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Previous volumes (2010-2020): 250 € / year (4 issues)
Acarologia, CBGP, CS 30016, 34988 MONTFERRIER-sur-LEZ Cedex, France
ISSN 0044-586X (print), ISSN 2107-7207 (electronic)

The digitalization of Acarologia papers prior to 2000 was supported by Agropolis Fondation under the reference ID 1500-024 through the « Investissements d’avenir » programme (Labex Agro: ANR-10-LABX-0001-01)

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A CONTRIBUTION TO THE STUDY OF THE GENUS RHIZOGLYPHUS CLAPAREDE, 1869 (ACARINA : ACARIDAE)

by

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ABSTRACT.

Nine species of the genus Rhizoglyphus are described and figured, three of these (R. echinopus, R. robini and R. ranunculi n. sp.) occurring in New Zealand. Eight species have been intercepted on plant material entering New Zealand from overseas and six of these are new, namely R. setosus from several hosts and localities in the South Pacific; R. caladii on caladium tubers from New Guinea; R. tacitri on citrus roots from Tahiti; R. minutus on taro from Niue Is.; R. howensis on palm seed from Lord Howe Is., and R. singularis on yams from India. An examination of type material of Rhizoglyphus longitarsis Banks, R. oblongus Ewing and R. elongatus Banks shows that these species do not belong to the genus Rhizoglyphus as it is currently defined.

INTRODUCTION.

This paper is mainly a taxonomic study of nine species of mites of the genus Rhizoglyphus, three of these occurring in New Zealand, the remainder having been intercepted on plant material entering this country. Each species is clearly defined and figured and its known host range and distribution listed. This paper should provide basic information which can be of future use for further studies relating to taxonomy, life history and economic significance.

All holotype slides are retained in the collection of the Department of Agriculture, Levin, and distribution of paratypes is listed under descriptions of the individual species.

The first species of this genus was described in 1868 by FUMOUE and ROBIN under the name Tyroglyphus echinopus. Since then many others have been described and Mr. D. MACFARLANE (1968) of the British Museum (pers. comm.) has supplied a list of some forty names which have been associated with this genus, although as he points out, this may be incomplete, contain synonyms, and refer to species no longer placed in Rhizoglyphus. Difficulties associated with the studies of Rhizoglyphus include the inadequacy of original descriptions and the locating and obtaining of type material, and even when type material is available it is frequently in too poor a condition for satisfactory examination. References which I have found to be particularly helpful in this study are those of MICHAEL (1901, 1903), ZACHVATKIN (1942), HUGHES (1961) and VAN EYNDHOVEN (1961, 1968). VAN EYNDHOVEN's papers are of considerable significance. In 1961 he clearly defined R. echinopus and separated it from allied species by the lengths of certain body setae and by the penal structure. In 1968 he described R. engeli from Freesia, and also indicated the importance of the female genital system in taxonomic studies.

Economic significance.

It is difficult to obtain from the literature a clear picture of the economic significance of the various species of Rhizoglyphus, or even whether it is Rhizoglyphus mites that are present. The bulb mite Rhizoglyphus echinopus is the species most frequently mentioned, but even here there is doubt as to whether this is the actual species present. Dr. G. L. van Eyndhoven (pers. comm.) states he has received mites of the genera Acarus, Tyrophagus, Caloglyphus and Histiotoma as possible representatives of the genus Rhizoglyphus! Bearing these remarks in mind, the following references are given as to the type of damage likely to be caused by Rhizoglyphus mites. It is doubtful whether the species mentioned are necessarily correct, but it is almost certain the genus Rhizoglyphus is the one concerned.

Garman (1937) gave an account of damage caused by the bulb mite under the name Rhizoglyphus hyacinthi. He stated that "bulbs of narcissus, hyacinth, tulip, crocus, gladiolus, amaryllis, Easter lily and other plants are infested by the bulb mite. In the laboratory the mite has been reared on onions and potatoes and is probably capable of subsisting on almost any tuber or bulb." He also stated that from tests he conducted the mites were able to feed on healthy tissue. Garman's R. hyacinthi is probably what we now recognise as R. echinopus although more than one species may be involved.

Rawlins (1955) recorded R. solani as attacking the seedling roots of onions in Oswego country U.S.A. and causing damage similar to "damping off." Growers reported that the problem was not new to them but was attributed to the onion maggot, Hylemya antiqua!

Bald and Jefferson (1952) indicated that the root mite Rhizoglyphus rhizophagus (Banks), is a serious pest of gladiolus in southern California, partly because of its direct action on roots and corms and partly because of its association with rotting organisms, or even with pathogens such as the organisms causing Fusarium basal rot and yellows and bacterial scab.

Forsberg (1959) discovered that the bulb mite, R. echinopus was responsible for the spread of Pseudomonas marginata (bacterial scab) in gladiolus.

In New Zealand there are several references to the bulb mite as a pest of some significance. David Miller (1944) referred to the bulb mite, Rhizoglyphus hyacinthi as a species capable of attacking practically all tubers or bulbs. Phyllis Robertson (1946) describes R. echinopus as being one of the best known Tyroglyphil species in New Zealand, although her illustration almost, certainly depicts R. robini or a closely allied species, certainly not R. echinopus. Cottier (1956) listed bulb mite, R. echinopus as attacking almost all types of bulbs. In my own experience the two commonly occurring species in New Zealand are Rhizoglyphus echinopus and R. robini and it is likely the New Zealand references apply to one or other of these. I have also found that garlic bulbs grown in New Zealand are periodically found to be heavily infested with Rhizoglyphus mites, usually R. robini and R. echinopus.

Diagnostic features of the genus.

Mites of the genus Rhizoglyphus are large and plump, of sluggish movement and with a glistening white body. The legs are usually short and stout, reddish brown, and armed with a varying number of setae and spines. Characters by which they can be distinguished from allied species are: — the presence of a short but prominent conical spine (ba) on the proximal part of tarsi I and II (Fig. 14); propodosomal setae v.e. when present, arising near the middle of the lateral edge of the propodosomal shield (Figs 2, 13); propodosomal setae sc.e. and sc.i.
are present, sc.e. always being longer than sc.i., which vary in length and in some species are so minute as to be almost imperceptible; the supra coxal seta and Grandjean's organ are always present (Fig. 8); the hysterosoma has a full complement of setae — d₁ — d₄, h.e., h.i., l₁, l₄, sa.e., and sa.i (Fig. 2); tarsi I-III in both sexes have a constant number of distal setae — tarsus I bears five setae (including one solenidion), tarsus II four setae and tarsus III, three setae. Tarsus IV of the female bears two setae and in the male has one seta only. Two sucker-like discs occur on tarsus IV of the male.

As well as the occurrence of normal males and females there is also frequently found, heteromorphic males and hypopi. Heteromorphic males are distinguished by the enlarged third leg, which is almost twice as thick as the fourth leg. This leg is purely of a clasping nature and is not used for walking, but held off the ground. The hypopus is usually regarded as a non feeding deutonymph, and acts as the dispersal stage being produced during periods of adverse environmental conditions.

The general features of each form are as follows, terminology being that of Hughes (1961).

Adult female.

*Gnathosoma* — Two main structures are involved, the chelicerae and the hypostome. Each chelicera (Figs 5, 6, & 7) is laterally compressed, consists of a large oval shaped basal area and distally, two pincer shaped structures, a fixed digit and a movable digit, these digits having toothed edges and working together with a powerful shearing action. A mandibular spine is present at the base of the fixed digits. This may vary in shape between different species. Posteriorly and laterally of the mandibular spine is a sclerotised tooth shaped structure appearing as two large triangular teeth. These may vary, being more acutely pointed in some species or one tooth developed more than the other. They may also vary in position. In *R. ranunculi* they are absent.

The hypostome (Figs 9 & 12) consists laterally of the two segmented palps and the basal portion, made up largely by the fused coxae of the pedipalps, which are produced forwards as two blunt lobes, the malae. The distal segment of the palp terminates with a short sensory rod and near this arises a single conspicuous seta. The maxillary spine is a distinctive structure arising laterally about one third the distance from the posterior margin. It can vary in length and shape between different species and may be of possible taxonomic significance.

*Propodosoma* — A propodosomal shield is always present (Figs 2 & 4) and approximately rectangular in shape. It is situated in the middle of the propodosoma, its anterior margin being almost on a level with the anterior margin of the propodosoma. Lateral of the propodosoma is the lateral sclerite which is produced anteriorly as a single or forked spine (Grandjean's organ — Figs 8, 10 & 11). At the base of the sclerite arises the supra coxal seta which may vary in length and thickness between species. Adjacent to the supra coxal seta is a conspicuous slit like opening.

The following setae are present (see Fig. 2) — the internal vertical setae (v.i.) arising from the middle of the anterior edge of the propodosoma, the external vertical setae (v.e.), which may or may not be present, arising from the lateral margins of the propodosomal shield at about half way; the external scapular setae (sc.e.) and internal scapular setae (sc.i.), both arising from the posterior part of the propodosoma and in a transverse line. Sc.e. is always longer than sc.i. and in some species (e.g. *R. tacitri* and *R. minutus*) sc.i. is scarcely visible.
Hysterosoma — A narrow transverse groove separates the hysterosoma from the propodosoma. The following setae are present: the internal and external humerals (h.i., h.e.), the dorsal setae (d₁ — d₄), the lateral setae (l₁, l₄), and the inner and outer sacrails (s.a.i., s.a.e.) which arise from the posterior body margin (Fig. 2). The lengths and positioning of the hysterosomal setae are of taxonomic significance. On the lateral edges of the hysterosoma, about midway between l₁ and l₄ are the openings of the latero-abdominal or «fat glands.» These are slit like in appearance. Four pairs of circular body pores are also present (Figs 1 & 3). One pair occurs near the humeral setae, one pair near seta l₁ and two pairs near the posterior end of the body. These are not visible in R. ranunculi.

Ventral Body Surface — Apodemes prominent, sclerotised, those of leg I united with the sternum. Apodemes II, III and IV free. Coxae I and III each with a single seta. The genital opening is situated between the third and fourth pair of legs. It is flanked by three pairs of setae and two pairs of suckers. Posterior to the genital area is the anal slit which runs longitudinally. From one to six pairs of anal setae are present, these varying in length and position. Posterior to the anal slit is the opening of the bursa copulatrix and from this there usually leads a narrow canal of varying length into a sac like structure, the receptaculum seminis. At the opening into the receptaculum seminis are two V-shaped or finger-like structures, usually situated close together, except in R. echinopus where they are widely separated (see Figs 3, 27 & 28). The setae on the ventral body surface are usually shorter and fewer in number than those on the dorsal surface. The ventral humerals (h.v.) arise near the anterior lateral mm g:: in proximity to h.i. and h.e. In some species these may be absent. There is usually one pair of long post anal setae arising from the posterior body margin.

Legs — Figs 14, 15 & 16 show typical leg structures for the genus Rhizoglyphus. Although the illustrations are of males, females are essentially similar. The tarsus terminates in a stout claw, the base of which is covered by a reduced pretarsus. At the distal extremity of tarsus I arises a group of five slender setae (including one solenidion) and five spines, some of the setae typically expanded distally. Towards the base of the tarsus arises a prominent stout conical spine (ba) and grouped at its base are two solenidia (o₁-0₂) and the famulus (ε). Tibia I bears a long whip like solenidion (σ) and two ventral setae (gT and hT), seta gT being spine-like. Genu I bears two solenidia (σ₁ and σ₂) arising close together dorsally, from the anterior margin of the segment. Two setae (cG and mG) also arise from genu I. Femur I and coxa I each with a single seta. Tarsus II bears a group of usually four slender setae and six spines distally; o₂ and ε are absent from the basal group of sense organs. Tibia II similar to tibia I. On genu II a single solenidion replaces σ₁ and σ₂ of genu I. Femur II with a single seta. Tarsus III usually with three seta and six spines distally. Tibia III with one solenidion (σ) and one spine (kT). Genu III with one solenidion and one seta (nG). Femur III without setae. Coxa III with one seta. Tarsus IV with usually two setae and seven spines distally. Tibia IV similar to tibia III. Genu IV without setae. Femur IV with one seta. The lengths and degree of development of various setae and solenidia can vary between species.

Homeomorphic male.

The homeomorphic male is essentially similar to the female, differing in the following characters: The penis is situated ventrally between the fourth pair of legs. Almost immediately behind the penis is the genital slit which is more anterior in position than in the female. It runs
a short distance before finally terminating in two anal suckers, which in some species have characteristic patterns that are of taxonomic significance. At the anterior margin of each sucker there usually arises a short seta. There are usually three pairs of post anal setae \((pa_1, pa_2, pa_3)\) arising from the posterior body margin (Fig. 1). One or two pairs may be greatly shortened, and the length and positioning of the anal setae is of taxonomic significance. On leg IV (Figs 19 & 20) the tarsus bears two disc like suckers which are of assistance during copulation. It also differs in only having six spines and one distal seta. Tibia IV has the solenidion \((\delta)\) replaced by a spine.

**Heteromorphic male**

The main difference between this and the homeomorphic male is the abnormally developed third leg (Fig. 18). Hughes (1961) points out that occasionally, abnormal specimens occur in which the hypertrophied leg is found on one side of the body only. The heteromorphic male also has longer body setae and leg segments than the homeomorphic form.

**Hypopus.**

The hypopus (Figs 47-50) is completely different in appearance to any of the previously described stages. It is usually smaller, of oval shape, with a brownish cuticle, and flattened dorso-ventrally. The dorsal surface is smooth and shining, bluntly projecting anteriorly and completely covering the body. It is clearly divided into propodosomal and hysterosomal shields. Mouthparts are lacking, being replaced by a simple structure similar to the tritosternum of the mesostigmata. Ventrally, the outlines of the coxal plates are clearly visible, and posteriorly there is a well defined sucker plate, consisting of two large central suckers surrounded by several smaller ones. The legs are well developed and taper distally. Legs I and II protrude further beyond the edges of the body than legs III and IV. Leaf like setae are usually present at the distal extremity of most tarsal segments.

The following key should enable the different species of *Rhizoglyphus* to be readily recognised. Males or females can be used. In the descriptions of the various species all measurements are in microns (\(\mu\)), and the measurements for the body setae h.v. are included under the description of the hysterosoma for convenience.

**Key to species of *Rhizoglyphus* based on males only.**

1. (a) Anal discs either completely or partially covered with radiating lines .................. 4
   1. (b) Anal discs without radiating lines .............................................................. 2
2. (a) Two pairs of short post anal setae ......................................................... *selosus* n. sp.
   2. (b) One pair of short post anal setae ............................................................ 3
3. (a) With long (75-133) \(\mu\) sc.i. setae; broad penal structure ..................... *echinopus* F. & R.
   3. (b) With short (6-22 \(\mu\)) sc.i. setae; penal structure narrower and more conical. *robini* Claparède
4. (a) Radiating lines on anal discs confined to anterior portion of disc; posterior body margin usually somewhat bluntly pointed ............................................................... *singularis* n. sp.
   4. (b) Radiating lines on anal discs covering the greater part of the disc and arising from a central point. Posterior body margin smoothly rounded ................................................. 5

*Acarologia, t. XIII, fasc. 4, 1972.*
5. (a) Conical spine (ba) on tarsi I & II short, less than half as long as $\omega_1$ (Figs 23, 24).  
   caladii n. sp.
5. (b) Conical spine (ba) on tarsi I & II of normal size, about as long or longer than $\omega_1$............. 6
6. (a) Seta sc. i. close to (11-14 $\mu$ distance) seta sc. e. (Fig. 13).............. ranunculi n. sp.
6. (b) Seta sc. i. normally placed — at least 22-25 $\mu$ from seta sc. e. .......................... 7
7. (a) Body seta la adjacent (10-15 $\mu$ distance) to opening of latero-abdominal gland; mean lengths of tarsi I, II, III, IV, 97 $\mu$, 101 $\mu$, 102 $\mu$, and 85 $\mu$ respectively........ tacitri n. sp.
7. (b) Body seta la at a considerable distance (32-46 $\mu$) from gland opening. Mean lengths of tarsi I, II, III, & IV not greater than 69 $\mu$, 75 $\mu$, 76 $\mu$, & 73 $\mu$ respectively............... 8
8. (a) Body seta la at a distance of 32-35 $\mu$ from opening of latero-abdominal gland opening. Mean lengths of tarsi I, II, III, & IV, 69 $\mu$, 75 $\mu$, 76 $\mu$, & 73 $\mu$............ howensis n. sp.
8. (b) Body seta la at a distance of 40-46 $\mu$ from gland opening. Mean lengths of tarsi I, II, III, & IV, 56 $\mu$, 54 $\mu$, 51 $\mu$, & 44 $\mu$........................................ minutus n. sp.

**KEY TO SPECIES OF RHIZOGLYPHUS BASED ON FEMALES ONLY.**

1. (a) With long (75-133 $\mu$) sc. i. setae; receptaculum seminis in the form of a large transverse sac with a fingerlike or V-shaped projection at each end....................... echinopus F. & R.
1. (b) With short (less than 50 $\mu$) sc. i. setae; receptaculum seminis not as in echinopus........ 2
2. (a) Conical spine (ba) on tarsi I & II short, less than half as long as $\omega_1$ (Figs 23, 24).  
   caladii n. sp.
2. (b) Conical spine (ba) on tarsi I & II of normal size, about as long or longer than $\omega_1$ (Figs 14, 15). 3
3. (a) Seta sc. i. close to (11-14 $\mu$ distance) seta sc. e. (Fig. 13).............. ranunculi n. sp.
3. (b) Seta sc. i. normally placed — at least 22-25 $\mu$ from seta sc. e. .......................... 4
4. (a) Six pairs of anal setae present.................................................. 5
4. (b) Not more than four pairs of anal setae.................................................................. 6
5. (a) The two posterior pairs of anal setae much longer than the others (Fig. 30).... setosus n. sp.
5. (b) The two posterior pairs of anal setae short, similar in length to the others... robini Claparède
6. (a) Body seta la close to (10-17 $\mu$ distance) opening of latero-abdominal gland...................... 7
6. (b) Body seta la situated at a considerable distance (40-57 $\mu$) from gland opening............. 8
7. (a) Setae sc. i. very short (approx 4 $\mu$ long)........................................ tacitri n. sp.
7. (b) Setae sc. i. long (29-47 $\mu$)........................................................................... singularis n. sp.
8. (a) Four pairs of anal setae. Mean lengths of tarsi I, II, III, & IV, 69 $\mu$, 71 $\mu$, 67 $\mu$, & 73 $\mu$.... minutus n. sp.
8. (b) One pair of anal setae. Mean lengths of tarsi I, II, III, & IV, 96 $\mu$, 108 $\mu$, 108 $\mu$, & 118 $\mu$.. howensis n. sp.

**Rhizoglyphus echinopus** (Fumouze and Robin).
(Figs 1-3, 5, 8, 18, 29, 42, 47, 48, 53, 54).


The distinguishing features of this species, as pointed out by van Eynhoven (1961), are the long internal scapular setae (40-133 $\mu$) and the broad penal structure. Also, the structure of the female genital system differs markedly from other species.

**Homomorphic Male**:

Description from 12 specimens. Length of body 576-809; greatest width of body 368-576. Lengths of propodosomal setae as follows: — v.i. 92-127; v.e. 16-20; sc.e. 165-288; sc.i. 40-130. Supra coxal seta thick, sabre like, approximately 36-47 long. Grandjean's organ with a forked tip (Fig. 8).

FIG. 4: *R. robini*, dorsal view of female.
FIG. 5: *R. echinopus*, chelicera of male.

FIG. 6: *R. setosus*, chelicera of male. (m. s. — mandibular spine).

FIG. 7: *R. caladii*, chelicera of male.

FIG. 8: *R. echinopus*, lateral sclerite (l.s.), Grandjean's organ (G), and supra coxal seta (s. cx.) of female.

FIG. 9-10: *R. robini*, hypostome of female (g. s. e. — lateral sclerite and associated structures of female.

FIG. 11: *R. setosus*, lateral sclerite and associated structures of male.

FIG. 12: *R. tacirii*, hypostome of male.

Lengths of hysterosomal setae as follows: d₁ 57-133; d₂ 44-127; d₃ 79-149; d₄ 136-241; h.i. 67-133; h.e. 149-241; h.v. 48-159; la 51-159; lp 82-197; sa.e. 87-224; sa.i. 138-250.

The penis is broad and rounded with a short tube like opening anteriorly.

Mean leg segment lengths as follows:

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<td>femur</td>
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Tarsi I and II usually with three distal setae thickened apically. Solenidion w₁ on tarsus I slightly enlarged distally. Tarsus IV with posterior tarsal sucker at about half way, the other sucker being anterior and lateral of this. Anal discs without radiating lines. Lengths of post anal setae — pa₁ 26-56; pa₂ 163-286; pa₄ 148-240.

**Female:**

Description from 12 specimens. Length of body 583-874; greatest width of body 420-608.

Lengths of propodosomal setae as follows : v.i. 95-127; v.e. 15-20; sc.e. 219-257; sc.i. 66-117. Supra coxal seta and Grandjean’s organ similar to that of homeomorphic male.

Lengths of hysterosomal setae d₁ 79-120; d₂ 80-155; d₃ 105-187; d₄ 140-254; h.i. 92-162; h.e. 162-234; h.v. 73-136; la 76-168; lp 105-193; sa.e. 92-189; sa.i. 138-245; Average number of eggs in body cavity 3. (range 1-8).

Bursa copulatrix with a large external opening just posterior to the anal slit, internally opening into a large transverse sac with a V-shaped projection at each end (Fig. 3). Anal slit surrounded by six pairs of short setae.

Length of post anal setae pa₄ 148-240.

Mean leg segment lengths as follows:

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Tarsus I without apically expanded distal setae; solenidion w₁ similar to that of homeomorphic male.

**Heteromorphic Male:**

Description from six specimens. Length of body 622-778; greatest width of body 376-467.

Lengths of propodosomal setae : v.i. 114-149; v.e. 112-16; sc.e. 216-298; sc.i. 66-110. Supra coxal seta straight, thick, with a cleft tip, 38-44 long. Grandjean’s organ forked.

Lengths of hysterosomal setae : d₁ 73-158; d₂ 73-143; d₃ 136-238; d₄ 216-291; h.i. 124-222; h.e. 223-292; h.v. 73-190; la 133-226; lp 181-285; sa.e. 189-265; sa.i. 199-301.

Mean leg segment lengths as follows:

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Tarsi I and II usually with three of the distal setae markedly expanded and leaf-like. Sole nidion \( e_1 \) on tarsus I similar to that of homeomorphic male. Leg III greatly enlarged (Fig. 18). The tarsal claw is large and thick set and at its base is a short conical spine. Five slender elongate setae arise from the tarsus.

Lengths of post anal setae \( pa_1 \) 37-56; \( pa_2 \) 230-330; \( pa_3 \) 189-286.

**Hypopus** : (Figs 47, 48, 53, and 54).

Length of body 250-321 (12 specs). Oval in shape and of a brownish colour. Dorsal surface convex, smooth and shining with minute pale coloured spots which are most pronounced at the anterior body margin. \( V.i \) setae prominent, 35-37 long; \( sc.i \) and \( sc.e \) setae present, but exceedingly small, \( sc.e \) being slightly longer and in a more anterior position. Hysterosomal setae very small. The following can be detected: \( d_1-d_4 \), \( h.i. \), \( h.e. \), \( la \), and \( lp \).

Ventrally, the gnathosoma consists of a simple plate produced into elongate lobes anteriorly. A long slender seta (40-42 long) arises from the apex of each lobe. Two shorter setae arise from the lateral margins of the plate. Sternum distinct, giving rise posteriorly to a shallow groove which reaches the posterior margin of the sternal plate. Apodemes II converge towards the mid line, almost meeting. Apodemes IV also converge towards the mid line, each terminating with a small seta. Coxae I and III each with a small sucker. A pair of suckers and setae flanking the genital opening. Sucker plate consisting of a central pair of large suckers surrounded by three pairs of peripherals. Two pairs of posterior body setae, the outer pair at least twice as long as the inner pair.

Leg setation as figured (Figs 67 and 68).

**Distribution and Host Range** :

This species is cosmopolitan. In New Zealand we have frequently intercepted it on various bulbs from Holland, and it has also been intercepted on plant material from the United Kingdom, Australia, U.S.A. and Hong Kong. It occurs throughout New Zealand. Specimens in the collection at Levin have been recorded from the corms of gladioli, the bulbs of iris, tulip, hyacinth, narcissus gloxinia and garlic (Allium sativum), and the roots of peony plants (Paeonia sp.).

**Rhizoglyphus robini** Claparède.

(Figs 4, 9, 10, 14-16, 20, 26).

**Rhizoglyphus robini** Claparède, 1869


**Rhizoglyphus solani** Oudemans, 1924

Acarologische Aanteekeningen LXXIV ; Ent. Bericht. 6 : 258.

**Rhizoglyphus fusculæ** Oudemans, 1937


**Rhizoglyphus echinopus** Turk, E. & F., 1937


**Rhizoglyphus echinopus** Zakharov, A.A. 1947

--- 631 ---

*Rhizoglyphus echinopus* Hughes, A. M., 1961
The Mites of Stored Food. p. 74.
(not Furnouze & Robin, 1868). Misidentification.

*Rhizoglyphus rhizophagus* Banks, 1906 (new synonymy).

Van Eyndhoven (1968) showed that this species is the type species for the genus *Rhizoglyphus* and not *Tyroglyphus echinopus* F. & R. as previously thought by most authors. Together with *Rhizoglyphus echinopus*, this is one of the commonest species of *Rhizoglyphus* encountered, and it has been frequently confused with *R. echinopus*. Van Eyndhoven (1961) separated it from *R. echinopus* by the shorter dorsal body setae, particularly the sc.i. setae, and also by the shape of the penis which is more conical. There are also differences in the female genital system, leg setation, and leg segment lengths.

**Homeomorphic Male**

Description from 12 specimens. Length of body 469-679; greatest width of body 295-480. Lengths of propodosomal setae as follows: v.i. 66-114; v.e. 5-8; sc.e. 149-209; sc.i. 5-15; Supra coxal seta slender, approximately 24-25 long. Grandjean’s organ without a distal fork.

Lengths of hysterosomal setae: d₁ 10-22; d₂ 8-30; d₃ 41-89; d₄ 125-203; h.i. 10-22; h.e. 117-165; h.v. 14-26; la 12-31; lp 71-155; sa.e. 48-155; sa.i. 98-190.

Mean leg segment lengths as follows:

<table>
<thead>
<tr>
<th></th>
<th>leg I</th>
<th>leg II</th>
<th>leg III</th>
<th>leg IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>tarsus</td>
<td>77</td>
<td>79</td>
<td>76</td>
<td>74</td>
</tr>
<tr>
<td>tibia</td>
<td>34</td>
<td>33</td>
<td>28</td>
<td>33</td>
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<tr>
<td>genu</td>
<td>38</td>
<td>36</td>
<td>29</td>
<td>34</td>
</tr>
<tr>
<td>femur</td>
<td>69</td>
<td>71</td>
<td>52</td>
<td>61</td>
</tr>
</tbody>
</table>

Tarsi I, II, and III usually with three distal setae thickened apically. Solenidion ø₁ on tarsus I similar to that of *R. echinopus*. Leg setae frequently shorter than in *R. echinopus*, this being particularly noticeable with cG and mG on genu I, cG on genu II and mG on genu III.

The penis is narrower and more cone shaped than in *R. echinopus*. Anal discs without radiating lines. Lengths of post anal setae: pa₁ 19-35; pa₂ 114-206; pa₃ 105-165.

**Female**

Description from 12 specimens. Length of body 609-868; greatest width of body 389-635. Lengths of propodosomal setae: v.i. 79-114; v.e. 7-10; sc.e. 158-225; sc.i. 6-15. Supra coxal seta similar to that of homeomorphic male, 22-32 long. Grandjean’s organ as figured (Fig. 10). Lengths of hysterosomal setae: d₁ 6-22; d₂ 13-22; d₃ 32-92; d₄ 121-174; h.i. 13-25; h.e. 110-184; h.v. 12-25; la 13-29; lp 69-117; sa.e. 54-102; sa.i. 117-149. Average number of eggs in body cavity 2, (range 1-6).

Mean leg segment lengths as follows:

<table>
<thead>
<tr>
<th></th>
<th>leg I</th>
<th>leg II</th>
<th>leg III</th>
<th>leg IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>tarsus</td>
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<td>75</td>
<td>71</td>
<td>78</td>
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<tr>
<td>tibia</td>
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<td>35</td>
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</tr>
<tr>
<td>femur</td>
<td>71</td>
<td>74</td>
<td>49</td>
<td>52</td>
</tr>
</tbody>
</table>
FIG. 14-16 and 20: \textit{R. robini}, male; leg I (14); leg II (15); leg III (16); leg IV (20).

FIG. 17: \textit{R. taciti}, male, leg I.

FIG. 18: \textit{R. echinopus}, heteromorphic male, leg III.

FIG. 19: \textit{R. minutus}, male, leg IV (t.s. = tarsal suckers).
Leg setation similar to that of male. Bursa copulatrix with a comparatively small external opening at some distance from the anal slit. A narrow tubular canal leads into the receptaculum seminis and the two V-shaped projections are grouped close together. Anal slit surrounded by six pairs of short setae. Length of post anal setae, pa 1 205-136.

Heteromorphic Male:

Description from 6 specimens. Length of body 518-713; greatest width of body 301-454. Lengths of propodosomal setae: v.i. 90-133; v.e. 8-16; sc.e. 181-241; sc.i. 9-25. Supra coxal seta slender, straight, or slightly curved, 22-36 long. Grandjean's organ with a slight but distinct fork.

Lengths of hysterosomal setae: d 1 27-36; d 2 16-38; d 3 95-136; d 4 165-222; h.i. 32-53; h.e. 187-212; h.v. 40-61; la 35-54; lp 136-190; sa.e. 127-190; sa.i. 95-238.

Mean leg segment lengths:

<table>
<thead>
<tr>
<th>Leg Segment</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>tarsus</td>
<td>93</td>
<td>99</td>
<td>62</td>
<td>99</td>
</tr>
<tr>
<td>tibia</td>
<td>42</td>
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<td>49</td>
<td>44</td>
<td>43</td>
</tr>
<tr>
<td>femur</td>
<td>82</td>
<td>83</td>
<td>103</td>
<td>70</td>
</tr>
</tbody>
</table>

Solenidion w 1 on tarsus I similar to that of homeomorphic male. Leg III similar to that of R. echinopus in structure. Length of post anal setae: pa 1 22-52; pa 2 193-266; pa 3 140-254.

Hypopus:

Similar to that of R. echinopus. The seta on femur I and II tends to be longer in R. echinopus (45-53) than in R. solani (29-48).

Distribution and Host Range:

This species appears to be cosmopolitan. It is the commonest species encountered in New Zealand, and undoubtedly has previously been confused with R. echinopus. Hosts from which I have recorded it in New Zealand are: Aciphylla sp. — on rotting basal material; Arthropodium cirrhatum — on decaying rhizome; carrot (Daucus carota); garlic (Alium sativum); gladioli corms (Gladiolus sp.); iris bulbs (Iris sp.); lily bulbs (Lilium sp.); narcissus bulbs (Narcissus sp.); onions (Alium cepa); and potatoes (Solanum tuberosum).

Overseas countries and hosts from which it has been mentioned in literature are as follows—Australia, on bulbs of Crinum, Lilium, and Narcissus; Greece, on dahlia tubers (Dahlia sp.); Holland, on bulbs of Amaryllis, Gladiolus, Iris and Lilium; Japan, on bulbs of Lyocoris squamiger and Lyocoris sp.; United States of America, on bulbs of Lilium.

Rhizoglyphus setosus n. sp.
(Figs 6, 11, 27, 28, 30, 35, 49, 50, 55, 56).

This species can be distinguished in that the female has two pairs of anal setae at the posterior extremity of the anal slit greatly elongate, particularly the inner pair (Fig. 30). In other species these are quite short. The male has two pairs of short post anal setae.
FIG. 21-23: leg I of male of *R. ranunculi* (21), *R. minutus* (22), and *R. caladii* (23).

Fig. 24: *R. caladii*, tarsus II. male.

Fig. 25: *R. singularis*, male, leg I.

Fig. 26: *R. robini*, male, genital area.

Fig. 27-28: *R. setosus*, enlarged view of opening into receptaculum seminis (27) (r.s. — receptaculum seminis, v. — V-shaped or finger-like structures); posterior ventral view of female (28) (b.c. — opening of bursa copulatrix).

Fig. 29: *R. echinopus*, male, genital area.

Fig. 30: *R. setosus*, posterior ventral view of female showing the three posterior anal more setae clearly.
Homeomorphic Male:

Description from 12 specimens. Length of body 479-777; greatest width of body 321-557. Lengths of propodosomal setae: v.i. 76-125; v.e. 5-10; sc.e. 152-231; sc.i. 5-16; Supra coxal seta a slender curved seta 32-47 long, GRANDJEAN's organ forked distally.

Lengths of hysterosomal setae: d 1 27-63; d 2 35-82; d 3 80-136; d 4 177-244; h.i. 35-83; h.e. 116-190; h.v. 19-42; la 16-43; lp 98-174; sa.e. 82-155; sa.i. 149-212.

Mean leg segment lengths as follows:

<table>
<thead>
<tr>
<th>Leg</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>tarsus</td>
<td>81</td>
<td>86</td>
<td>87</td>
<td>77</td>
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<td>tibia</td>
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<td>genu</td>
<td>36</td>
<td>36</td>
<td>32</td>
<td>39</td>
</tr>
<tr>
<td>femur</td>
<td>67</td>
<td>72</td>
<td>59</td>
<td>67</td>
</tr>
</tbody>
</table>

Leg structure and setation similar to that of R. robini. Penis cone shaped and similar to that of R. robini. Anal discs without radiating lines. Lengths of post anal setae: pa 1 13-26; pa 2 139-238; pa 3 86-284.

Female:

Description from 12 specimens. Length of body 469-946; greatest width of body 325-674. Lengths of propodosomal setae: v.i. 79-117; v.e. 8-11; sc.e. 130-250; sc.i. 3-22. Supra coxal seta (32-49 long) and GRANDJEAN's organ similar to that of homeomorphic male.

Lengths of hysterosomal setae: d 1 27-82; d 2 44-92; d 3 70-142; d 4 124-212; h.i. 33-98; h.e. 124-206; h.v. 19-48; la 22-51; lp 86-184; sa.e. 78-155; sa.i. 139-227. Average number of eggs in body cavity 5 (range 1-16).

Mean leg segment lengths:

<table>
<thead>
<tr>
<th>Leg</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>tarsus</td>
<td>80</td>
<td>86</td>
<td>86</td>
<td>97</td>
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<tr>
<td>tibia</td>
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<tr>
<td>genu</td>
<td>37</td>
<td>37</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td>femur</td>
<td>68</td>
<td>72</td>
<td>52</td>
<td>59</td>
</tr>
</tbody>
</table>

Leg setation similar to that of male. Genital system as figured (Figs 27 & 28). The receptaculum seminis is more roughened and prominent than in R. robini and the copulatory opening protrudes slightly as a cone shaped nozzle. Anal slit surrounded by six pairs of short setae, the three posterior pairs being considerably elongate, particularly the inner pair. Length of post anal setae, pa 116-184.

Heteromorphic male not observed.

Hypopus: (Figs 49, 50, 55, 56).

Length of body 272-317 (7 specs). Of oval shape, brownish, smooth, shining, convex, with minute pale coloured spots. Setae v.i. prominent, 35-44 long; setae sc.i. and sc.e. present as short slender hairs. Transverse division between propodosoma and hysterosoma. Dorsal setae d 1-d 4, h.i., h.e., and la present as short slender hairs. Ventrally, the gnathosoma is similar to that of R. echinopus. Length of apical setae 35-44. Sternum distinct, forked anteriorly, terminating abruptly on a level with coxae II. Apodemes II curving towards the mid line, and then
running parallel with it for a short distance. Apodemes III directed diagonally forwards initially, and then bending abruptly to run tranversely towards the mid line, finally bending posteriorly to meet with apodemes IV. The suckers on coxae III frequently have a dark coloured strip running diagonally forwards to meet apodemes IV. Leg setation similar to that of *R. echinopus*.

The chief distinguishing features between the hypopi of *R. setosus* and *R. echinopus* are as follows:

1. The sternum ends abruptly in *setosus*, but gives rise to a shallow groove in *echinopus*.
2. Apodemes II in *echinopus* run diagonally towards the centre line, almost meeting, whereas in *setosus* they curve posteriorly and run parallel to the midline.

**Holotype**: Female, ex *Caladium* tubers, New Guinea, 3-x-66, R.F. Winch.


**Rhizoglyphus ranunculi** n. sp.

(Figs 13, 21, 36, 41).

The closeness of the propodosomal setae sc.i. to sc.e. separate this species from all others dealt with in this paper. Also, the male has radial lines on the anal discs.

All the specimens of this species had to be remounted prior to examination and unfortunately most of the posterior body setae were dislodged, so that accurate measurements of these setae was not always possible.

**Hemomorphetic Male**:

Description from 6 specimens. Length of body 454-576; greatest width of body 262-363. Lengths of propodosomal setae: v.i. 73-106; v.e. 5-6; sc.e. 130-225; sc.i. 21-35. Setae sc.i. situated at a distance of 11-14 u from sc.e. setae. Supra coxal seta curved, seta like, 32-41 long. Grandjean’s organ forked.

Lengths of hysterosomal setae: d₁ 19-20; d₂ 19; d₃ 117-152; d₄ ~ 136; h.i. 25-29; h.e. ~ 149; h.v. 22-25; la 25-32; lp ~ 200; sa.e. ~ 216; sa.i. 184.

Mean leg segment lengths:

<table>
<thead>
<tr>
<th></th>
<th>leg I</th>
<th>leg II</th>
<th>leg III</th>
<th>leg IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>tarsus</td>
<td>64</td>
<td>63</td>
<td>69</td>
<td>69</td>
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<td>tibia</td>
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<td>31</td>
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<tr>
<td>genu</td>
<td>32</td>
<td>29</td>
<td>24</td>
<td>32</td>
</tr>
<tr>
<td>femur</td>
<td>62</td>
<td>65</td>
<td>48</td>
<td>52</td>
</tr>
</tbody>
</table>
Fig. 31-36: Posterior ventral view of males; *R. singularis* (31); *R. caladii* (32); *R. minutus* (33); *R. taciti* (34); *R. setosus* (35); *R. ranunculi* (36).
Terminal tarsal setae not expanded distally. Solenidion $\omega_4$ on tarsus I of even thickness throughout, not expanded distally. Setae eG and mG of genu I and II slender and elongate, more so than in the previous three species. Spine at apex of tibia IV bluntly rounded.

Anal discs with 6-8 radiating lines. Post anal setae $pa_1$ 22-29; lengths of $pa_2$ and $pa_3$ not accurately discernible, but probably about 200 $\mu$.

**Female:**

Description from 9 specimens. Length of body 531-648; greatest width of body 324-413. Lengths of propodosomal setae: v.i. 86-101; v.e. 5-8; sc.e. 204-263; sc.i. 21-25. Seta sc.i. situated close to sc.e. as in male. Supra coxal seta (32-44) and Grandjean’s organ similar to that of homeomorphic male.

Lengths of hysterosomal setae: $d_1$ 19-29; $d_2$ 22-29; $d_3$ 120-171; $d_4$ 196-257; h.i. 24-32; h.e. 228; h.v. 22-29; la 22-32; lp ? 79-181; sa.e. 143-174; sa.i. 199-225. No specimen with eggs.

Mean leg segment lengths:

<table>
<thead>
<tr>
<th></th>
<th>leg I</th>
<th>leg II</th>
<th>leg III</th>
<th>leg IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>tarsus</td>
<td>70</td>
<td>71</td>
<td>68</td>
<td>76</td>
</tr>
<tr>
<td>tibia</td>
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<td>27</td>
</tr>
<tr>
<td>genu</td>
<td>33</td>
<td>32</td>
<td>25</td>
<td>27</td>
</tr>
<tr>
<td>femur</td>
<td>60</td>
<td>67</td>
<td>48</td>
<td>50</td>
</tr>
</tbody>
</table>

Leg setation similar to that of male. A narrow tubular canal leads into the circular opening of the receptaculum seminis, the two V-shaped structures somewhat further apart than in other species. Anal slit surrounded by six pairs of short setae. Length of post anal setae $pa_2$ 165-212.

**Heteromorphic male** not observed.

**Hypopus** not observed.

**Holotype**: Male, ex base of stem of *Ranunculus* leaf, Mt. Alexander, Puhi puhi River, near Kai-koura 31-i-66, E. Collyer.

**Paratypes**: 6 males, 16 females, with same data as holotype.

Paratype slides are deposited in the collections of the United States National Museum, Washington D.C., U.S.A., Zoölogisch Museum, der Universität van Amsterdam, the Netherlands, and the British Museum (Natural History), London.

**Rhizoglyphus caladii** n. sp.

(Figs 7, 23, 24, 32, 37, 38, 40, 45, 57).

This species is very distinct, being distinguished from all others in this paper by the small size of the conical spine (ba) on tarsi I and II which is about half the size of that found on other species, and by the length of seta $d_4$ which is longer than in any other species dealt with here, being 203-247 long in the female and 187-196 long in the male. In addition, the female bears three pairs of long anal setae and the male has radial lines on the anal discs and two pairs of short post anal setae.
Homeomorphic Male: (Fig. 37).

Description from 4 specimens. Length of body 466-573; greatest width of body 305-368. Lengths of propodosomal setae: v.i. 82-101; v.e. not apparent; s.c.e. 174-285; s.c.i. 41-48. Supra coxal seta a straight or slightly curved seta, 32-42 long. Grandjean's organ forked distally.

Lengths of hysterosomal setae: d₁ 26-44; d₂ 36-52; d₃ 187-206; d₄ 269-307; h.i. 38-57; h.e. 159-221; h.v. 29-38; l.a 33-52; l.p 165-260; s.a.e. 181-269; s.a.i. 200-247.

Mean leg segment lengths:

<table>
<thead>
<tr>
<th></th>
<th>leg I</th>
<th>leg II</th>
<th>leg III</th>
<th>leg IV</th>
</tr>
</thead>
<tbody>
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<td>89</td>
<td>81</td>
</tr>
<tr>
<td>tibia</td>
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<td>genu</td>
<td>3x</td>
<td>36</td>
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<td>43</td>
</tr>
<tr>
<td>femur</td>
<td>6x</td>
<td>66</td>
<td>54</td>
<td>58</td>
</tr>
</tbody>
</table>

Solenidion w₁ on tarsi I and II is at least twice as long as the conical spine (ba). Solenidion w₁ on tarsus I slightly swollen distally. Penial covering broad basally, and produced anteriorly as two elongate sheath-like structures. Penis a stout S-shaped structure. Anal discs with radiating lines. Lengths of post anal setae: p.a₁ 24-25; p.a₂ 238-327; p.a₃ 16-25.

Female: (Fig. 38).

Description from 4 specimens. Length of body 550-609; greatest width of body 350-376. Lengths of propodosomal setae: v.i. 82-98; v.e. not apparent; s.c.e. 241-263; s.c.i. 35-48. Supra coxal seta and Grandjean's organ similar to that of homeomorphic male.

Lengths of hysterosomal setae: d₁ 27-32; d₂ 41-63; d₃ 203-260; d₄ 269-317; h.i. 38-51; h.e. 197-247; h.v. 31-35; l.a 32-41; l.p 216-285; s.a.e. 165-247; s.a.i. 260-295. Average number of eggs in body cavity 3.

Mean leg segment lengths:

<table>
<thead>
<tr>
<th></th>
<th>leg I</th>
<th>leg II</th>
<th>leg III</th>
<th>leg IV</th>
</tr>
</thead>
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<tr>
<td>femur</td>
<td>58</td>
<td>63</td>
<td>51</td>
<td>56</td>
</tr>
</tbody>
</table>

As in the male, the sensory rod w₁ on tarsi I and II is at least twice as long as the conical spine (ba).

Three pairs of long (35-79) prominent setae surround the anal slit. Genital system similar to that of R. setosus. Length of post anal setae pa 197-238.

Heteromorphic male not observed.

Hypopus not observed.

Holotype Male, ex Caladium tubers, New Guinea, 3-x-66, R. F. Winch.

Paratypes — 3 males, 4 females with same data as holotype.

Fig. 37-38: *R. caladii*, ventral view of male (37); dorsal view of female (38).

Fig. 39: *R. tacitri*, posterior ventral view of female.

Fig. 40: *R. caladii*, posterior ventral view of female.

Fig. 41-46: Solenidion o1 of tarsus I of males; *R. ransomei* (41); *R. echidopus* (42); *R. minutus* (43); *R. singularis* (44); *R. caladii* (45); *R. tacitri* (46).
Rizoglyphus tacitri n. sp.
(Figs 12, 17, 34, 39, 46, 58).

The extreme smallness of the propodosomal setae sc.i., the absence of setae h.v., and the proximity of seta la to the opening of the latero-abdominal gland are distinctive features of this species.

**Homeomorphic Male**

Description from 9 specimens. Length of body 540-704; greatest width of body 342-536. Lengths of propodosomal setae: v.i. 95-125; v.e. 6-14; sce. 162-212; sc.i. 3-4. Supra coxal seta short, seta like, 4-11 long. Grandjean’s organ forked distally.

Lengths of hysterosomal setae: d. 1 25-54; d. 2 28-50; d. 3 95-152; d. 4 155-199; h.i. 29-48; h.e. 149-181; h.v. absent; la 12-25; lp 117-155; sa.e. 63-92; sa.i. 150-190. Seta la usually situated just anteriorly (10-15 u) of opening of latero-abdominal gland.

Mean leg segment lengths:

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<th>leg I</th>
<th>leg II</th>
<th>leg III</th>
<th>leg IV</th>
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<tbody>
<tr>
<td>tarsus</td>
<td>97</td>
<td>101</td>
<td>102</td>
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<td>tibia</td>
<td>38</td>
<td>37</td>
<td>36</td>
<td>42</td>
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<td>45</td>
<td>44</td>
<td>37</td>
<td>47</td>
</tr>
<tr>
<td>femur</td>
<td>77</td>
<td>81</td>
<td>66</td>
<td>75</td>
</tr>
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</table>

Solenidion w.1 on tarsus I similar to that of R. ranunculi; although slightly shorter.

Tarsal segments unusually long, particularly tarsi I, II and III. Penal structure broad with a short anterior projection (Fig. 58). Anal discs with radiating lines. Lengths of post anal setae: pa. 1 14-24; pa. 2 149-184; pa. 3 4-15.

**Female**

Description from 12 specimens. Length of body 658-882; greatest width of body 408-645. Lengths of propodosomal setae: v.i. 95-129; v.e. 11-16; sce. 177-228; sc.i. 3-4. Supra coxal seta (9-16) and Grandjean’s organ similar to that of homeomorphic male.

Lengths of hysterosomal setae: d. 1 32-50; d. 2 32-67; d. 3 98-146; d. 4 130-212; h.i. 24-63; h.e. 155-206; h.v. absent; la 16-25; lp 108-163; sa.e. 63-127; sa.i. 149-190. Average number of eggs in body cavity 1. Seta la situated similarly to that of the male.

Mean leg segment lengths:

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<td>115</td>
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<td>tibia</td>
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<td>43</td>
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<tr>
<td>femur</td>
<td>78</td>
<td>83</td>
<td>60</td>
<td>68</td>
</tr>
</tbody>
</table>

Tarsal segments unusually long, as in the male. Tarsus IV longer than that of any other species described in this paper. Leg setation similar to that of the male. The external opening of the bursa copulatrix arising from the centre of a distinctively shaped stippled area, the basal piece of which is semi circular. Imposed on this is a cone-shaped area (Fig. 39). Anal slit usually flanked by two pairs of setae (Fig. 39), the anterior pair located about one third the distance...
of the anal slit from the anterior end, the posterior pair, which are larger, being situated at the posterior margin of the anal slit. Length of post anal seta p.a. II4-II9.

*Heteromorphic male* not observed.

*Hypopus* not observed.

**Holotype**: Male, ex roots of cuttings of *Citrus aurantifolia* and *Citrus grandis*, Tahiti, 20-xii-68, D. C. M. Manson.

**Paratypes**: 8 males, 37 females and immature forms, with same data as holotype.

Paratype slides are deposited in the collections of the United States National Museum, Washington D.C., U.S.A., Zoologisch Museum der Universiteit van Amsterdam, the Netherlands, and the British Museum (Natural History), London.

*Rizoglyphus minutus* n. sp.

(Figs 19, 22, 33, 43, 52).

This species most closely resembles *R. tacitri* but can be distinguished in that seta la is further removed from the latero-abdominal gland opening. Tarsus I of the male is shorter than that of any other species described in this paper and also setae v.i. and sc.e.

**Homeomorphic male**:

Description from 2 specimens. Length of body 492-544; greatest width of body 402-412. Lengths of propodosomal setae: v.i. 40-48; v.e. not apparent; sc.e. 105-133; sc.i. 3 (only visible in on specimen). Supra coxal seta, seta-like, 24-28 long. Grandjean's organ a thick curved seta, probably forked, although this is not visible.

Lengths of hysterosomal setae: d 1 13; d 2 13; d 3 73-86; d 4 136; h.i. 14-15; h.e. 92-95; h.v. 13; la 21-22; lp 105; sa.e. 95; sa.i. 101.

Mean leg segment lengths:

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<td>tibia</td>
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<td>24</td>
<td>20</td>
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<tr>
<td>femur</td>
<td>54</td>
<td>54</td>
<td>41</td>
<td>48</td>
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</table>

Leg segments very short, shorter than those of any other species dealt with in this paper. Solenidion ø 1 on tarsus I of even thickness, rounded distally. Penal structure not clearly discernible. Anal discs with radiating lines. Lengths of post anal setae: pa 1 13; pa 2 114; pa 3 16.

**Female**:

One specimen only. Length of body 674; greatest width of body 505. Lengths of propodosomal setae: v.i. 54; v.e. not apparent; sc.e. 149; sc.i. not visible, although basal socket present. Supra coxal seta not visible. Grandjean's organ a thick, curved seta, forked distally.

Lengths of hysterosomal setae: d 1 16; d 2 16; d 3 89; d 4 124; h.i. 16; h.e. 152; h.v. 16; la 22; lp III; sa.e. III; sa.i. 139 (sa.i. missing on one side). One egg present.
Fig. 47-48: *R. echinopus*, hypopus; dorsal view (47); ventral view (48).
Fig. 49-50: *R. setosus*, hypopus; dorsal view (49); ventral view (50).
Leg segment lengths:

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<td>73</td>
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<td>tibia</td>
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<tr>
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<td>32</td>
<td>32</td>
<td>26</td>
<td>30</td>
</tr>
<tr>
<td>femur</td>
<td>65</td>
<td>68</td>
<td>48</td>
<td>51</td>
</tr>
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</table>

Leg segments longer than in the male. Bursa copulatrix projecting slightly from posterior body margin as a blunt cone. Canal a broad tube, more so than in any other species, increasing in width as it nears the receptaculum seminis. Anal slit (Fig. 52) surrounded by four pairs of setae. Posterior body setae broad basally, tapering rapidly distally. Length of post anal setae pa 98.

*Heteromorphic male* not observed.

*Hyopopus* not observed.

**Holotype**: Male, ex taro (*Colocasia* sp.), Niue Is., 10-iv-68, N. F. Emery.

**Paratypes**: 1 male, 1 female and 1 immature form, with same data as holotype. All material retained in the collection of the Department of Agriculture, Levin.

**Rhizoglyphus singularis** n. sp.

(Figs 25, 31, 44, 51, 60).

In the male, radiating lines are present to a reduced extent on the anterior portion of the anal discs, and the posterior body margin is usually more bluntly pointed than in other species (Fig. 31). The female differs from other species in that the body setae la are adjacent to the opening of the latero-abdominal gland and setae sc.i. are comparatively long (29-47 µ).

**Homeomorphic male**:

Description from two specimens. Length of body 525-642; greatest width of body 369-428. Lengths of propodosomal setae: v.i. 73-86; v.e. not apparent; sc.e. 159-190; sc.i. 29-33. Supra coxal seta a slender slightly curved seta, 30-32 long. Grandjean's organ a thick curved seta, forked apically.

Lengths of hysterosomal setae: d 1 47-69; d 2 44-60; d 3 130-140; d 4 174-178; h.i. 47-50; h.e. 139-165; h.v. 12-14; la 18-22; lp 111-149; sa.e. 83-127; sa.i. 92-139. Seta la situated just anterior (6-9 µ distance) of opening of latero-abdominal gland.

Mean leg segment lengths:

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<tr>
<td>femur</td>
<td>74</td>
<td>80</td>
<td>68</td>
<td>73</td>
</tr>
</tbody>
</table>

Solenidion $\omega_1$ on tarsus I straight, of even thickness, rounded distally. Penal structure broad basally, tapering rapidly anteriorly (Fig. 60). Posterior body margin usually more bluntly pointed as compared to other species dealt with in this paper. Anal discs with a granulate pattern.
Fig. 51-52: Posterior ventral view of female; *R. singularis* (51); *R. minutus* (52).

Fig. 53-54: *R. echiponus*, hypopus, leg I (53); leg II (54).

Fig. 55-56: *R. setosus*, hypopus; leg I (55); leg II (56).

Fig. 57: *R. caladii*, male; genital area.

Fig. 58: *R. taciti*, male; genital area.
and towards the anterior end is an oval or circular shaped area on which occur several radiating 
lines (Fig. 31). Lengths of post anal setae: \( \text{pa}_1 \) 16-19; \( \text{pa}_2 \) 177-181; \( \text{pa}_3 \) 102-123.

**Female** :

Description from four specimens. Length of body 699-765; greatest width of body 472-544. Lengths of propodosomal setae: v.i. 79-98; v.e. 5-6; sc.e. 152-212; sc.i. 29-47. Supra coxal seta 29-35 long, similar to that of homeomorphic male. **Grandjean's organ** similar to that of homeomorphic male.

Lengths of hysterosomal setae: \( d_1 \) 60-98; \( d_2 \) 66-79; \( d_3 \) 105-143; \( d_4 \) 136-159; h.i. 48-82; h.e. 156-177; h.v. 11-22; la 13-19; lp 124-143; sa.e. 76-139; sa.i. 127-143. Seta la situated at a distance of 11-17 \( \mu \) from opening of latero-abdominal gland. Average number of eggs present 5 (range 1-7).

Mean leg segment lengths:

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<td>86</td>
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<td>35</td>
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<tr>
<td>genu</td>
<td>39</td>
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<td>29</td>
<td>36</td>
</tr>
<tr>
<td>femur</td>
<td>73</td>
<td>76</td>
<td>60</td>
<td>66</td>
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Immediately posterior to the anal slit is the large « horseshoe-shaped » opening of the bursa copulatrix (Fig. 51). A narrow canal, widening slightly as it progresses, leads into the circular opening of the receptaculum seminis. There are three pairs of anal setae, the posterior pair being longest. Length of post anal setae pa 101-162.

**Heteromorphic male** : not observed.

**Hyposalp** not observed.

**Holotype** : Male, intercepted on yams (Dioscorea sp.) from India, 1-v-67, R. T. Spinks.

**Paratypes** : One female and immature forms with same data as holotype. Also, one male and three fe males off taro, (Colocasia antiquorum) from India, 3-vii-70, D. C. M. Manson.


**Rhizoglyphus howensis** n. sp.

(Fig. 59).

The male can be separated from allied species by the presence of radiating lines on the anal discs, the distance of seta la from the opening of the latero-abdominal glands (32-35 \( \mu \)) and the mean lengths of the tarsal segments (69, 75, 76 and 73 \( \mu \)). The female has only one pair of anal setae.

**Homeomorphic male** :

Description from two specimens. Length of body 535-561; greatest width of body 382-385. Lengths of propodosomal setae: v.i. 108-115; v.e. 3 (visible on one specimen only); sc.e. 158-
196; sc.i. 5-7. Supra coxal seta a slightly curved seta, 27-32 long. *Grandjean's* organ a thick curved seta, forked apically.

Lengths of hysterosomal setae: \(d_1 22-41\); \(d_2 31-57\); \(d_3 133-216\); \(d_4 190-244\); h.i. 52-89; h.e. 169-228; h.v. 32; la 25-32; lp 130-203; sa.e. 143-206; sa.i. 193-244. Seta la situated at a distance of 32-35 \(\mu\) from opening of latero-abdominal gland.

Mean leg segment lengths:

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<td>76</td>
<td>73</td>
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<td>tibia</td>
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<td>32</td>
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<tr>
<td>genu</td>
<td>62</td>
<td>67</td>
<td>55</td>
<td>65</td>
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</table>

Solenidion \(\omega_1\) on tarsus I straight, of even thickness, slightly pointed apically. Penal structure not visible. Anal discs with radiating lines. Lengths of post anal setae: \(pa_1 25-35\); \(pa_2 174-228\); \(pa_3 114-174\).

**Female:**

It is not certain that the female is of the same species as the males, but since it came off the same host material and in association with the males, it is in the meantime assumed to be the identical species.

Description from one specimen only: Length of body 751; greatest width of body 581. Lengths of propodosomal setae: v.i. 165; v.e. 8; sce. 260; sc.i. 6. Supra coxal seta 48 long. *Grandjean's* organ a strongly curved seta, the tip not visible.
Lengths of hysterosomal setae: \( d_1 \) 89; \( d_2 \) ? 57; \( d_3 \) 222; \( h.i. \) III; \( h.e. \) 231; \( h.v. \) 47; \( l.a \) 38; \( l.p \) 165; \( s.e. \) 190; \( s.a. \) 241. Seta \( l.a \) situated at a distance of 55-57 \( \mu \) from opening of latero-abdominal gland. Three eggs in body cavity.

Leg segment lengths:

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<td>tibia</td>
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<td>44</td>
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<td>43</td>
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<tr>
<td>femur</td>
<td>82</td>
<td>86</td>
<td>63</td>
<td>71</td>
</tr>
</tbody>
</table>

Details of genital system not visible. One pair of anal setae at about anterior \( \frac{1}{4} \). Length of post anal setae pa 222.

*Heteromorphic* male not observed.

*Hypopus* not observed.

*Holotype*: Male, on palm seed, Lord Howe Is., 25-vi-70. Host material forwarded by P. G. Whitham and specimens collected by D.C.M. Manson.

*Paratypes*: One male, one female and one immature specimen with same data as holotype.

All material retained in the collection of the Department of Agriculture, Levin, New Zealand.

As well as the above species, type material of four other species has been examined as follows:

*Rhizoglyphus longitarsis* Banks.


The type slide of this species was kindly forwarded to me by Mr. R. Smiley. It bears the following label — No. 4909. In bulbs of *Caladium esculentum* (rotten) Emporia Kans. R. Miliken.

This species does not belong to the genus *Rhizoglyphus* as it is now recognised, but is almost certainly a species of *Caloglyphus*.

*Rhizoglyphus oblongus* Ewing.


A paratype slide was received from the British Museum through the courtesy of Mr. D. Macfarlane. This is not a species of *Rhizoglyphus*, but probably *Caloglyphus*. A syntype of this species was also received from Miss A. Bliss of the Museum of Comparative Zoology, Harvard University, U.S.A., and proved to be a species of *Caloglyphus*.

*Rhizoglyphus prasinimaculosus* Ewing.


A paratype slide was received from the British Museum through the courtesy of Mr. D. Macfarlane. The specimen was immature, but probably *Rhizoglyphus*. It was too poorly mounted to make out any significant details.
Rhizoglyphus elongatus Banks.

Mr. R. Smiley kindly forwarded me holotype material of this species. Jacot (1939) and Woodring (1966) considered this species to be of the genus Schwiebia and it is my intention to re-describe it in a forthcoming paper dealing with several species of Schwiebia.

Acknowledgements.

Dr. G. L. van Eynhoven read through the manuscript and made many valuable suggestions and comments. I am greatly indebted to him for his assistance. My thanks are also due to the following people—Mr. D. Macfarlane of the British Museum for supplying a list of Rhizoglyphus species, indicating the location of type material and lending paratype slides of Rhizoglyphus oblongus and R. prasini-maculosus for examination; Dr. K. Samšiňák of the Czechoslovak Academy of Sciences for providing photos of Berlese’s material; Dr. E. W. Bakey and Mr. R. L. Smiley, U.S.A.D., Washington D. C., for the loan of holotype material of R. elongatus and R. longitarsis and paratype material of R. rhizophagus; Miss A. Bliss and Dr. H. W. Levi of the Museum of Comparative Zoology, Harvard University, U.S.A. for the loan of the syntype of R. oblongus.

References


