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Diversity and host range of the tribe Saissetiini (Hemiptera: Coccomorpha: Coccidae) in Kerala, India

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ABSTRACT: Purposive field surveys were conducted during 2021-2025 across different districts of Kerala to document the species diversity and host range of soft scale insects. Soft scales were collected from agricultural, horticultural and forest ecosystems and road side avenue plants. Morphological characterization of the slide mounted female specimens revealed three species of Saissetiini *viz., Saissetia coffeae, S. oleae* and *Parasaissetia nigra*. The distribution and host range of the soft scale of Saissetini in Kerala are presented in this paper. The field diagnostic characters and taxonomic keys are provided for accurate identification of the species. The study reports a new distribution record of *S. oleae* from Kerala. Several new hosts are recorded for the soft scales, indicating their adaptability to a wider host range in the region.

Keywords: Coccids, soft scale, Saissetia, taxonomy, diversity, host range, distribution, Kerala

INTRODUCTION

The family Coccidae (Hemiptera: Coccidae), commonly known as soft scales, is one of the serious economic pests on agricultural, horticultural, and ornamental plants globally, with a wide distribution (Kondo and Watson, 2022). It is the third most species-rich family among Coccoidea (Henderson and Hodgson, 2005). Soft scale insects cause damage by sucking the sap which affects plant growth, leading to defoliation, withering of shoots/entire plant. The honeydew excreted coats the plant surface, which impedes assimilation and photosynthesis, and also acts as a perfect medium for sooty mould. Honeydew was also observed to attract ants, which potentially protected the pest from its natural enemies (Ben-Dov and Hodgson, 1997).

Hodgson (1994) revised the classification of soft scale insects based on the morphological characteristics of adult females and male since around 1960. He proposed a division of the family Coccidae into ten subfamilies, with the subfamily Coccinae further divided into four tribes including Saissetiini. According to the ScaleNet database, the tribe Saissetiini Hodgson, 1994 under the subfamily Coccinae, comprises approximately 148 species under 13 genera, distributed worldwide (Hodgson, 1994; García Morales *et al*., 2016). Although, the majority of Saissetiini species are primarily distributed in Neotropical and Ethiopian regions, several species exhibit cosmopolitan distribution and are recognised as economically important agricultural pests, such as *Parasaissetia nigra* (Nietner), *Parthenolecanium corni* (Bouché), *P. persicae* (Fabricius), and *Saissetia coffeae* (Walker) (Ben-Dov and Hodgson, 1997).

The genus *Saissetia* Deplanche comprises 46 known species worldwide, of which four species, *viz*., *S. coffeae, S. oleae, S. miranda* and *S. privigna* De Lotto have been documented from India (Ali, 1971; Shafee *et al*., 1989; Varshney, 1992; Hodgson, 1994; García Morales *et al*., 2016). *Saissetia coffeae* is a polyphagous pest that attacks coffee, tea, citrus and gauva (Le Pelley, 1968), ornamental plants, especially cycads and ferns (Ben-Dov, 1993) and pest of vegetable, fruit crops (Henderson *et al*., 2010). In India, *S. coffeae* is regarded as a pest of sandal trees, causing severe leaf and fruit fall in successive years until the tree dies (Sivaramakrishnan *et al*., 1987); it is also one of the main pests of coffee and cardamom (Narasimham, 1987). Waterhouse and Norris (1987) regarded *S. coffeae* as one of the main pests in the Pacific region. In California, it is a serious pest on ornamental plants, especially Boston fern (Gill, 1988; CABI, 2017). *S. oleae* is one of the most important pests of citrus in the Mediterranean Basin, Florida, California and South

America (Bartlett, 1978). Gill (1988) considered it to be the most injurious soft scale in California, and the most important pest of citrus there until 1940; he also reported it as a serious pest of olives. *S. privigna* De Lotto has been recorded on *Abelmoschus esculentus* (Varshney, 1992) and *Hibiscus rosa-sinensis* (Shafee *et al.,* 1989).

The genus *Parasaissetia,* includes five described species globally, with the majority occurring in the Ethiopian region (García Morales *et al*., 2016). Among them, only one species has been documented from India *i.e., Parasaissetia nigra* (Nietner) (Ali, 1971).This species is cosmopolitan in distribution and is considered as an occasional agricultural pest (Hamon and Williams, 1984). In this study, we re-describe and illustrate three species of the tribe Saissetiini from Kerala and their host associations.

MATERIALS AND METHODS

Purposive sampling surveys were conducted in different agricultural and horticultural ecosystems of Kerala during 2021-2025. Scale-infested plant parts *viz.,* leaves, stems, branches, twigs, fruits were cut with secateurs and collected in polythene bags. The samples were labelled with details such as locality, host plant, date of collection and GPS co-ordinates (using the mobile app, GPS Map Camera Lite) and brought to the Insect Systematics Laboratory. Photographs of the live specimens were captured under a stereo zoom microscope (ZEISS) attached with digital camera (Axiocam 208 color). Adult female scales were preserved in plastic vials containing 70% ethyl alcohol, furnished with accession numbers, for further processing. The preserved adult female coccid specimens were slide mounted following the techniques outlined by Hodgson and Henderson (2000). Morphological characterisation of the slide-mounted specimens were carried out by studying under a phase contrast microscope (RADICAL RXLr-4) and photomicrographs were captured using the ProCAM Multi Port 8MP HD camera with image analyzing software RADICAL attached to the microscope. Morphometry of the specimens was also made with the same software and are presented in micrometers (µm). The terminology used for describing both live and slide-mounted scales was adopted from Hodgson and Henderson (2000). All the studied specimens were deposited in the collection of the Insect Systematics Laboratory of the Department of Agricultural Entomology. A distribution map for the species of Saissetiini was prepared using Quantum GIS software 3.28 version.

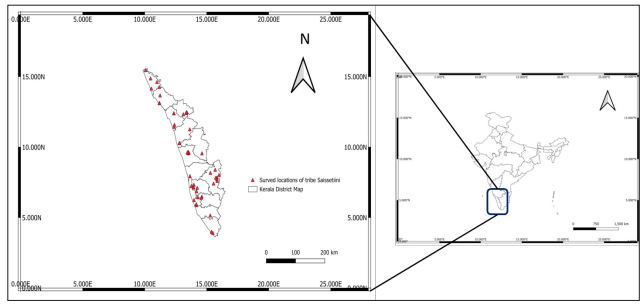

Fig. 1. Distribution of the tribe Saissetiini in Kerala, India

RESULTS AND DISCUSSION

This study reports three species of Saissetiini under two genera *viz.*, *Saissetia* and *Parasaissetia,* from different agroecosystems of Kerala state. The host plants and distribution details are provided in Table 1 and Figure 1.

Diagnostic characters of the tribe Saissetiini Hodgson

Dorsum typically convex and becomes heavily sclerotised with age, with distinct dermal aerolations. A broad submarginal band of ventral tubular ducts,

Table 1. Host association and distribution of Saissetiini in Kerala

Species	Host plant	Location (District & Locality)	GPS Co-ordinates in decimal degrees	
			Latitude (^{O}N)	Longitude (^{O}E)
Saissetia coffeae	*Tabernaemontana divaricata, Manilkara zapota, Psidium guajava, Coffeae arabica*	**Kasargod:** Nallompuzha, Padanakkad	12.3052 12.2636	75.3720 75.1273
	T. divaricata	**Kannur:** Kannothuchal	11.8847	75.3760
	Crossandra infundibuliformis, Ixora coccinea, Averrhoa carambola	**Kozhikode:** Kozhikode, Chelavoor	11.2438 11.3000	75.8266 75.8411

Saissetia coffeae	*C. arabica, Manilkara zapota, I. coccinea*	**Wayanad:**		
		Edakkal,	11.6140	76.2105
		Ambalavayal,	11.6278	76.2064
		Maaniveyil	11.5794	76.1169
	Wrightia tinctoria	**Malappuram:**		
		Tavanur	10.8136	75.9924
	T. coronaria, Gardenia jasminoides, Mangifera indica, Cycas revoluta, Plumeria alba, Coccinea grandis, Ficus hispida	**Thrissur:**		
		Mannuthy,	10.5355	76.2639
		Vellanikkara,	10.5481	76.2829
		Villadam	10.5621	76.2434
	C. arabica	**Palakkad:**		
		Nelliyampathy	10.5353	76.6930
	Citrus limon, Spathiphyllum wallisii	**Ernakulam:**		
		Nettor	9.9275	76.3198
	M. indica, M. zapota, Pseuderanthemum carruthersii, C. grandis, Phaleria macrocarpa	**Alappuzha:**		
		Krishnapuram,	9.1485	76.5145
		Haripad,	9.2821	76.4453
		Kayamkulam	9.1766	76.5178
	C. arabica, P. guajava, Gardenia jasminodes, I. coccinea, C. grandis, Ferula asafoetida, C. limon, Garcinia mangostana, Cestrum diurnum, Magnolia champaca, Zamia furfuraceae, Aristolochia indica, Aphanamimis polystachya	**Idukki:**		
		Pampadumpara,	9.7985	77.1644
		Santhanpara,	9.9598	77.2218
		Myladumpara,	9.8857	77.1560
		Adimali, Munnar	10.0149	76.9534
			10.0960	77.1015
	Abiu pouteria, Gardenia jasminodes, Psidium guajava, C. arabica	**Kottayam:**		
		Thalayazham,	9.6966	76.44194
		Kumarakom,	9.6241	76.4275
		Kavanatinkara,	9.3715	76.2535
		Nattassery	9.6117	76.5458
	Abiu pouteria	**Pathanamthitta**		
		Pullad	9.3445	76.6689
	C. arabica, Justicia adathoda	**Kollam:**		
		Chingavanam,	9.5188	76.5245
		Punalur	8.8682	76.9491
Saissetia oleae	*M.indica, Nerium oleander*	**Kasargod:**		
		Kolichal, Majarpalli	12.4387	75.3008
			12.7529	74.9478
	Cnidoscolus acontifolius, Gliricidia sepium	**Kozhikode:**		
		Peruvannamuzhi	11.6032	75.8244
	Morinda citrifolia	**Wayanad:**		
		Manniveyil	11.5794	76.1169
	M. indica, Rollinia deliciosa, S. cumini	**Thrissur:**		
		Mannuthy,	10.5355	76.2639
		Vellanikkara	10.5505	76.2828

Saissetia oleae	*M. zapota*	**Alappuzha:** Krishnapuram	9.1485	76.5145
	M. zapota, Cycas revoluta	**Idukki:** Maavadi,	9.8835	77.1190
		Murikkattukudy	9.7272	77.0499
	M. zapota	**Trivandrum:** Balaramapuram	8.3990	77.0305
Parasaissetia nigra	*S. aquaeum*	**Kasargod:** Chengala	12.5328	75.1014
	Hibiscus rosa-sinensis, Canna sp.,	**Kannur:** Kannur,	11.8756	75.3766
		Panniyoor	12.0813	75.3974
	M. fragrans, S. aromaticum, Cnidoscolus acontifolius	**Kozhikode:** Chelavoor,	11.3000	75.8411
		Peruvannamuzhi	11.6080	75.8223
	R. deliciosa	**Wayanad:** Ambalavayal	11.6319	76.2258
	Myristica fragrans, Cnidoscolus acontifolius	**Malappuram:** Kaalikavu	11.1773	76.3150
		Edappal	10.8098	75.9917
	Morinda citrifolia, Reulia tuberosa, M. fragrans, A. squamosa, Annona muricata, Alpinia purpurata, Blumea sp.	**Thrissur:** Mannuthy,	10.5355	76.2639
		Madakkathara,	10.5505	76.2827
		Kannara,	10.5782	76.2666
		Chirakkaikode	10.5499	76.2883
	S. jambos, A.squamosa, M. zapota	**Alappuzha:** Cherthala,	9.6566	76.3619
		Krishnapuram	9.1485	76.5145
	Terminalia catappa, Xanthostemon chrysanthus, H. rosa-sinensis, M. indica, Artocarpus heterophyllus	**Idukki:** Nedukandem,	9.8433	77.1518
		Murikkattukudy,	9.7272	77.0499
		Santhanpara,	9.9598	77.2218
		Myladumpara	9.8857	77.1560
	H. rosa-sinensis, Myristica fragrans	**Kottayam:** Kumarakom,	9.6241	76.4275
		Nattassery	9.6117	76.5458
	Manihot esculenta, S. samarangense	**Pathanamthitta** Thiruvalla,	9.3566	76.5618
		Thadiyoor	9.3786	76.6874
	H. rosa-sinensis	**Kollam:** Punalur	8.8682	76.9491
	S. cumini	**Trivandrum:** Vellayani	8.4309	76.9871

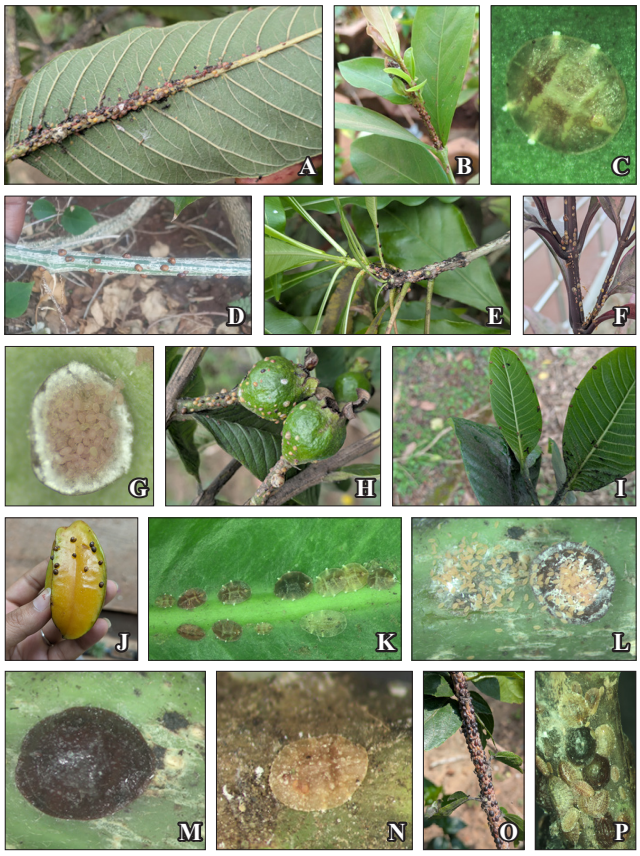

Fig. 2. Saissetiini (a-k, *Saissetia coffeae*) a. on guava congregated along the midrib of leaf, b. on shoot tip of *Ixora coccinea*, c. female with prominent 'H'-shaped ridge, d. on stem of ivy gourd, e. on the shoot of *Aristoalochia indica*, f. on the shoot of *Pseuderanthemum carruthersii*, g. mature adult female with eggs underneath body, h. on fruit & stalk of *Psidium guajava*, i. mature adult female below the leaf of *P. guajava*, j. on fruit of *Averrhoa carambola*, k. early instars congregated along the mid-vein; (l-n, *S. oleae*) l. mature adult female with eggs under the concave body, m. mature adult female dorsal view, n. early instar with white waxy granules on the body; (o-p, *Parasaissetia nigra*) o. congregation of scales along the shoot of hibiscus, p. colony of nymphs and adult females on the stem.

comprising one or two types present; dorsal tubular ducts absent. Eye spots near margin; dorsal submarginal tubercles and pocket like sclerotisations often present. Anal plate quadrate, with anterior margin never distinctly longer than posterior. Stigmatic cleft shallow, unsclerotised. Multilocular disc pores usually with 10 loculi, extending medially onto the thoracic region. Leg with or without tibio-tarsal sclerosis, claw without denticle; unsclerotised shallow stigmatic clefts, spiracle without sclerotic plate.

Key to genera of the tribe Saissetiini collected during the study

1a. Anal plate with discal setae (Fig. 4f); dorsal setae often spinose, with sharply pointed apices (Fig. 4h); leg with tibio-tarsal articulatory sclerosis (Fig. 3j); derm with distinct aerolations (Fig. 3f) .... ***Saissetia* Deplanche**

1b. Anal plate without discal setae (Fig. 5f); dorsal setae spinose, with clavate apices (Fig. 5g); leg without tibio-tarsal articulatory sclerosis; derm with numerous polygonal reticulations (Fig. 5e) .... ***Parasaissetia* Takahashi**

Genus: *Saissetia* Deplanche

Only two species were collected during the study *viz*., *S. coffeae* and *S. oleae.*

Key to the species of genus *Saissetia* Deplanche

1a. Anal plate without sclerosis around the margin (Fig. 3g); ventral tubular ducts of two types: type I -with broad inner ductule, present on medial sub marginal area and few ducts present around pro and meso coxa; type II -with broad narrow inner ductule, present on inner sub marginal area and medial area of thorax and abdomen (Fig. 3c) ..... ***coffeae* Walker**

1b. Anal plate with sclerosis around the margin (Fig. 4e); tubular ducts of only one type, each with narrow inner ductule, present in sub marginal area (Fig. 4g) .... ***oleae* Olivier**

***Saissetia coffeae* Walker, 1852**

Distribution: This species is cosmopolitan and a polyphagous pest on a wide range of ornamental plants. It has been documented from all zoogeographical regions (Zhang *et al*., 2018). It is particularly known as a pest of ornamental plants, with a notable preference for cycads (García Morales *et al*., 2016; Kondo and Watson, 2022; Paik, 1978; Kwon *et al*., 2005). In India, it has been reported from nearly all regions (Ali, 1968; Varshney, 1992).

Field characters: Adult females were broadly oval to nearly round and strongly convex. Mature adults were highly chitinised, with smooth, glossy brown coloured dorsal surface, typically with a layer of white silky wax protruding from beneath the abdomen, but not forming distinct ovisac (Fig. 2g). The integument was brown and sclerotized (Fig. 3a). The early developmental stages were yellowish and exhibited a characteristic 'H' shaped ridge on the dorsum (Fig. 2c), which became inconspicuous upon maturation (Fig. 3a). Adult female develops a concavity underneath the body, where light pinkish coloured eggs were laid (Fig. 2g). This species

was generally found on the leaves (Fig. 2a, i), along vein (Fig. 2k), fruits, stalks (Fig. 2h, j), shoots (Fig. 2b, f) and stem (Fig. 2d, e) of the host plants.

Diagnostic characters: Dorsum: dorsal setae spine-like with pointed apices and distal end expanded, flat, and frayed; dermal aerolations more prominent with age (Fig. 3f); dorsal tubercles present; dorsal tubular ducts absent; anal plate quadrate (Fig. 3g), discal setae conspicuous with pointed or frayed apex; three apical setae, without subdiscal setae. **Margin:** setae bifid or fimbriate, with branched apices (Fig. 3d); three spiracular setae with middle one longer than lateral setae (Fig. 3e). **Venter:** antenna 8 segmented (Fig. 3h); multilocular disc-pores, mostly with 10 loculi, located near vulva and sparsely distributed on the meso-meta coxae (Fig. 3i); legs each with tibio-tarsal articulatory sclerosis (Fig. 3j); submarginal band of ventral tubular ducts with expanded filaments, scattered across venter (Fig. 3c).

Remarks: Commonly called the 'brown scale' or 'hemispherical scale' (BenDov, 1993). This species was collected on 27 plants belonging to 21 families. Tewlve new host plants are recorded for the species *viz., Crossandra infundibuliformis, Averrhoa carambola*, *Ficus hispida, Spathiphyllum wallisii, Phaleria macrocarpa, Ferula asafoetida, Garcinia mangostana, Magnolia champaca, Aphanamimis polystachya, Abiu pouteria, Wrightia tinctoria* and *Justicia adathoda*.

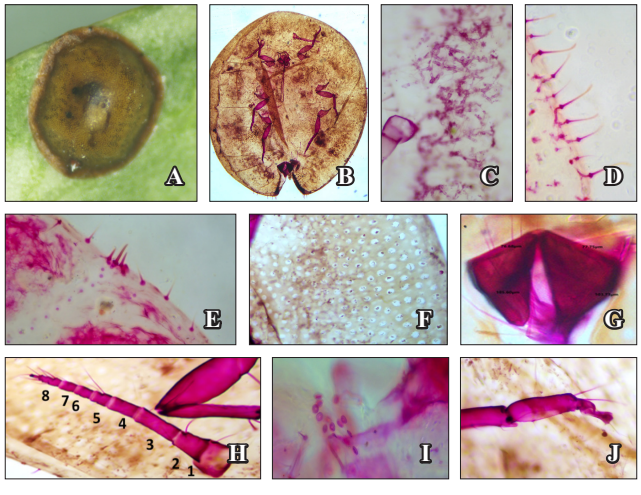

Fig. 3. *Saissetia coffeae* Walker a. Adult female, b. Habitus, c. Submarginal tubular ducts, d. Marginal setae, e. Body derm, f. Anal plate, g. Antenna, h. Multilocular pores, i. Tibio-tarsal sclerosis

4.1.2.1.2.1.2. *Saissetia oleae* Olivier, 1791

Distribution: *Saissetia oleae* is a cosmopolitan species with a wide distribution across all zoogeographical regions (Gill and Kosztarab, 1997; Kondo and Watson, 2022). It is a major pest of citrus, olive and ornamentals in many countries and Mediterranean region (Bodenheimer, 1951; Bartlett, 1978). It was also reported as a significant pest in Brazil (Ricalde *et al*., 2014), Argentina (Murua and Fidalgo, 2001), Peru (Lazo *et al*., 2008) and Uruguay (Vilamil and Albin, 2006).

Field characters: The body orange-yellow or grey in early stages, turning light brown or black colour on maturity (Fig. 2m). The dorsal surface rough, highly chitinized, and strongly convex. All developmental stages with a prominent median longitudinal ridge intersected by two transverse ridges, forming a characteristic "H"-shaped pattern (Fig. 2n). Small areas of clear, greyish to colourless wax granules were present on the dorsum (Fig. 4a). Adult female deposit eggs underside body (Fig. 2l). The scale was found infesting both leaves and shoots of host plants.

Diagnostic characters: Dorsum: dermal aerolations prominent in older females; dorsal setae pointed (Fig. 4h); anal plate quadrate with a sclerotized area surrounding them (Fig. 4e) and a conspicuous discal seta, but not fimbriate (Fig. 4f). **Margin**: Marginal setae pointed or with slightly fimbriate apices (Fig. 4c). **Venter**: Multilocular disc pores abundant around the vulvar area extending upto second abdominal segment, usually with 10 loculi; tubular ducts each with a narrow inner ductule restricted to the submarginal area (Fig. 4g); legs with tibio-tarsal articulation; antenna 8 segmented (Fig. 4d).

Remarks: Commonly called as 'black scale' or 'olive scale' (BenDov, 1993). This is the first report of the species from Kerala state. It was collected on nine plants belonging to nine families. *Cnidoscolus acontifolius, Gliricidia sepium, Morinda citrifolia, Rollinia deliciosa* and *Syzygium cumini* are documented as new host plants for this scale.

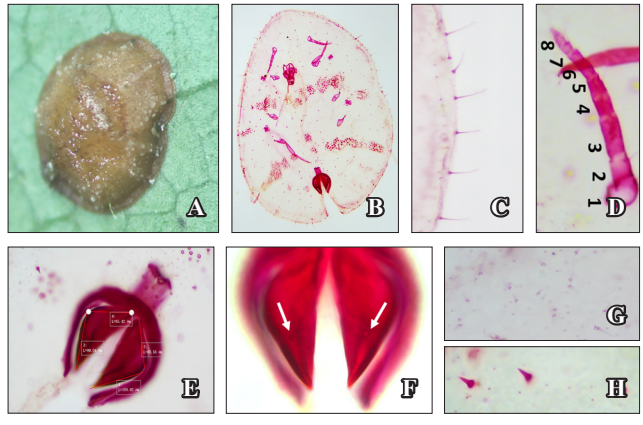

Fig. 4. *Saissetia oleae* Olivier a. Adult female, b. Habitus, c. Marginal setae, d. Antenna, e. Anal plate, f. Discal setae, g. Tubular ducts, h. Dorsal setae

4.1.2.1.2.2. Genus: *Parasaissetia* Takahashi

Only one species under the genus was collected during the study.

4.1.2.1.2.2.1. *Parasaissetia nigra* Nietner, 1861

Distribution: It was recognised as a cosmopolitan pest, reported from all zoogeographical regions and recorded on host plants belonging to over 100 families (García Morales *et al*., 2016; Gill and Kosztarab, 1997; Kondo and Watson, 2022). Waterhouse and Norris (1987) regarded *P. nigra* as a major crop pest in the Pacific region. This scale insect was reported on wide host range from different parts of India and also from Kerala (Ali, 1968; Kondo and Lin, 2022).

Field characters: Adult female typically convex and elongate to oval; body oval to almost circular, and colour varied depending on the host plant (Fig. 2o). Mature females were with brown or red mottling initially, later turned shiny dark brown, castaneous, or deep purple-black, and often darkening with age (Fig. 5a). The dorsum exhibited a slight median longitudinal carina and shallow lateral depressions, and was usually humped above the abdomen. At immature stages, body was less convex, elongate to narrow, translucent yellow, and mottled (Fig. 2p).

Diagnostic characters: Dorsum: Mature adult female derm with distinct polygonal reticulate pattern (Fig. 5e); dorsal setae often slightly capitate with clavate apices (Fig. 5g); dorsal tubular ducts absent; anal plate quadrate (Fig. 5f), each with four apical setae, but lacked discal setae; preopercular pores prominent anterior to anal plate. **Margin:** with slightly enlarged, fimbriate marginal setae (Fig. 5c). **Venter:** tubular ducts in asubmarginal band around the body margin, absent from median area of the venter (Fig. 5h); multilocular pores usually with 10 loculi, concentrated at the vulvar region; antennae 7 or 8 segmented (Fig. 5d), leg without tibio-tarsal sclerosis.

Remarks: Commonly called as 'hibiscus scale' or 'black scale' (Kondo and Lin, 2022). This specimen was collected on 22 plants belonging to 15 families. New host plants are recorded in the study *viz., Rollinia deliciosa, Reulia tuberosa, Annona squamosa* and the weed plant, *Blumea* sp.

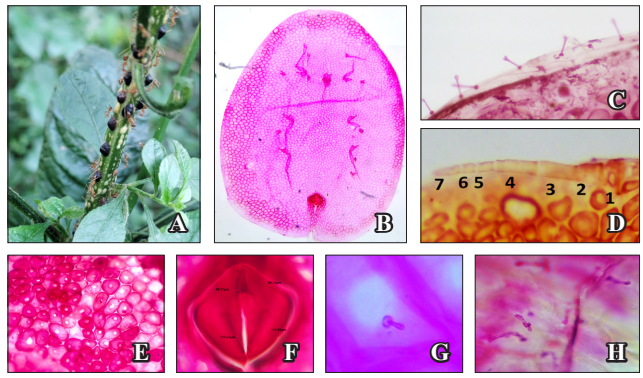

Fig. 5. *Parasaissetia nigra* Nietner a. Adult female, b. Habitus, c. Marginal setae, d. Antenna, e. Body derm, f. Anal plate, g. Dorsal setae, h. Tubular ducts

CONCLUSION

The present study documents distribution, and host range of three soft scale species of the tribe Saissetiini *viz*., *S. coffeae*, *S. oleae*, and *P. nigra* from Kerala. These species were found infesting a wide range of host plants across agricultural, horticultural, forest, and ruderal habitats, and several new host associations are recorded. The tribe Saissetiini possesses significant ecological adaptability and potential economic importance as polyphagous pest in tropical agroecosystems. The detailed morphological descriptions and key diagnostic characters presented in this study will aid in accurate identification and future taxonomic and ecological assessments. Several new hosts are recorded for the soft scales indicating their adaptability to wider host range in the region. In the changing climatic scenario, there is a chance that these scale insects further expand their host range and turn invasive, posing threat to agroecosystems.

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