12 to 17 pairs, circulus may be present or absent, antennae 7 to 8 segmented, 2 pairs auxiliary setae and conical setae present in the sclerotized area, anterior ostioles always present, discoidal pores larger than the trilocular pores.....*Pseudococcus* Westwood (Fig. 5)
 Body elongated to oval, cerarii 6 to 17 pairs, antennae 6 to 8 segmented, conical setae 2 to 8 with auxiliary setae, translucent pores may present or absent.....*Dysmicoccus* Ferris (Fig. 3)

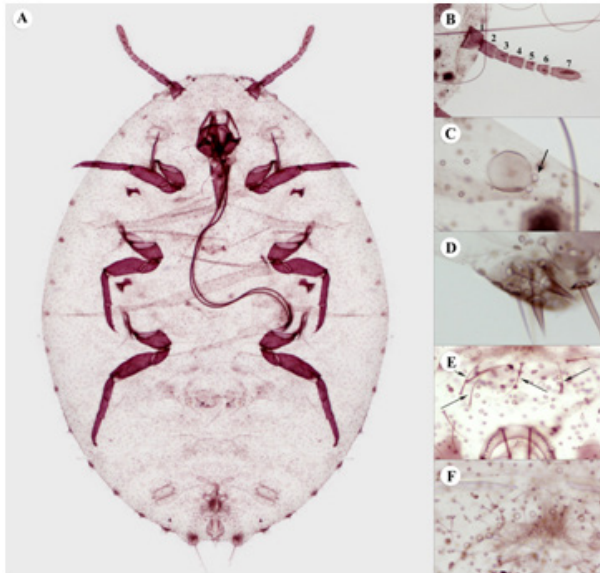


Fig. 3. Diagnostic characters of *Dymicoccus brevipes* (Cockerell): A. Broadly oval body with 17 pairs of cerarii, B. Antenna 7 or 8 segmented, C. One or two discoidal pores present adjacent to each eye, D. Anal lobe cerarii with two conical setae and 6-7 auxiliary setae, E. Dorsal setae on abdominal segment VIII anterior to anal ring, longer than other dorsal setae, F. Multilocular disc pores present around vulva and abdominal segment VI-VII



Fig. 4. Diagnostic characters of *Ferrisia virgata* (Cockerell): A. Body elongate oval with tapering abdomen having only one pair of anal lobe cerarii, B. Antenna eight segmented, C. Anal lobe cerarii with two or three conical setae and one or two auxiliary setae, D. Dorsal ducts each with rim larger than multilocular pore, containing setae situated within border of rim, E. Multilocular pores present posterior to vulva and abdominal segment VI and VII, F. Oral collar tubular ducts present across abdominal segment V and on margin on posterior abdominal segments

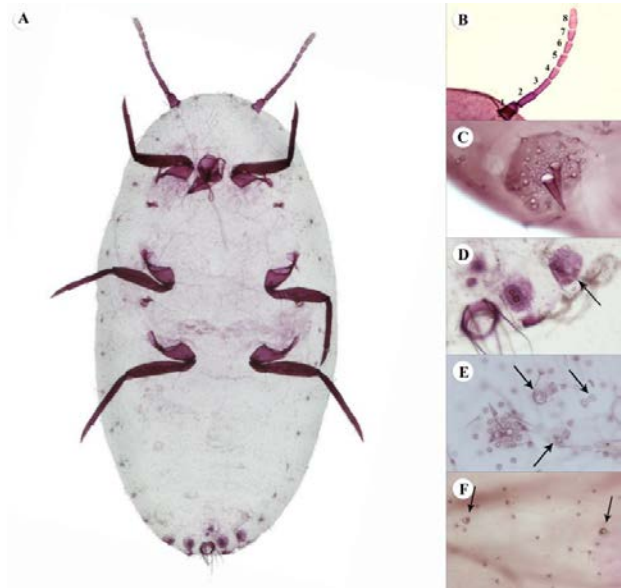


Fig. 5. Diagnostic characters of *Pseudococcus longispinus* (Targioni Tozzetti): A. Body broadly oval and membranous, B. Antenna eight segmented, C. Anal lobe cerarii with two conical setae and 3-4 auxiliary setae, D. Penultimate cerarii as large as anal ring, E. Oral collar tubular ducts of three sizes present, F. Oral rim tubular ducts present adjacent to all cerarii on dorsum

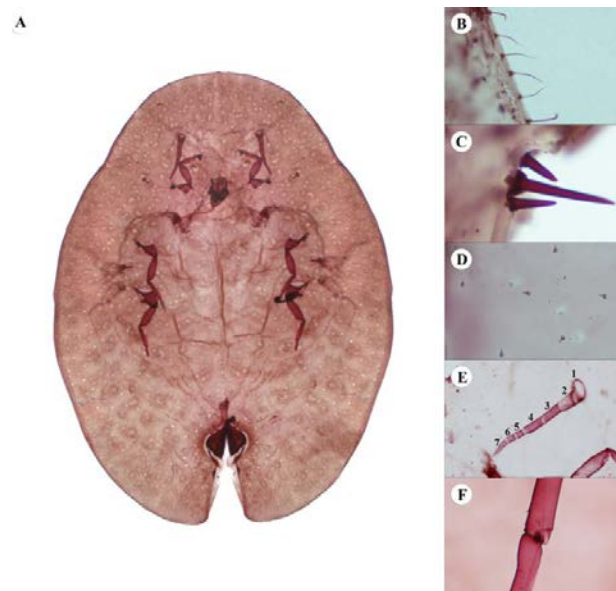


Fig. 6. Diagnostic characters of *Coccus hesperidum* (L.): A. Derm with small dispersed clear areas; B. Marginal setae slightly enlarged, usually weakly fimbriate, occasionally simple; C. Spiracular setae easily differentiated from other marginal setae, middle seta conspicuously longer than lateral setae; D. Dorsal setae enlarged, apically acute or slightly rounded, not capitate; E. Antenna seven segmented; F. Tibio tarsal scleritis present

Coccidae

1. Stigmatic setae tubular like.....*Ceroplastes* Gray (Fig. 7)
 Stigmatic setae setose.....2
2. Ventral tubular ducts in the form of band on submarginal rea.....*Parasaissetia* Takahashi (Fig. 8)
 Ventral tubular ducts not as above; present on abdomen between the leg.....3
3. Legs and antenna reduced.....
Prococcus Linnaeus (Fig. 9)
 Legs and antenna well developed.....
Coccus Linnaeus (Fig. 6, 7)

Diaspididae

1. Body shape oval.....2
 Body elongate.....3
2. Paraphyses frequently present anterior to lobe 3; the paraphyses as long as or longer than lobe; fourth lobe represented by a series of low swellings.....
Chrysomphalus Asmead (Fig. 11)
 Small paraphyses arising from the bases of the median to third lobe; fourth lobe not in the least developed.....*Aspidiotus* Bouche (Fig. 10)

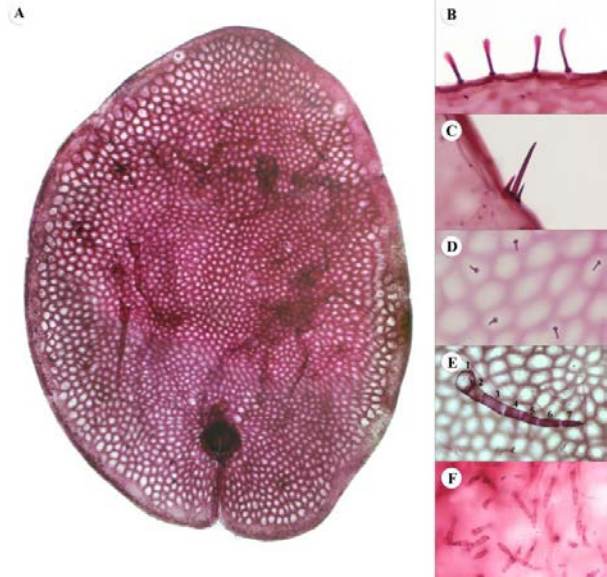


Fig. 8. Diagnostic characters of *Parasaissetia nigra* (Neitner): A. Body oval to almost circular, derm with reticulate pattern on dorsum; B. Marginal setae fimbriate; C. Stigmatic setae differentiated from other marginal setae, middle seta conspicuously longer than lateral setae; D. Dorsal setae often slightly capitate; E. Antenna seven segmented; F. Ventral tubular ducts present in the form of marginal band

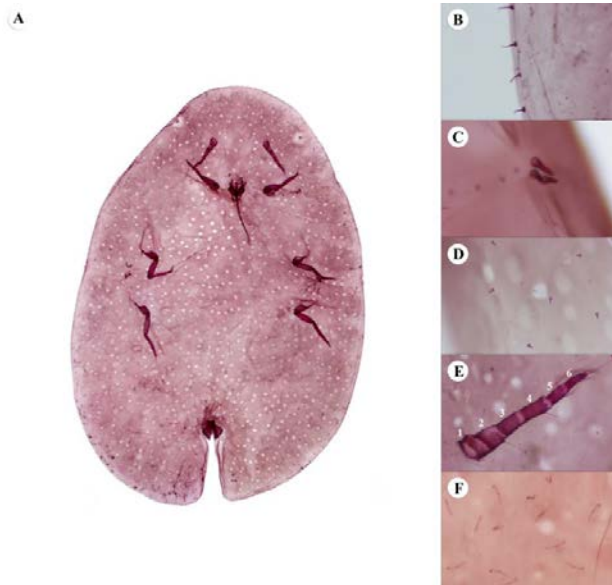


Fig. 7. Diagnostic characters of *Coccus viridis* (Green): A. Derm of older females with scattered clear areas; B. Marginal setae slightly enlarged, strongly fimbriate; C. Stigmatic setae can be differentiated from other marginal setae, middle seta slightly longer than lateral setae; D. Dorsal setae enlarged, apically clavate or rounded; E. Antenna six segmented; F. Ventral tubular ducts present between hind and middle leg

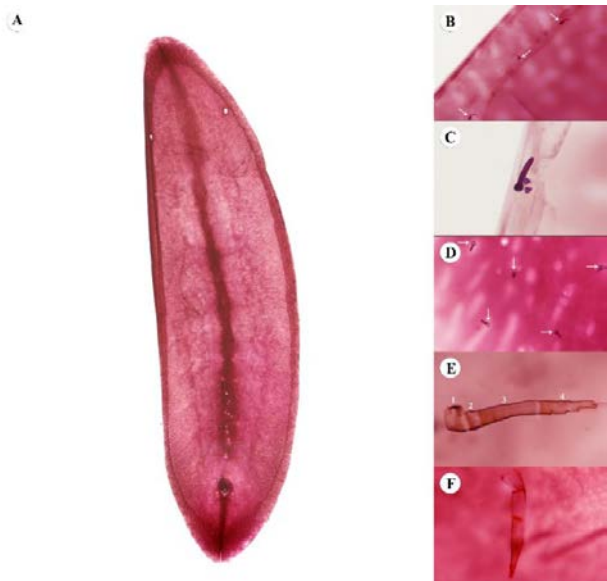


Fig. 9. Diagnostic characters of *Prococcus acutissimus* (Green): A. Body elongate, acutely pointed at both ends; B. Marginal setae short, slender, apices rounded; C. Stigmatic setae differentiated from other marginal setae, middle seta longer than lateral setae; D. Dorsal setae variable, usually spine like, with bluntly pointed to rounded apices; E. Antenna reduced, four segmented; F. Legs reduced, without tibiotarsal sclerosis

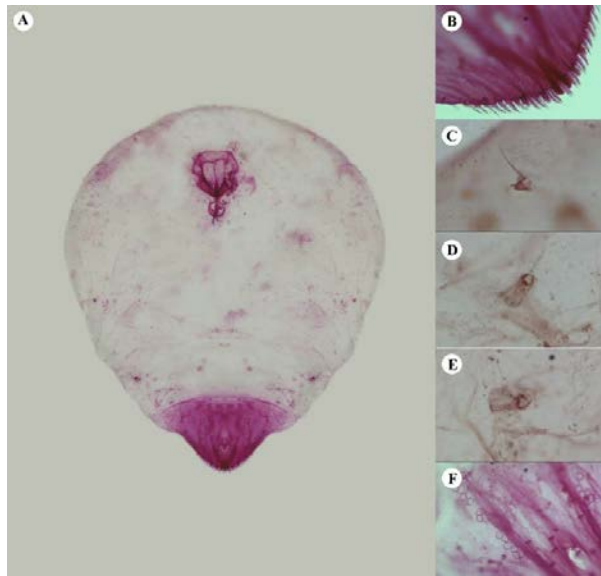


Fig. 10. Diagnostic characters of *Aspidiotus destructor* Signoret: A. Female with well-developed three pairs of lobes, paraphyses could not be seen; B. Pygidial margin showing well developed lobes and fimbriate plates; C. Stub like antenna with single seta; D. Anterior spiracle without spiracular pores; E. Posterior spiracle without spiracular pores; F. Perivulvar pores in four groups with 13-18 pores on each side

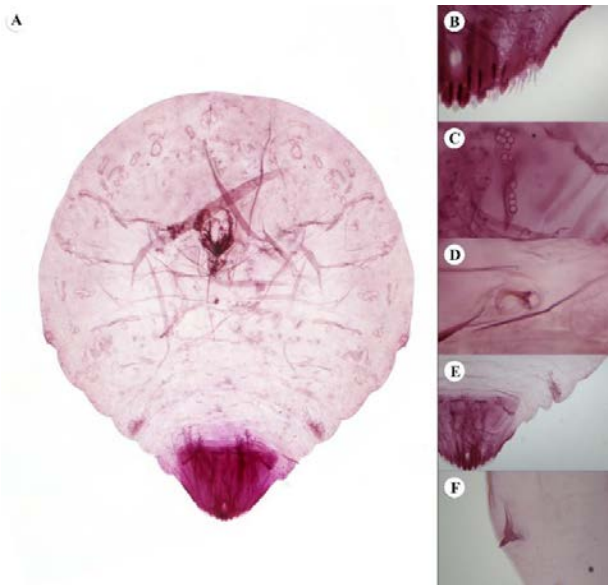


Fig. 11. Diagnostic characters of *Chrysomphalus aonidum* (L.): A. Female with well-developed three pairs of lobes, fourth pair represented by sclerotized points, paraphyses could be seen clearly; B. Pygidial margin showing well developed lobes, paraphyses and fimbriate plates; C. Perivulvar pores in four or five groups with 9-13 pores on each side; D. Spiracle without perispiracular pores; E. Prepygidial macroducts in one cluster on dorsal side of segment 2 composed of 9-27 ducts; F. spine like eye on margin



Fig. 12. Diagnostic characters of *Lepidosaphes gloverii* (Packard): A. Female elongate with two pairs of definite lobes; B. Pygidium with well-defined lobes and thin thin paraphyses like sclerotization; C. Antenna with two or four conspicuous curved setae; D. Anterior spiracle with 2-4 perispiracular pores; E. Posterior spiracle without perispiracular pores; F. Perivulvar pores in 4 or 5 indistinct groups with 10-15 pores on each side

- 3. Pygidium with paraphyses, median lobes singly arranged, larger and always present.....
Pseudaulacaspis MacGillivray (Fig. 14)
Pygidium with median lobes present in pairs
.....4
- 4. Median lobes of pygidium fully or partially merged, median notch absent on pygidium.....
Pinnaspis Cockerell (Fig. 13)
Median lobes of pygidium present separately, median notch
presentt *Lepidosaphes* Shimer (Fig. 12)

Key to species of *Coccus*

- 1. Ventral multilocular disc pores restricted up to anal cleft; below anal plates few only present, ventral tubular ducts are absent, marginal setae are small but not fimbriate.....*C. hesperidum* L. (Fig. 6)
Ventral multilocular disc pores not restricted up to anal plates, ventral tubular ducts present in the central region of thorax, marginal setae short and strongly fimbriate.....*C. viridis* (Green) (Fig. 7)



Fig. 13. Diagnostic characters of *Pinnaaspis aspidistrae* (Signoret): A. Female elongate with two pairs of definite lobes; B. Pygidium showing six macroducts on each side; C. Anterior spiracle with 7-34 perispiracular pores; D. Antenna with one conspicuous seta; E. Preanal scleritis represented by light sclerotized patch; F. Perivulvar pores in 5 groups with 29-59 pores



Fig. 14. Diagnostic characters of *Pseudaulacaspis cockerelli* (Cooley): A. Female elongate with two to three pairs of well-developed lobes; B. Pygidium showing five macroducts on each side; C. Antenna with one conspicuous curved seta; D. Anterior spiracle with 7-13 perispiracular pores; E. Posterior spiracle without perispiracular pores; F. Perivulvar pores in 5 groups with 35-47 pores

This study on the species composition of the sternorrhynchan insect pests of arecanut in major arecanut growing districts of Karnataka is a maiden attempt in India. Among the sternorrhynchan pests in arecanut, the most predominant insect pests were scales which includes both soft scales and armoured scales. This was followed by mealybugs and aphid. Among the soft scale species recorded, the most prevalent species was *P. acutissimus* followed by *C. sp.nr. rusci*, *C. viridis*, *C. hesperidum* and *P. nigra*. Among the armoured scales, the most prevalent species recorded was *C. aonidium* and the least prevalent species was *P. aspidistrae*. Among the mealybugs, the most dominant species recorded was *P. longispinus* and the least was *D. brevipes*. Only one species of aphids, *C. lataniae* was recorded.

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