Descriptions of Three Economically Important Species of Root-Feeding Mealybugs in Japan (Hemiptera: Pseudococcidae)

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Two new root-feeding species of the genus Rhizococcus from Japan are described and illustrated: R. theae, n. sp., collected from Thea sinensis in Shizuoka-ken is close to R. kondonis, from which it is distinguished by fewer ventral multilocular disc pores and by having only one circulus. R. hibisci, n. sp., collected from various potted ornamentals in Tokyo and from Hibiscus rosasinensis in Kagoshima-ken is allied to R. fulceifer and R. nitidalis, but it is distinct in having bitubular pores instead of tritubular ones. Furthermore, a redescription of R. kondonis, a pest of citrus in Japan, is given.

The Japanese species of the genus Rhizococcus Künckel d’Herculais has been represented by a single citrus ground mealybug, R. kondonis Kuwana. In the present paper two new species, both feeding on the roots of some cultivated plants in Japan, are described and illustrated. Furthermore, a redescription of R. kondonis is given.

The slide-mounted specimens studied in this paper are deposited in the Entomological Institute, Hokkaido University, Sapporo and in the Tokyo Agricultural Experiment Station, Tachikawa.

Rhizococcus theae, n. sp.

(Japanese name: Chano-ne-Konakaigaramushi), (Fig. 1)

Adult female: As mounted on slide, body slender, lateral sides almost parallel or slightly contracted near middle in young specimens, body segments little lobed laterally; length about 0.9–2.2 mm. Antennae 5-segmented, relatively stout, about 200 μ long; apical segment bearing 5 sensory setae, 4 of them moderately stout, elongate, falciform with apex rounded, the other slenderer, tapering apically; penultimate segment without sensory seta. Eyes absent. Cephalic plate weakly sclerotized. Rostrum about 80 μ long in combined distal 2 segments. Legs well developed; hind trochanter+femur about 145–150 μ long, the femur about 55 μ wide; hind tibia+tarsus about 160–165 μ long, the tibia about 36 μ wide; tarsal claws elongate, those of hind legs about 38 μ long, the digitule indiscernible. Legs without micropores. Apparently, only 1 circulus present on 4th abdominal segment,
Fig. 1. *Rhizoecus thore*, n. sp. Adult female.
A: Body;  B: Apical segment of antenna;  C: Distal part of hind leg;
D: Anal ring;  E: Anal lobe.
broadly oval with a narrow sclerotized rim, about 25 μ wide. Two pairs of dorsal ostioles well developed, the lips broadly sclerotized on inner edge, each with 12–15 trilocular pores and a few small setae. Anal ring cellular, about 50 μ wide; bearing 6 setae about 70 μ long at maximum. Distinct cerarii absent. Anal lobe moderately developed in young specimens; dorsum of anal lobe with 6–7 elongate setae about 80 μ long at maximum and arising at weakly sclerotized oblong area; venter of anal lobe un sclerotized; anal lobe seta about 75–85 μ long.

Dorsum beset with numerous fine setae, those occurring along margin and median area of posterior abdominal segments elongate. Trilocular pores evenly distributed within the limits of each segment. Multilocular disc pores absent. Bitubular pores present, small, formed of a sclerotized cone and 2 curved tubes produced beyond apex of the cone, about 20–23 in number on dorsum arranged in marginal series with 1 pore on each of most abdominal and thoracic segments, median series with 4–5 pores including 1 near anterior margin of head, and intermediate series with 2–3 pores. Minute tubular ducts present in moderate numbers on 4th to 9th abdominal segments, distributed in transverse rows across the segments; a few scattered laterally on 3rd.

Ventrally with numerous fine setae somewhat smaller in size than those on dorsum. Trilocular pores moderately sparsely scattered. Multilocular disc pores confined to venter, a total of 30–50 on 7th to 9th abdominal segments. Bitubular pores very few, a total of 4–7 on posterior portion of abdomen. Some minute tubular ducts present on most abdominal segments.

Specimens examined: Kanaya, Shizuoka-ken, on the roots of Thea sinensis.

Remarks: This species is very close to R. kondonis, from which it is distinguished by fewer ventral multilocular disc pores (90–120 in kondonis, whereas at most 50 in theae), and by having only one circulus. This species is also quite close to R. spinosus McKenzie from California. So far as based on McKenzie’s (1960) original description of spinosus, however, this species differs in possessing minute tubular ducts on the abdomen both dorsally and ventrally, in having fewer ventral multilocular disc pores, etc.

This mealybug is found in the soil mostly at the depth of about 10 cm; 20–50 individuals are usually obtained from 100 g of the soil of a tea garden at Kanaya by Takagi’s (1970) centrifugal-flotation method. The damage on tea bushes caused by this mealybug is manifested in poor growth of new shoot and in abnormal defoliation during winter. These symptoms become more severe under unfavourable conditions to tea plants in edaphic factor and drainage of the tea garden.

**Rhizoeus kondonis** Kuwana,

(Fig. 2)

*Rhizoeus kondonis* Kuwana 1923: 55; Hambleton 1946: 56;
Ferris 1953: 448; McKenzie 1960: 749; ibid. 1967: 394

Adult female: Body in slide-mounted specimens slender, elongate, lateral sides almost parallel, each segment weakly produced laterally in young specimens; length about 1.5–2.2 mm. Antennae 5-segmented, moderately slender, about 280 μ long; 4 thick, falcate and 1 thinner finger-like sensory setae on apical segment, wanting on
Fig. 2. *Rhizoeus kondo* KUWANA. Adult female.
A: Body; B: Apical segment of antenna; C: Distal part of hind leg;
D: Anal ring; E: Anal lobe.
penultimate segment. Eyes lacking. Cephalic plate obscure. Rostrum about 100 μ long in combined distal 2 segments. Legs well developed; hind trochanter+femur about 180–190 μ long, the femur about 70 μ wide; hind tibia+tarsus about 190 μ long, the tibia about 33 μ wide; tarsal claws elongate, those of hind legs about 40 μ long, the digitules very short, fine, apically acute. Legs without discernible micropores. Two circuli present, situated on 3rd and 4th abdominal segments, each with a broadly oval, narrow sclerotized rim; the one on 4th segment larger, about 50–60 μ wide. Two pairs of dorsal ostioles well developed, the lips moderately sclerotized on the inner edge, each with 15–20 trilocular pores and a few small setae. Anal ring cellular, about 56 μ wide; bearing 6 setae about 70 μ long at maximum. Distinct cerarii absent. Anal lobe well developed in young specimens; dorsum of anal lobe with 6–8 elongate setae about 120 μ long at maximum and arising from a faintly sclerotized oblong area; venter of anal lobe unsclerotized; anal lobe seta about 110–120 μ long.

Dorsal surface densely clothed with fine setae, those occurring along margin and median area quite long. Trilocular pores evenly distributed within the limits of each segment. Multilocular disc pores lacking, but at times 1–3 present near posterior border of 8th abdominal segment. Bitubular pores present, small, formed of a sclerotized cone and 2 curved tubes, as many as 20–23 on dorsum, arranged in marginal series with 1 pore on each of most abdominal and thoracic segments, median series with 4–5 pores including 1 near anterior margin of head, and intermediate series with 2–3 on thorax and abdomen. Minute tubular ducts present on all abdominal segments, each with a small sclerotized rim; in considerable numbers in transverse rows across segments 3rd to 9th, a few scattered laterally on 1st and 2nd.

Ventral surface with numerous setae somewhat smaller than those on dorsum and occurring in associated with the trilocular pores, both forming together a common pattern of distribution on the thorax and head. Multilocular disc pores present on 7th to 9th abdominal segments, a total of about 90–120 in number. Bitubular pores sparse, arranged singly on margins of 5th to 9th abdominal segments, there being also 1 or 2 in the submedian area. Minute tubular ducts rather numerous, present on most of abdominal segments.

Specimens examined: Kanaya, Shizuoka-ken, on the roots of Citrus unshiu: Haibara, Shizuoka-ken (H. Kurano leg.); Izumi, Osaka-fu (Y. Kimura leg.); Kishiwada, Osaka-fu (Hiraoka leg.); Oku-anrakugawa, Wakayama-ken (K. Hiramatsu leg.); Katsurara, Tokushima-ken (S. Okudai leg.); on the citrus roots, respectively.

Remarks: This species is probably most closely related to R. spinosus, but differs from the latter in the possession of both dorsal and ventral minute tubular ducts on abdomen, and in the normal presence of two circuli on third and fourth abdominal segments (in spinosus only one circlus is present).

This species was originally described from specimens collected on the roots of orange at Wakayama-ken and Shizuoka-ken. Since that time this mealybug is known as a pest of considerable importance on citrus in Japan. The biology and control methods of this mealybug were studied in detail by Yoshida and Kubota (1962), and a wide variety of host plants, besides Rutaceae, were observed. McKenzie (1960) pointed out that this species is one of the more wide-spread and economically important forms of subterranean mealybugs in California, aggressively feeding on the roots of alfalfa, strawberry and prune trees and causing serious damage.
Fig. 3. *Rhizococcus hibisci*, n. sp. Adult female.

A: Body; B: Apical segment of antenna; C: Distal part of hind leg; D: Anal ring; E: Anal lobe.
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There are some discrepancies between the Japanese specimens and the descriptions and figures of "R. kondonis" given by Ferris (1953) and McKenzie (1967), which are based upon specimens collected from prevet in Menlo Park, California. In the present specimens the abdominal segments have numerous minute tubular ducts, which are lacking in Ferris' and McKenzie's figures, and the bitubular pores and the ventral multilocular disc pores are more numerous than in the Californian specimens.

*Rhizococcus hibisci*, n. sp.

(Japanese name: Hibiscus-ne-konakaigaramushi), (Fig. 3)

Adult female: As slide-mounted, body elongate oval, each segment more or less lobed laterally in young specimens; length about 1.2–2.2 mm. Antennae 5-segmented, moderately slender, about 250 μ long; 4 thick, falcate and 1 thinner finger-like sensory setae on apical segment, wanting on penultimate segment. Eyes absent. Cephalic plate weakly sclerotized, roughly triangular. Rostrum about 100 μ long in combined distal 2 segments. Legs well developed; hind trochanter+femur about 200 μ long, the femur about 70 μ wide; hind tibia+tarsus about 200 μ long, the tibia about 45 μ wide; tarsal claws elongate, those of hind legs about 40 μ long, the digitules not discernible. Legs without micropores. Circulus usually absent, but occasionally 1 present on 4th abdominal segment, small, circular, with a narrow sclerotized rim. Two pairs of dorsal ostioles well developed, their lips moderately sclerotized at inner edge, with a few trilocular pores and small setae. Anal ring cellular, about 60 μ wide; bearing 6 setae about 70 μ long at maximum. Distinct cerarii absent. Anal lobe moderately developed in young specimens; dorsum of anal lobe with 3–4 elongate setae about 100 μ long at maximum and arising from a well sclerotized area; venter of anal lobe unsclerotized; anal lobe seta about 110 μ long.

Dorsum moderately sparsely clothed with fine setae, those of abdomen mostly about 15–40 μ in length; longer setae of marginal area up to 70 μ in length. Trilocular pores numerous, evenly distributed within the limits of each segment. Multilocular disc pores confined to abdomen, but occasionally 1–2 are found on prothorax marginally; a few on lateral margin on each abdominal segment; 1–2 submedian pores on anterior 4 segments; fairly numerous in transverse rows on 5th and 6th. Bitubular pores in 2 types different in size, with tubes rather stout, straight and arising on a sclerotized patch; larger type rather sparse, confined to the dorsum, arranged in marginal series with 1 pore on each of most abdominal and thoracic segments, median series with 4–5 pores including 1 near anterior margin of head, and intermediate series with 1–2 on abdomen, totaling as many as 20–23 so far as observed; the smaller one present in moderate numbers on 5th and 6th abdominal segments, distributed in transverse rows across these segments, with a few marginally on succeeding 3 segments. Tubular ducts of other kinds evidently lacking.

Venter beset with numerous trilocular pores and a relatively small number of fine setae in more or less isolated patches, leaving rather marked "clear areas". Multilocular disc pores present in considerable numbers on 4th to 10th abdominal segments, divided into medio-submedian and margino-submarginal series; a few on
marginal and sternal areas of thorax. Usually, 2–4 uncertain simple circular pores discernible on 3rd and 4th abdominal segments, with a diameter slightly greater than that of a trilocular pore. Bitubular pores belong definitely to smaller type, rather numerous on 5th to 10th abdominal segments, divided into medio-submedian and margino-submarginal series. Tubular ducts of other kinds lacking.

Specimens examined: Tachikawa, Tokyo, on variegated Carex sp. Crinum asiaticum, Cuphea hyssopifolia, Deffenbachia sp., variegated Hakonechloa macra, Nerium oleander, Pelargonium sp., Phoenix canariensis, Sabal sp.: Kagoshima, Kyushu, on Hibiscus rosasinensis (K. Nagata leg.). Collected on the roots of the host plants in greenhouses.

Remarks: This species is perhaps allied to R. falcifer Künckel d'Herculais, as defined by Ferris (1953), and R. nitidalis Hambleton, both of which lack circulus, have two types of tubular pores different in size and have multilocular disc pores both dorsally and ventrally. The latter two species have, however, tribital pores instead of bitubular pores. R. hibisci also resembles to R. carolinensis Beardsley except that in the latter the body is much smaller and both multilocular disc pores and smaller bitubular pores are less numerous.

This mealybug appears to be a greenhouse-pest which is exceedingly omnivorous occurring on the roots of various potted ornamentals, and occasionally causes serious damage to Cuphea, Hibiscus, Pelargonium, Phoenix, etc.

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REFERENCES


