*Boll. Zool. agr. Bachic.*
Ser. II, 37 (3): 141-150

30 December 2005

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# A new genus and species from Rhizoecinae (Homoptera Coccoidea Pseudococcidae), with a phylogeny and key for the genera

**Abstract** - A new genus and species, *Kissrhizoecus hungaricus* gen. et sp. nova, is described from the subfamily Rhizoecinae. A review, phylogeny and a key for genera are given for the subfamily. With this new description the number of genera in the subfamily Rhizoecinae increased to 16, and to 13 in the tribe Rhizoecini. The subfamily Rhizoecinae now contains 210, and the tribe Rhizoecini 186 species. Two main lines known in the subfamily, the tribes of Rhizoecini and Xenococcini. In the tribe Rhizoecini based on morphological and zoogeographical data two phylogenetic lines presented. A new generic name *Hambletonrhizoecus* is proposed instead of *Hambletonia* Kozár & Foldi, 2004.

**Riassunto** - *Un nuovo genere e specie di Rhizoecinae (Homoptera Coccoidea Pseudococcidae), con studio della filogenesi e chiave dei generi.*

E' descritto *Kissrhizoecus hungaricus* gen. et sp. nova appartenente alla sottofamiglia Rhizoecinae. Viene effettuata la revisione della sottofamiglia, con studio della filogenesi e predisposizione di una chiave dei generi. Con questa nuova descrizione il numero di generi di Rhizoecinae sale a 16, di cui 13 appartenenti alle tribù Rhizoecini. Attualmente la sottofamiglia Rhizoecinae comprende 210 specie, la tribù Rhizoecini 186. Sono conosciute due linee filetiche principali nella sottofamiglia, le tribù dei Rhizoecini e quella degli Xenococcini. Sono presentate due linee filogenetiche della tribù dei Rhizoecini, basate su dati morfologici e zoogeografici. Il nuovo nome generico di *Hambletonrhizoecus* viene proposto al posto di *Hambletonia* Kozár & Foldi, 2004.

**Key words**: Homoptera, Coccoidea, Pseudococcidae, Rhizoecinae, *Kissrhizoecus hungaricus* gen. and sp. nova, Hungary, phylogeny, review, key.

## INTRODUCTION

Downie & Gullan (2004) treated the phylogeny of the family Pseudococcidae in detail. They found on the basis of earlier data on morphology, symbionts and their new molecular biology that the mealybug subfamily Rhizoecinae is "well defined".

This subfamily was studied extensively by Hambleton (1946, 1976), Tang (1992), Williams & Granara de Willink (1992), Williams (1998, 2004) and Ben-Dov (1994). The computer database Scalenet (the family Pseudococcidae last updated 7 March 2005) (Ben Dov & German, 2002) contains most important information (taxonomy, distribution, biology, etc). The World fauna of the subfamily is not well explored as the new data published by Kozár & Konczné Benedicty (2002, 2003, 2004) and Kozár & Foldi (2004) show.

The aim of this work is to describe a new genus and species in subfamily Rhizoecinae, and to give a phylogenetic tree of the tribes and genera.

## MATERIALS AND METHODS

The specimens were collected in Hungary in 2005. The descriptions follow the terminology of morphological characters as given in the works of Hambleton (1946, 1976) and Williams (1998, 2004). The insects, including females, male and larval stages are preserved on microscopic slides and in ethanol (70 and 96%) at the Plant Protection Institute, Hungarian Academy of Sciences, Budapest,

## RESULTS

In the studied samples, 19 females, 7 larvae in moulting stages, 3 males and 3 larvae stages were mounted and studied. On the base of this material a new genus and species are described. A phylogenetic analysis and key for the tribes and genera of the Rhizoecinae are given.

### Genus: *KISSRHIZOECUS* gen. n.

Type species: ***Kissrhizoecus hungaricus*** sp. n.

Description: Body elongate oval. Antennae 6 segmented, typical for the tribe. Legs well developed. Dorsum and venter with five-locular pores. Tubular ducts absent. Anal ring with small number of elongated pores, some of them with spicula, with 6 long hairlike setae. Ostioles absent, circulus present.
The new genus named after Dr. Kiss Balázs, the collector of the species.
Comments: This genus is distinct from all other genera of subfamily, by the presence of the five-locular pores.

### ***Kissrhizoecus hungaricus*** sp. n. (Fig. 1)

Type material: The holotype, female (leg. Dr. Balázs Kiss) (No. 7369), Kádárta (N: 47° 06 595, E: 017° 58.497, UTM code YN 22), 2005 07, 04. Paratypes: 18 females

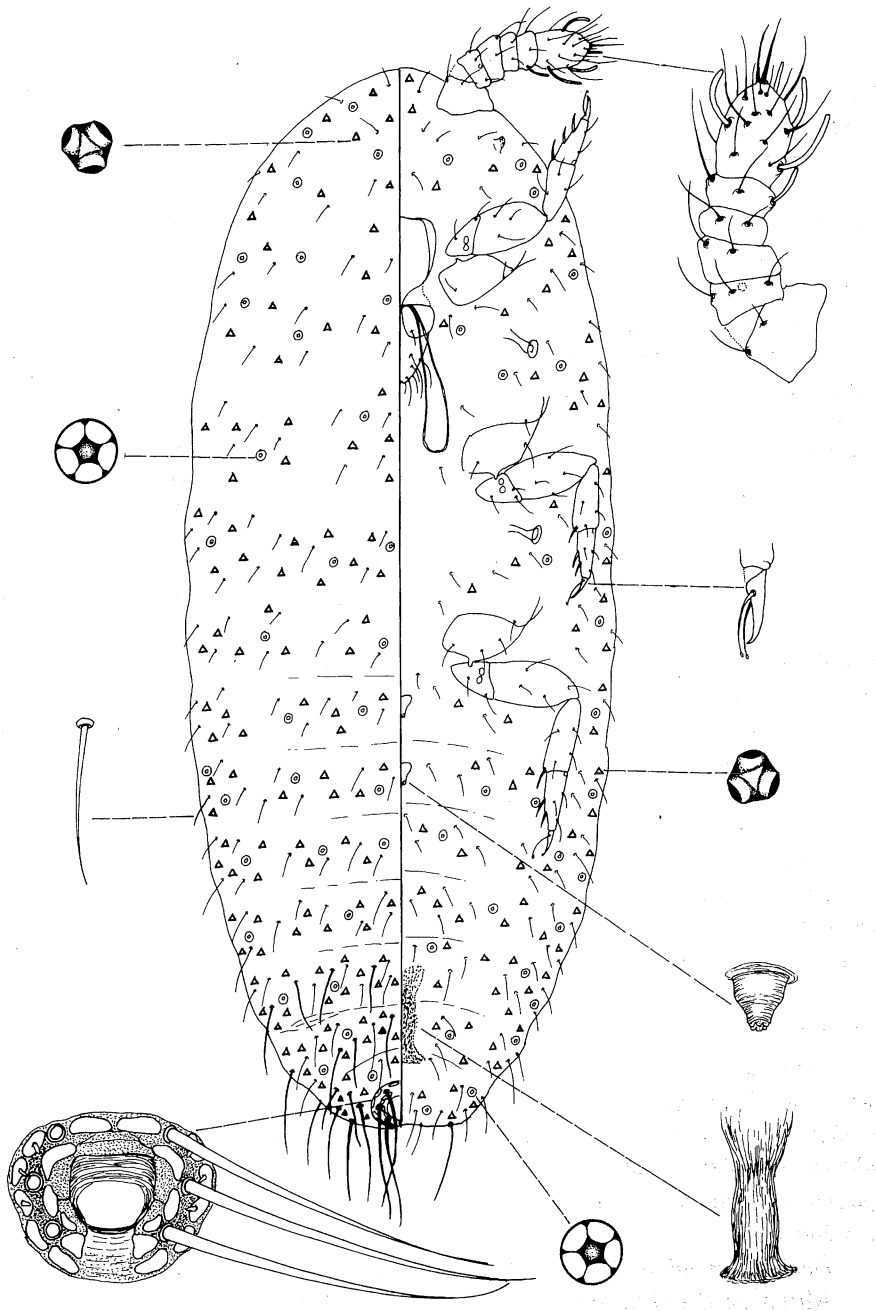

Fig. 1 - *Kissrhizoecus hungaricus* genus and species nova, adult female.

from the same locality (2005 07 04 and 2005 07 12, No. 7369, 7371). Also three neotenic males, 2 males in, 5 females in moulting stage, and 3 larvae were mounted. Deposited in the Collection of Plant Protection Institute, Hungarian Academy of Sciences (Budapest, Hungary). Paratypes deposited in MNHN (Paris), USNM (Beltsville) and BMNH (London).

Description: Female: Body elongate oval. Mounted specimen (Fig. 1) 0.525-mm long and 0.188 mm wide. Antenna 6 segmented, the size of the segments: 1st – 16 μm, 2nd - 10 μm, 3rd – 12 μm, fourth –7 μm, fifth – 8 μm and sixth 26 μm. There is one sensory pore on the 2nd segment of the antenna. The 3rd segment is almost parallel sided. Apical setae of antenna 19 μm. On apical segment three 20 μm long sensory falcate setae are found. On the penultimate segment one short, 12 μm long, blunted sensory seta is present. The segments of the antenna are covered with few hairlike setae, 18 μm long. Eye visible. Anal lobe slightly developed with three hairlike setae.

VENTER

Labium short and wide, two-segmented, 32 μm long. Stylet loop 2 times longer than labium. Cephalic plate absent. Legs robust: coxa of anterior legs 16, trochanter 14, femur 37, tibia 32, tarsus 25, claw 11 and claw digitules 10 μm long. Coxae of middle legs 17, trochanter 15, femur 37, tibia 29, tarsus 20, claw 12, and claw digitules 10 μm long. Coxae of posterior legs 17, trochanter 8, femur 40, tibia 35, tarsus 25, and claw 15 μm, claw digitules, 12 μm long, knobbed. Trochanter with two pores on each side. Claw without denticle. Legs with few spine and hairlike setae, and with one sensory pore on tibia. Five-locular pores distributed on all segments, 4 μm in diameter. Very short tritubular cerores present on all segments, 3 μm in diameter. The diameter of anterior spiracles 8 μm. Venter with a small number of scattered 12 μm long, hairlike setae. Two conical circulus present, 10 μm in diameter. Tubular duct and trilocular pores absent. Internal genital organ chitinized, elongated, as long as width of one and half segments.

DORSUM

Ostioles absent. With five-locular pores on all segments. Anal ring oval, 40 μm wide and 35 μm long. Anal ring with six, 62 μm long hairlike setae. Anal ring pores (cells) typical, as in other species of the Rhizoecini, some of them with one strong, blunted spiculae. Tritubular cerores present on all segments. Some trilocular pores present on anal lobes. Tubular ducts absent. Hairlike setae 11 μm long, scattered on the dorsum.

*Derivatio nominis*: The species is named after the country of origin.

Affinities: *Kissrhizoecus hungaricus* different from all genera and species of the subfamily and tribes by presence of five-locular pores.

Male: The male is neotenic, without wings, cerores and pores. Antennae 8-9 segmented, with 2 pairs of eyes, ocelli absent. Similarly Schmutterer (1952) and Hodgson (2005, unpublished) found two pairs of eyes on winged male of *Rhizoecus albidus* and on *Ripersiella hibisci*.

Larva: The studied larval stages are also without pores, or cerores.

## REVIEW OF THE SUBFAMILY RHIZOECINAE, WITH AN IDENTIFICATION KEY OF GENERA BELONGING TO TRIBE RHIZOECINI

The subfamily Rhizoecinae Williams, 1968 contains two tribes: Rhizoecini Williams, 1968, and Xenococcini Tang, 1992. In the Xenococcini ostioles, pores, tubular ducts and cerores are absent. In the Rhizoecini ostioles, pores, tubular ducts and cerores are usually present.

The tribe Xenociccini (24 species) covers the following genera:

*Eumyrmococcus* Silvestri, 1926 (18 species). Type species: *Eumyrmococcus smithii* Silvestri, 1926, by monotypy and original designation.

*Xenococcus* Silvestri, 1924 (2 species). Type species: *Xenococcus annandalei* Silvestri, 1924, by monotypy and original designation.

*Neochavesia* Williams & Granara de Willink, 1992 (4 species). Type species: *Chavesia caldasiae* Balachowsky, 1957, by original designation.

The tribe Rhizoecini (186 species) covers the following genera:

*Rhizoecus* Kunckel d'Herculais, 1878 (79 species). Type species: *Rhizoecus falcifer* Kunckel d'Herculais, 1878, by monotypy.

*Ripersiella* Tinsley, 1899 (73 species). Type species: *Ripersia rumicis* Maskell, 1892.

*Geococcus* Green, 1902 (14 species). Type species: *Geococcus radicum* Green, 1902, by original designation.

*Pseudorhizoecus* Green, 1933 (1 species). Type species: *Pseudorhizoecus proximus* Green, 1933, by original designation.

*Brevicoccus* Hambleton, 1946 (1 species). Type species: *Brevicoccus clavisetosus* Hambleton, 1946, by monotypy and original designation.

*Coccidella* Hambleton, 1946 (8 species). Type species: *Morrisonella poensis*, Hambleton, 1946, by original designation.

*Pygmaeococcus* McKenzie, 1960 (1 species). Type species: *Pygmaeococcus morrisoni* McKenzie, 1960, by monotypy and original designation.

*Capitisetella* Hambleton, 1977 (1 species). Type species: *Pseudorhizoecus migrans* Green, 1933, by monotypy and original designation.

*Leptorhizoecus* Williams, 1998 (1 species). Type species: *Leptorhizoecus deharvengi* Williams, 1998 by monotypy and original designation.

*Marottarhizoecus* Kozár et Konczné Benedicty, 2002 (1 species). Type species *Marottarhizoecus issisi* Kozár et Konczné Benedicty, 2002, by monotypy and original designation.

*Benedictycoccina* Kozár et Foldi, 2004 (4 species). Type species: *Ripersiella ornata* Hambleton, 1946, by monotypy and original designation.

*Hambletonrhizoecus* **nomen novum** (1 species). The generic name *Hambletonia Kozár et Foldi, 2004*, is a homonym of the *Hambletonia* Compere, 1936, in Hymenoptera. Type species: *Hambletonrhizoecus bitubularis* (Kozár et Foldi, 2004), by monotypy and original designation.

Comment: *Prorhizoecus* Miller & McKenzie, 1971 (1 species). Type species: *Prorhizoecus atopoporus* Miller and McKenzie, 1971, by monotypy and original designation. Following Williams (1998) it was excluded from this subfamily.

KEY TO GENERA OF RHIZOECINI
(After Kozár & Foldi, 2004, with addition)

1. Anal ring with protuberances ..... *Pseudorhizoecus*
- Anal ring without protuberances ..... 2
2. Anal ring ventral in position ..... *Leptorhizoecus*
- Anal ring dorsal in position ..... 3
3. Bulbous tubular ducts present ..... *Pygmaeococcus*
- Bulbous tubular ducts absent ..... 4
4. All body setae knobbed ..... 5
- All body setae flagellate ..... 6
5. Antennae 3 segmented ..... *Capitisetella*
- Antennae 4 segmented ..... *Brevicoccus*
6. Antennae with 5-6 segments ..... 7
7. Anal lobes well developed, with a stout spine-like seta ..... *Geococcus*
- Anal lobes not well developed, without spine-like seta ..... 8
8. Body with tritubular cerores ..... 9
- Body with bitubular cerores ..... 13
9. Body without groups of pores on venter, or around tritubular cerores ..... 12
- Body with groups of pores ..... 10
10. On the venter with groups of trilocular pores ..... *Coccidella*
- On the venter without groups of trilocular pores ..... 11
11. Tritubular pores surrounded by multilocular pores ..... *Marottarhizoecus*
- Tritubular pores surrounded by trilocular pores ..... *Benedictycoccina*
12. Body with five-locular pores ..... *Kissrhizoecus* gen. n.
- Body without five-locular pores ..... *Rhizoecus*
13. Groups of trilocular pores on venter absent ..... *Ripersiella*
- Groups of trilocular pores on venter present ..... *Hambletonrhizoecus*

With this new description the number of genera in the subfamily Rhizoecinae increased to 16, and to 13 in the tribe Rhizoecini. The subfamily Rhizoecinae now contains 210, and the tribe Rhizoecini 186 species.

## PHYLOGENETIC ANALYSES AND DISCUSSION

Based on morphological characters of the females, the tribes Xenococcini and Rhizoecini are well separated by the absence of ostioles, pores, tubular ducts and cerores in the Xenococcini (Fig. 2).

In the tribe Rhizoecini two main lines are characteristic. The *Rhizoecus* group (in subtribe status) has tritubular cerores. Several new evolutionary lines appeared in this group: *Marottarhizoecus,* has tritubular cerores, surrounded by multilocular pores, *Benedictycoccina* has tritubular cerores, surrounded by trilocular pores, *Coccidella* has groups of trilocular pores on the venter, *Geococcus* has sclerotized anal lobes, with strong spines and *Kissrhizoecus*, which has five-locular pores. In the *Ripersiella* group (in subtribe status, however it should be studied more) thorough several members have bitubular cerores. Some genera, which have no bitubular cerores, and have special characters, are included here tentatively, but because of the character reduction tendency in this line, they can be assigned to this group.

The presence of tritubular cerores in first instar larvae of some studied species of both genera could indicate a common root with *Rhizoecus*. This reduction of tritubular cerores in second and third instar larvae, to bitubular cerores in the adult female, seems a new way of speciation that was shown by Jansen (2001) studying *Ripersiella hibisci*. Another important example of character reduction found in *Ripersiella malschae* (Williams, 2004), where the second instar larva has bitubular cerores, but in the adult female they are absent. The last example shows that the study of larval characters of the species tentatively included in the genus *Ripersiella*, and other genera in this evolutionary line, could help in the clarification of their status too. It is remarkable that in *Rhizoecus* line, clear character diversification was observed, while in the *Ripersiella* line character reduction is common. This character reduction is even clearer in the tribe Xenococcini, where the adult female lost pores, cerores and pores, and the neotenic male has only 1-2 segmented antennae. In the tribe Rhizoecini (*Rhizoecus* group) the neotenic male of *Kissrhizoecus* has 8-9 segmented antennae, while that of (*Ripersiella* group) the neotenic male of *Pseudorhizoecus* has 5 segmented antennae. The few known *Rhizoecus* and *Ripersiella* winged males have 10 segmented antennae. Concerning the male characters, in some cases they can be useful indicating relationships, however it is important to remember that for the studied 210 species in the subfamily, the males are know only in about ten species.

The roots of the connection of the Rhizoecini and Xenococcini are not clear. It may be suggested that in view of the strong character reduction in he Xenococcini that it gave origin to from the Ripersiella line of the Rhizoecini tribe. Some support for this is found in the distribution map of *Ripersiella* species, where for the highest

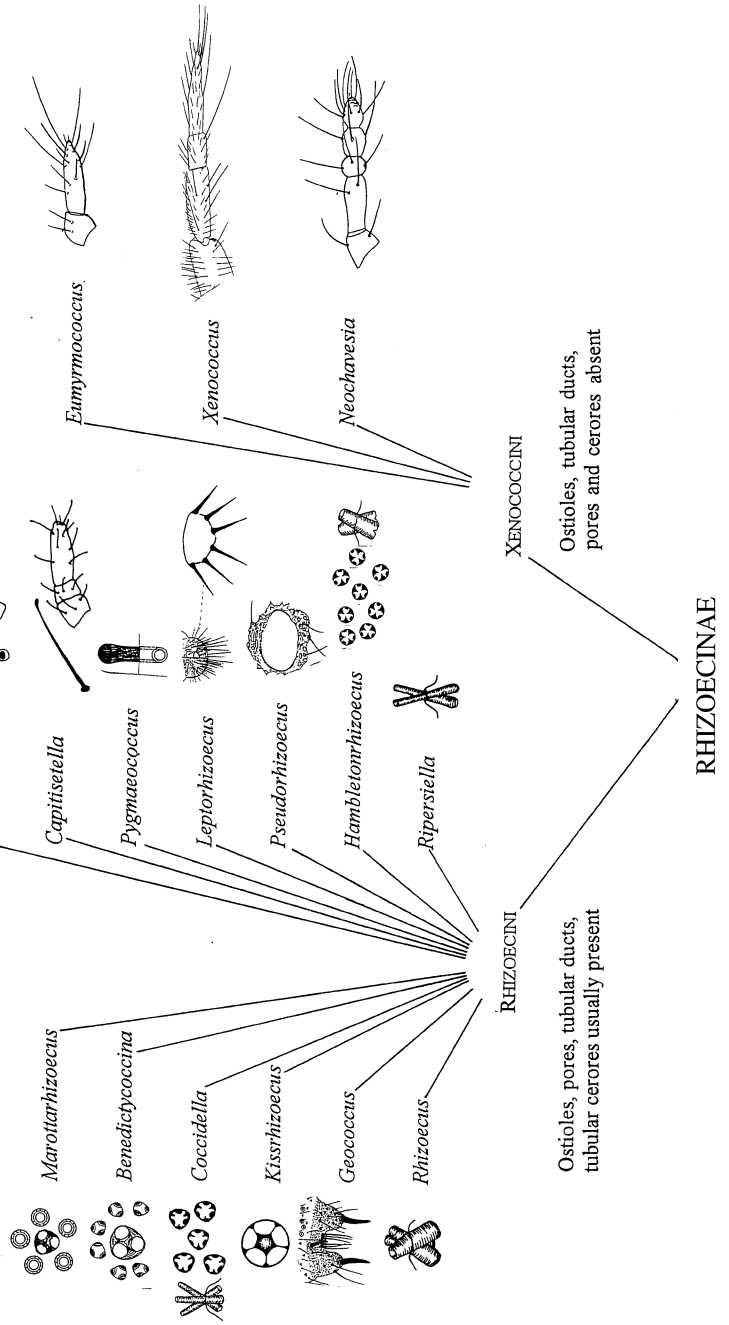


Fig. 2 - Phylogenetic tree of the subfamily Rhizoecinae.

number of species they overlap with the regions having species of *Xenococcus* and *Eumyrmococcus*. (Kozár & Konczné Benedicty, 2003; 2004; Williams, 2004).

The new genus presented here, having five-locular pores, could be an additional support for the connection of the Rhizoecinae with the Phenacoccinae, showed by Downie & Gullan (2004).

The appearance of this new genus in the Palaearctic region surprising, as, most of the genera from the Rhizoecini were found in the Nearctic and Neotropic regions (Hambleton, 1976; Kozár & Foldi, 2004). Most of the species of the genus *Rhizoecus* are known also from the Nearctic and Neotropic regions (Hambleton, 1976). The species of the genera Ripersiella and *Geococcus*, and species of the Xenococcini tribe are more numerous in the Oriental and Austro-Oriental regions (Kianek et al, 2005; Kozár & Konczné Benedicty, 2003; 2004; Williams, 2004). The northern part of the Palaearctic region is pure in Rhizoecini species.

## ACKNOWLEDGEMENTS

The authors would like to thank Balázs Kiss for his collecting efforts, the OTKA (Hungarian National Science Found) (Grant No. T 034236, and T 048801) for financial support of this project. Concerning the homonymy of *Hambletonia* John Pape, Yair Ben-Dov and Christian Kammerer called our attention, thanks for the help. Thanks also for the English correction to Jan H. Giliomee (Department of Botany & Zoology, University of Stellenbosch, Private bag X1, Matieland, South Africa)

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Accepted 4 October 2005