Statens Planteavlsforsøg **1364. beretning**
Statens plantepatologiske Forsøg (H. Ingv. Petersen)
Zoologisk afdeling (K. Lindhardt)

Some soil mealybugs *(Homoptera: Pseudococcidae)* found in Denmark

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Summary
An account is given of seven species of mealybugs found in soil in Denmark, with data on host plants and distribution. Three of these mealybugs solely habit on the roots and belong to the soil-inhabiting or hypogaeic group. The other four do not live permanently in soil and are here named as soil-occurring species. A key to six genera is presented.

Key word: Coccids.

Resumé
Nærværende beretning omhandler syv arter af uldlus, som lever i jorden. Tre af arterne er nært knyttet til planternes rødder, medens de fire øvrige kan træffes på såvel planternes underjordiske som overjordiske dele.

Der er redegjort for de enkelte arters udbredelse og værtplanteforhold, ligesom der er udarbejdet en nøgle til bestemmelse af seks af arterne.

Nøgleord: Uldlus.

Introduction

The mealybugs, which may be found in soil and on the roots of plants, can be classified in two groups: soil-inhabiting forms and soil-occurring forms.

The representatives of the first group are true subterranean, hypogaeic mealybugs, which solely live and feed on plant roots. These coccids belong to the family *Pseudococcidae* and were defined by *Williams* (1969) in the tribe *Rhizoecini*. The hypogaeic mealybugs differ from most *Pseudococcidae* by some characters, such as 4–6 segmented antennae set closely together on the head, short legs, bitubular or tritubular pores consisting of 2 or 3 small ducts placed closely together in a twisted position. The hypogaeic mealybugs of the world were monographed by *E.J. Hambleton* (1946) and later on studied by *Hambleton* (1973, 1974) and by *Beardsley* (1959, 1966). According to Hambleton and Beardsley soil-inhabiting mealybugs are common and widely distributed elements of the soil fauna and occur in all zoogeographical regions of the world. They may become abundant and cause damage or even kill their host plants and, therefore, in recent years some species of subterranean mealybugs have become of increasing importance in the production of commercially grown plants.

The members of the second group or soil-occurring coccids, as the name implies, do not habit permanently in soil. Some species live on the subterranean parts of the plants and occasionally move up to the stems and leaves. On the other hand, other ones feed on the upper parts, but sometimes may be found on the roots in soil. Some more species are known to occur in the ground or on the surface of soil under stones and pieces of wood in connection with ants. The re-

presentatives of the second group refer to several coccid families, except such as *Ortheziidae, Margarodidae, Pseudococcidae, Coccidae.*

This paper presents Danish soil mealybugs from the family *Pseudococcidae* only. Up to now seven species from this family have been found. They are mostly greenhouse species, except *Spinococcus calluneti* (Lind.) and *Chnaurococcus subterraneus* (Newst.), which were found in the open. Three species belong to the soil-inhabiting group, such as *Geococcus coffeae* Green, *Rhizoecus cacticans* (Hambl.) and *R. dianthi* Green. The other four refer to the soil-occurring group of coccids.

Key to Genera

1. Anal lobes strongly protuberant and sclerotized, each bearing at apex a single large spinelike process nearly as long as the lobe ..... *Geococcus* Green
   Anal lobes less protuberant, without such a large spinelike process ..... 2.
2. (1) Bi- or tritubular pores present somewhere on the body, antennae 5- or 6-segmented, set closely together on head ..... *Rhizoecus* Künckel d'Herculais
   Bi- or tritubular pores lacking, antennae 6- to 9-segmented, set further apart on head ..... 3.
3. (2) Oral rim ducts present somewhere on the body ..... 4.
   Oral rim ducts lacking ..... 5.
4. (3) With from 0 to 4 pairs of cerarii present ..... *Chorizococcus* McKenzie
   With from 6 to 17 pairs of cerarii present ..... *Spilococcus* McKenzie
5. (3) With 17–18 pairs of cerarii with conical setae, antennae 8–9 segmented, quinquelocular pores present on venter ..... *Spinococcus* Borchsenius
   Cerarii confined to anal-lobe pair, antennae 6-segmented, quinquelocular disc pores absent
   Chnaurococcus Ferris

1. Geococcus coffeae Green

Geococcus coffeae Green, 1933, Stylops 2; *Williams,* 1958, Bull. Brit. Mus. (Nat. Hist.), Ent. 6 (8); *Beardsley,* 1959, Proc. Haw. Ent. Soc., 17 (1); Ibid., 1966, 19 (2).

Up to date only one collection of this rather unique mealybug has been made in Denmark. Specimens were found on the roots of different plants, by Kozarzhevskaya and Reitzel, 18/7 1972, at Botanical Garden, Århus University (adult females with ovisacs, eggs and larvae). Insects, presumably immigrants from Thailand, were imported on the roots of plants to greenhouses and spread rapidly.

The habitat of this species was not described by Green in his original description, and until now no information is available on appearance of this mealybug in life.

The mealybug has a milky-white colour. The body form of larvae and females is ovally elongate. Adult females with ovisacs are broadly elongate, almost immobile. Antennae and legs are light yellow.

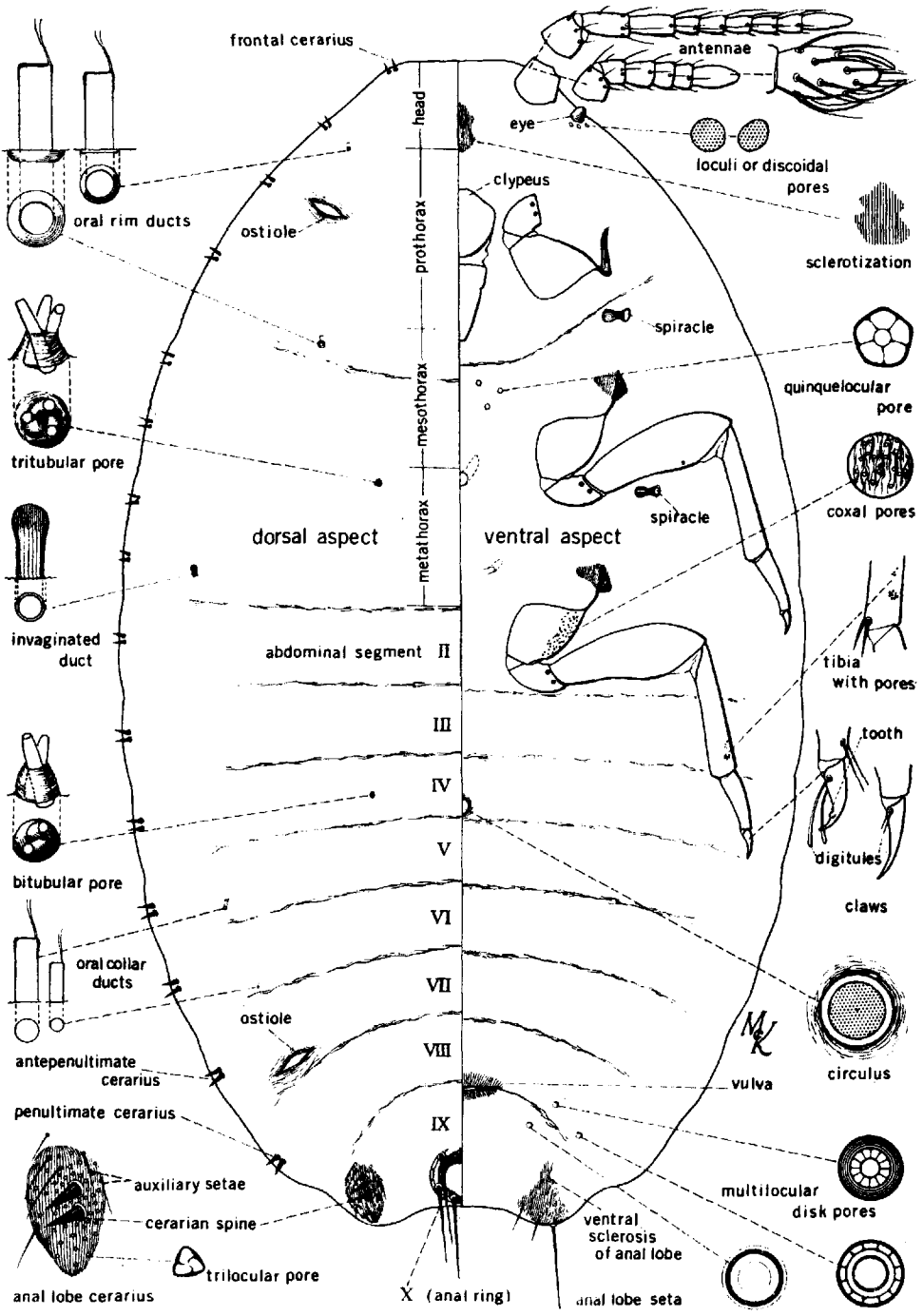
This species should not be mistaken to be any other Danish soil coccid because of large sclerotized dark brown spines at anal lobes, a pair of smaller spines dorsally between bases of anal lobes and similar spines on the head. Other distinguishing differences are: presence of 3 circuli, two sizes of tritubular pores, multilocular disc pores and absence of tubular ducts.

Hosts

Roots of many plants. In Denmark recorded from *Caesalpinia pulcheriana, Capsicum annua, Coffea arabica, Coleus sp., Diaspiros montanus, Eleusine indica, Eranthemum variegatum, Ficus religiosa, Strobilantus, Aechmea miniata, Billbergia nutans* and some species belonging to *Laeaceae.* The type host is *Coffeae liberica.*

Distribution

Originally described from Dutch Guiana. *G. coffeae* is distributed widely on tropical and subtropical areas of the world.



Generalized and semidiagrammatic drawing representing morphological structures of the mealybug family, Pseudococcidae.
From McKenzie 1960

Rhizoecus Künckel d'Herculais

Only two species of *Rhizoecus* are known from Denmark and these may be separated by the following key:

Body elongate, circulus present: *cacticans* (Hambleton).

Body broadly oval, circulus lacking: *dianthi* Green.

2. R. cacticans (Hambleton)

Ripersiella cacticans Hambleton, 1946, Rev. de Ent. (Rio de Janeiro), 17 (1–2). *Rhizoecus cacticans* (Hambleton), *Williams,* 1962, Bull. Brit. Mus. (Nat. Hist.) Ent., 12 (1), *McKenzie,* 1967, Mealybugs of California, Univ. Calif. Press.

Specimens examined all originates from greenhouses and were collected by Kozarzhevskaya and Reitzel. They include the following localities: Zealand: Ishøj, 13/4 1972; Ballerup, 13/4 1972; Botanical Garden, Copenhagen University, 9/8 and 18/8 1972 (adult females, larvae different stages and eggs). Jutland: Herning, 18/7 1972 (adult females, eggs in abundance); Botanical Garden, Århus University, 18/7 1972 (adult females).

The body form of adult female is ovally elongate. Eggs are white, ovally elongate.

The important characters separating *R. cacticans* from other Danish soil mealybugs are its well developed legs, elongate, weakly knobbed digitules, extending to or beyond tip of claw, short, stout 6-segmented antennae, comparatively large anal ring with 32–40 mostly subtriangulate or quadrate large cells, absence of multilocular disc pores and presence of small tubular ducts on dorsal and ventral surfaces.

Hosts

Roots of many plants. In Denmark known from *Aconium arborea atropurpurea, A. arborea f. variegata, Binghamia humboldtii, Caesalpinia pulcheriana, Hexachlamys edulis, Mammilaria sp.* and *Vriesia splendens.* The type hosts is Yorkshire fog, *Holcus lanatus (Graminea).*

Distribution

Originally described from Ecuador. At present reported from North and South America and from some European countries.

3. R. dianthi Green

Rhizoecus dianthi Green, 1926, Ent. Month. Mag., 62, *Williams,* 1962, Bull. Brit. Mus. (Nat.Hist.) Ent. 12 (1).

For *R. dianthi* in Denmark two records are based on specimens collected by Kozarzhevskaya and Reitzel, on roots of several plants, 18/7 1972, at Botanical Garden, Århus University (mainly adult females, several young females and a lot of crawlers) and 9/8 1972, at Botanical Garden, Copenhagen University (adult female, larvae different stages and adult males).

Since Green (1926) recorded the male of *R. dianthi,* pictured its general form and showed its length, which is less than one millimetre, nobody else has mentioned it in literature.

On the base of our observation the species secretes wax which gives the soil white appearance, when the insects are numerous. Heavy infestation was observed on *Withania somnifera* and *Chlorophytum comosum* in the Botanical Garden, Copenhagen University. All roots and soil in pots were quite white and on first view looked like fungus disease.

The body of the adult female is white, broadly oval; for young female slightly elongate. Males with dark red eyes. Larvae are very mobile, young females less and adult females almost immobile. No eggs have been observed; this species seems to be viviparous.

Other helpful identification characters are its very small eyes, 6-segmented antennae, few large oval areas on posterior coxae, very short, pointed digitules on slender claw, absence of tubular ducts and the presence of a few multilocular disc pores on posterior abdominal segments only.

Hosts

Known from the roots of *Adiantum sp., Aspidistra lurida, Chlorophytum sp., Dracaena stricta, Eryngium bromeliaefolium, Fuchsia sp.* In Denmark recorded from the roots of *Aeonium spraegeri, Chlorophytum comosum, C. capansa,*

Disphyma crassifolium, Pelargonia odoratissimum, P. quercifolium, Solanum sodomaeum, Withania somnifera, Yucca aloifolia. The type species are *Dianthus plumarius* and *D. barbatus.*

Distribution
This species was described from England and later mentioned from Sweden.

4. Chorizoccoccus brevicruris McKenzie
Chorizococcus brevicruris McKenzie, 1960, Hilgardia, 29 (15); 1967, Mealybugs of California, Univ. Calif. Press.

This species is reported to occur on upper and subterranean crowns and roots of succulent host plants. According to McKenzie's original description it was not observed by him on the subterranean parts of plants.

In Denmark two records are known for *C. brevicruris.* Adult females were collected by H. Philipsen in Zealand, 9/6 1972, Roskilde and Hjelmsølille.

Rather extensive damage on *Stapelia* and *Huernia* plants was observed in greenhouses in the Copenhagen district.

The body is ovally elongate, light pinky-violet, with white waxy secretion. According to *McKenzie* (1967) the eggs and first instar nymphs are light pink in colour, ovisac is filamentous and »sticky«, which may cover the entire adult female body.

Some useful identification characters of *C. brevicruris,* which is not presented in the key, are its small and slender dorsal body setae, comparatively short and stout legs with small translucent dots or pores on hind femur and tibia, claws without denticle and with long ungual digitules, multilocular disc pores and two sizes of tubular ducts and absence of circulus.

Hosts
The mealybug is reported as a rather serious pest of *Huernia spp.* and *Stapelia spp. (Asclepiadaceae).* Found on *Myrtillocactus geometrizans (Cactaceae).* In Denmark known from the roots of *Huernia* and from the upper parts of *Stapelia* (in abundance). The type plant is *Caralluma nebrowni (Asclepiadaceae).*

Distribution
Known from North America (Arizona and California). Holotype female on succulent plant taken in quarantine at Honolulu, Hawaii from California.

5. Spilococcus cactearum McKenzie
Spilococcus cactearum Mc Kenzie, 1960, Hilgardia, 29 (15); 1967, Mealybugs of California, Univ. Calif. Press; *Williams,* 1962, Bull. Brit. Mus. (Nat. Hist.) 12 (1).

For *S. cactearum* in Denmark two records are known; these are both from Zealand: Hjelmsølille, 9/6 1972, collected by H. Philipsen (adult females and third stage larvae) and Copenhagen, in private house, 15/3 1973, found by W. Buch (adult females, first stage larvae and adult male).

The body of the adult female is broadly oval, covered with a light grey secretion, green inside. In potash specimens turned purpur-black.

S. cactearum may be readily distinguished by the presence of rather large oval circulus, few translucent pores on posterior coxae and tibia, denticle on the claw, multilocular disc pores and two sizes of tubular ducts on ventral surface.

Hosts
As far as known, the species confined to the *Cactaceae.* In Denmark it was found on the green fleshy parts and between spines of *Echinopsis sp.* and on the roots of other cactus plants. The type plant is *Homalocephala texensis (Cactaceae).*

Distribution
Originally described form California. Distributed in USA, Mexico and greenhouses in Europe.

6. Spinococcus calluneti (Lindinger)
Pseudococcus calluneti Lindinger, 1912, Die Schildläuse *(Coccidae)* Eur., Nordafr. und Vorderasiens, einschliesslich der Azoren, der Kana-

ren, und Madeiras, Stuttg. *Spinococcus calluneti* (Lindinger), *Williams,* 1962, Bull. Brit. Mus. (Nat. Hist.) Ent., 12 (1).

Up to now only one record is known for this species. The insect was found by sieving the soil under a young oak in fir forest, by H. Kauri (from Norway), at Jutland, Filsø avlsgård, 14/8 1972. Mealybugs were sent by H. Kauri to Ossiannilsson (Sweden), who kindly informed about it.

No information available on appearance of this insect alive. It lives and feeds mainly on the roots, but occur on the upper parts of the stems as well.

The original description is very short and not illustrated. Perfect pictures and description were given by *Danzig* (1960) and *Williams* (1962).

Except distinguishing differences given in the key *S. calluneti* may be identified on such characters as 18 pairs of cerarii, a distinct denticle on the claw, small and round circulus, two conical setae on a large sclerotized plate nearly same size as anal ring on anal lobe cerarii, multilocular disc pores and tubular ducts on both surfaces.

Hosts

Apparently confined to *Calluna spp.* and *Erica spp. Mentioned on Vaccinium spp., Empetrum nigrum, Oxycoccus quadripetalus, Ramischia secunda* and wild strawberry. The type host is *Calluna vulgaris.*

Distribution

Originally described from Germany. Known from England, Germany and USSR (Leningrad region and Latvia).

7. Chnaurococcus subterraneus (Newstead)

Ripersia subterranea Newstead, 1893, Ent. Month. Mag. 29. *Chnaurococcus subterraneus* (Newst.), *Williams,* 1962, Bull. Brit. Mus. (Nat. Hist.) Ent. 12, 1, *Ossiannilsson,* 1971, Kullabergs Natur, Häfte 14.

The specimens of this mealybug were collected by H. Enghoff during the past two years at 3 localities which are situated very close to each other. These are in north-west part of Zealand: Rørvig, Flyndersø, 23/3 1974, under stone (immature) with ants – *Lasius alienus.* Sjællands Odde, 22/4 1975, under a piece of wood (immature) with ants – *Lasius alienus.* Sejrø, south end, 21/6 1975, under a piece of wood (adult females) with ants – *Lasius alienus.*

Newstead gave a short description of second stage female and adult female, which is dark red-brown, more or less pyriform, narrowed in front.

The most important identification characters are: 6-segmented antennae, small and stout legs, absence of circulus, a pair of cerarii on anal lobes only and multilocular disc pores and tubular ducts on ventral surface.

Hosts

Newstead found this mealybug on roots of *Nardus stricta,* in nests of *Formica flava,* but he pointed that he »could not find a single example at the roots of *Nardus stricta,* except those growing in the ant's nest«.

All other known specimens were collected in soil or on the surface of soil, under stone and pieces of wood, not on any particular plant, but allways in connection with the ants. Williams reported it in nests of *Lasius niger,* Ossiannilsson found it on grass roots in a nest of *Lasius niger.*

Distribution

Originally described from England and later mentioned from Scotland and Sweden.

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Manuskript modtaget den 22. april 1977.