

Key to Tarsonemidae of New Zealand

**Final report to MAF Science Policy
for Project FMA102**

Project Leader
ZHI-QIANG ZHANG
Ladcare Research, Auckland

Other team members
DAVOR BEJAKOVICH
MAF National Plant Pest Reference Laboratory, Lincoln
&
NICK A. MARTIN
Crop & Food Research, Auckland

July 1999 - June 2000

Table of Contents

Summary Final Report	5
Full report	7
Introduction	7
Aims of the project	7
Methodology	7
Results	8
General account	8
Checklist of subfamilies, genera and species	8
Guide to use of key	10
Key to Tarsonemidae of New Zealand	11
Appendix	36
1 <i>Polyphagotarsonemus latus</i> (Banks)	36
2 <i>Acarapis dorsalis</i> Morgenthaler	39
3 <i>Acarapis externus</i> Morgenthaler	40
4 <i>Genus A. sp. A</i>	41
5 <i>Daidalotarsonemus sp. A</i>	42
6 <i>Daidalotarsonemus sp. B</i>	43
7 <i>Daidalotarsonemus sp. C</i>	44
8 <i>Daidalotarsonemus sp. D</i>	45
9 <i>Suskia masoni</i> Lindquist	46
10 <i>Rhyncotarsonemus sp. A</i>	47
11 <i>Rhyncotarsonemus sp. B</i>	48
12 <i>Genus Z sp. A</i>	49
13 <i>Genus Z sp. B</i>	50
14 <i>Genus Z sp. C</i>	51
15 <i>Genus Z sp. D</i>	52
16 <i>Genus Z sp. E</i>	53
17 <i>Genus Z sp. F</i>	54
18 <i>Xenotarsonemus sp. A</i>	55
19 <i>Xenotarsonemus sp. B</i>	56

20	<i>Dentroptus</i> sp. A	57
21	<i>Fungitarsonemus</i> sp. A	58
22	<i>Fungitarsonemus</i> sp. B	59
23	<i>Genus B</i> sp. A	60
24	<i>Genus B</i> sp. B	61
25	<i>Steneotarsonemus</i> sp. A	62
26	<i>Steneotarsonemus</i> sp. B	63
27	<i>Steneotarsonemus</i> sp. C	64
28	<i>Phytonemus pallidus</i> (Banks)	65
29	<i>Tarsonemus</i> sp. N	71
30	<i>Tarsonemus</i> sp. Y	72
31	<i>Tarsonemus</i> sp. D	73
32	<i>Tarsonemus</i> sp. B	74
33	<i>Tarsonemus</i> sp. O	75
34	<i>Tarsonemus</i> sp. W	76
35	<i>Tarsonemus</i> sp. S	77
36	<i>Tarsonemus</i> sp. F	78
37	<i>Tarsonemus waitei</i> Banks	79
38	<i>Tarsonemus</i> sp. G	80
39	<i>Tarsonemus parawaitei</i> Kim, Qin & Lindquist	81
40	<i>Tarsonemus</i> sp. R	82
41	<i>Tarsonemus</i> sp. Z	83
42	<i>Tarsonemus</i> sp. J	84
43	<i>Tarsonemus</i> sp. K	85
44	<i>Tarsonemus confusus</i> Ewing	86
45	<i>Tarsonemus</i> sp. P	87
46	<i>Tarsonemus talpae</i> Schaarschmidt	88
47	<i>Tarsonemus</i> sp. I	89
48	<i>Tarsonemus</i> sp. H	90
49	<i>Tarsonemus</i> sp. V	91
50	<i>Tarsonemus</i> sp. U	92
51	<i>Tarsonemus</i> sp. T	93
52	<i>Tarsonemus</i> sp. E	94

53 <i>Tarsonemus</i> sp. C	95
54 <i>Tarsonemus</i> sp. X	96
55 <i>Tarsonemus</i> sp. L	97
56 <i>Tarsonemus</i> sp. A	98
57 <i>Tarsonemus</i> sp. M	99
58 Methods for preparation of slides for microscopic study	100

Summary Final Report - Operational Research 1999/2000

Project Code:

FMA102

Institution:

Landcare Research, Auckland

Project Leader:

Dr Zhi-Qiang Zhang

Programme Title:

Identification Key to Tarsonemidae of New Zealand

Goals:

To provide a user-friendly identification key to the genera and species of the mites in the families Tarsonemidae occurring in New Zealand.

Contexts of the Project:

A key is required which allows identification of tarsonemid mites in New Zealand in order to facilitate requests for rapid quarantine decisions from trading partners.

Approach:

Existing slide-mounted specimens in NZAC, MAF Operations in Lincoln and Lynfield, and other available material, were collated, assessed and examined by light microscopy and diagnostic features discriminating genera and species were identified and illustrated by line drawings and by photography. The information was collated into an illustrated dichotomous key. Unnamed species were referred to by code. Distributional information were provided based on published records but mostly from data accompanying the specimens.

Outcomes:

Over 600 slides containing over 1,500 specimens of New Zealand tarsonemid mites were studied. An illustrated key to 3 subfamilies, 14 genera and 57 species of the Tarsonemidae was constructed. All three subfamilies of the Tarsonemidae are represented in New Zealand. Among the 14 genera, three are new to science and five new records for New Zealand. Among the 57 species, 84% are unnamed. A species file is provided for each species, which includes distribution data, a brief diagnosis, a list of specimens examined and illustrations.

Summary:

This project provides a user-friendly identification key to the genera and species of the mites of Tarsonemidae in New Zealand. It enables the identification of tarsonemid mites in New Zealand to facilitate requests for rapid quarantine decisions from trading partners. The key was constructed through careful studies of over 1,500 specimens preserved on slides and was illus-

trated with drawings and photographs of discriminating characters. A total of 3 subfamilies, 14 genera and 57 species was included in the key, including 3 genera new to science. Distribution, diagnosis, list of specimens and illustrations were provided for each species.

Publications:

Zhang, Z.-Q. & Martin, N.A. A new genus of Tarsoneminae (Acari: Tarsonemidae) from New Zealand. (in preparation)

Zhang, Z.-Q. & Bejakovich, D. New record of *Rhyncotarsonemus* (Acari: Tarsonemidae) from New Zealand with description of a new species from leaves and twigs of plum (in preparation)

Key to Tarsonemidae of New Zealand

MAF Science Policy Project FMA102

Full report

Introduction

Mites belong to the arthropod class Arachnida. They are among the smallest arthropods and many of them can not be seen by the naked eye. The family Tarsonemidae belongs to the mite order Prostigmata, which includes some 120 families of mites with diverse feeding habits.

Mites of the Tarsonemidae have a diversity of feeding habits, including fungus feeders, plant feeders, and parasitic/symbiont associates of insects. Several species, notably *Polypogotarsonemus latus* and *Phytonemus pallidus*, are important pests of agricultural crops.

The life cycle of tarsonemid mites is simple and includes three stages: egg, larva and adult. Development from egg to adult takes normally a few days at ambient temperatures.

The family Tarsonemidae currently includes three subfamilies, 37 genera and about 600 described species in the world. Less than 2% of these species are currently recorded in New Zealand.

Tarsonemidae are among the smallest mites, with average length of about one-fifth of a millimetre. Female tarsonemids are easily distinguished from mites of other families by their attenuated and 3-segmented leg IV (femur and genu fused to form femorogenu, and tibia and tarsus fused to form tibiotarsus). Males have leg IV always inserted ventrally and legs IV have 3 or 4 segments (tibia and tarsus separate or fused).

Aim of the project

To facilitate identifications of tarsoenmid mites and enable rapid quarantine decisions from trading partners by producing an illustrated and user-friendly identification key suitable for non-specialists and provide data on distribution of each species.

Methodology

Existing slide-mounted specimens in New Zealand Arthropod Collection (NZAC) at Landcare Research in Auckland, Crop & Food Research in Auckland, Ministry of Agriculture and Forestry Operations in Lincoln and Lynfield, and other available material, were collated and assessed. New slides were prepared where existing material was inadequate. All slides were examined by light microscopy and diagnostic features discriminating genera and species identified. Diagnostic features were illustrated by line drawings using a drawing tube attached to a high-quality compound microscope, and by photography. The information were comparatively

analysed and collated into an illustrated dichotomous key. Unnamed species were referred to by code and were formally described, but specimen deposition and collecting data were provided. Distributional information are provided based on published and unpublished records.

Results

GENERAL ACCOUNT

During this one-year project, over 600 slides containing over 1,500 specimens of New Zealand tarsonemid mites were studied. A key to 3 subfamilies, 14 genera and 57 species of the Tarsonemidae was constructed. The key was illustrated with diagnostic characters. All three subfamilies of the Tarsonemidae are represented in New Zealand. Among the 14 genera, three are undescribed genera (coded as genus *A* near *Eotarsonemus*, genus *B* near *Phytonemus* and genus *Z* near *Phytonemus*) new to science and five are new records for New Zealand. Among the 57 species, 84% are unnamed. A species file is provided for each species, which includes distribution data, a brief diagnosis, a list of specimens examined (including hosts and localities) and illustrations. For described species, a reference to published literature is also given.

CHECKLIST OF TAXA

Family Tarsonemidae

- 1 Subfamily Pseudotarsoneminae
 - 1.1 Genus *Polyphagotarsonemus* Beer & Nucifura
 - 1.1.1 *Polyphagotarsonemus latus* (Banks)
- 2 Subfamily Acarapinae
 - 2.1 Genus *Acarapsis* Hirst
 - 2.1.1 *Acarapsis dorsalis* Morgenthaler
 - 2.1.2 *Acarapsis externus* Morgenthaler
- 3 Subfamily Tarsoneminae
 - 3.1 Genus *A* near *Eotarsonemus*
 - 3.1.1 *Genus A. sp. A*
 - 3.2. Genus *Daidalotarsonemus* De Leon
 - 3.2.1 *Daidalotarsonemus sp. A*
 - 3.2.2 *Daidalotarsonemus sp. B*
 - 3.2.3 *Daidalotarsonemus sp. C*
 - 3.2.4 *Daidalotarsonemus sp. D*
 - 3.3 Genus *Suskia* Lindquist
 - 3.3.1 *Suskia masoni* Lindquist
 - 3.4 Genus *Rhyncotarsonemus* Beer
 - 3.4.1 *Rhyncotarsonemus sp. A*
 - 3.4.2 *Rhyncotarsonemus sp. B*

- 3.5 Genus *Z* near *Phytonemus*
 - 3.5.1 Genus *Z* sp. A
 - 3.5.2 Genus *Z* sp. B
 - 3.5.3 Genus *Z* sp. C
 - 3.5.4 Genus *Z* sp. D
 - 3.5.5 Genus *Z* sp. E
 - 3.5.6 Genus *Z* sp. F
- 3.6 Genus *Xenotarsonemus* Beer
 - 3.6.1 *Xenotarsonemus* sp. A
 - 3.6.2 *Xenotarsonemus* sp. B
- 3.7 Genus *Dendroptus* Kramer
 - 3.7.1 *Dendroptus* sp. A
- 3.8 Genus *Fungitarsonemus* Cromroy
 - 3.8.1 *Fungitarsonemus* sp. A
 - 3.8.2 *Fungitarsonemus* sp. B
- 3.9 Genus *B* near *Phytonemus*
 - 3.9.1 Genus *B* sp. A
 - 3.9.2 Genus *B* sp. B
- 3.10 Genus *Steneotarsonemus* Beer
 - 3.10.1 *Steneotarsonemus* sp. A
 - 3.10.2 *Steneotarsonemus* sp. B
- 3.11 Genus *Phytonemus* Lindquist
 - 3.11.1 *Phytonemus pallidus* (Banks)
- 3.12 Genus *Tarsonemus* Canestrini & Fanzago
 - 3.12.1 *Tarsonemus confusus* Ewing
 - 3.12.2 *Tarsonemus parawaitei* Kim, Qin & Lindquist, 1998
 - 3.12.3 *Tarsonemus talpae* Schaarschmidt
 - 3.12.4 *Tarsonemus waitei* Banks
 - 3.12.5 *Tarsonemus* sp. A
 - 3.12.6 *Tarsonemus* sp. B
 - 3.12.7 *Tarsonemus* sp. C
 - 3.12.8 *Tarsonemus* sp. D
 - 3.12.9 *Tarsonemus* sp. E
 - 3.12.10 *Tarsonemus* sp. F
 - 3.12.11 *Tarsonemus* sp. G
 - 3.12.12 *Tarsonemus* sp. H
 - 3.12.13 *Tarsonemus* sp. I
 - 3.12.14 *Tarsonemus* sp. J
 - 3.12.15 *Tarsonemus* sp. K
 - 3.12.16 *Tarsonemus* sp. L
 - 3.12.17 *Tarsonemus* sp. M
 - 3.12.18 *Tarsonemus* sp. N

- 3.12.19 *Tarsonemus* sp. O
- 3.12.20 *Tarsonemus* sp. P
- 3.12.21 *Tarsonemus* sp. Q
- 3.12.22 *Tarsonemus* sp. R
- 3.12.23 *Tarsonemus* sp. S
- 3.12.24 *Tarsonemus* sp. T
- 3.12.25 *Tarsonemus* sp. U
- 3.12.26 *Tarsonemus* sp. V
- 3.12.27 *Tarsonemus* sp. W
- 3.12.28 *Tarsonemus* sp. X
- 3.12.29 *Tarsonemus* sp. Y
- 3.12.30 *Tarsonemus* sp. Z

GUIDE TO USE OF KEY

This key is designed for identifying mites prepared on glass microslides. A good compound microscope with differential interference contrast is best for viewing all the characters. A simple good phase contrast microscope can also be used if the former is not available. Oil immersion is usually required for seeing the detailed morphological characters of tarsonemid mites.

Best results can be obtained from examining clean and properly prepared slides. Methods for preparing mites for microscopic study is provided in Appendix 58 at the end of the report.

This dichotomous key allows identification of tarsonemid mites to subfamily, genera and species. The part of the key to subfamilies and genera is based on both adult males and females, whereas the part of key to species is based on adult females only as males were often not available for study for most species.

Distinguishing characters are compared and contrasted in couplets on the left side of each page and figures of key characters are placed on the right side of each page for easy reference. The first few pages of the key are fully illustrated so that the user can easily associate descriptions of characters with illustrations. In the latter part of the key where these characters are repeated, they are not illustrated as the user should know them at this stage, or they can refer to earlier couplets in the key.

When a specimen is keyed to the specific level, it is referred to a species file in the appendix, which provides data on distribution, a brief diagnosis, a list of specimens examined (including hosts and localities) and illustrations (for described species, a reference to published literature is also given). The user is advised to compare the specimen(s) with the illustrations and also descriptions in the references for confirmation. In case of difficulty, the user should ask a specialist for help.

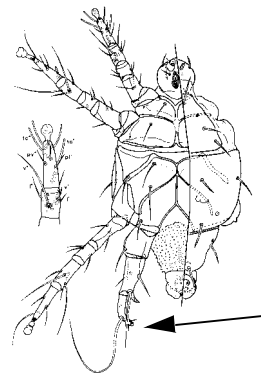
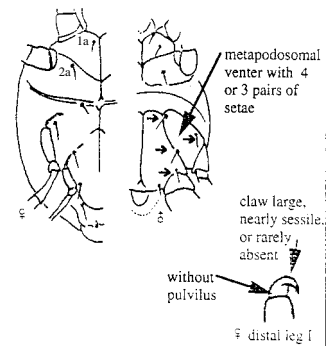
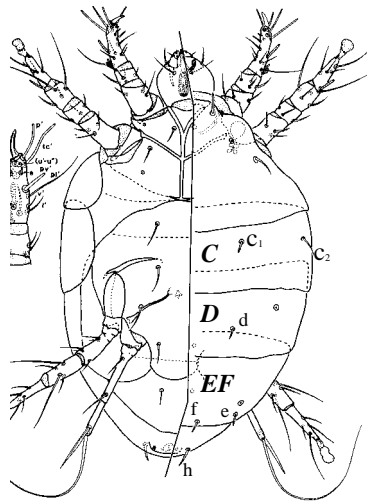
All measurements are made in micrometers (μm).

KEY TO TARSONEMIDAE OF NEW ZEALAND

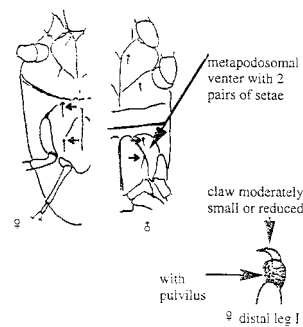
- 1a **Male & female:** metapodosomal venter with 3 or 4 pairs of setae;
female: ambulacrum I with membranous part absent, but with a large sessile claw
subfamily **Pseudotarsonemoidinae**

One single genus and species known in New Zealand: *Polyphagotarsonemus latus* (Banks). A cosmopolitan species.

See Appendix 1 for more information.

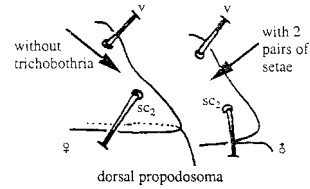


- 1b **Male & female:** metapodosoma venter with 2 pairs of setae;
female: ambulacrum I with membranous part and a claw
Subfamilies **Tarsonemidae** and **Acarapinae**2



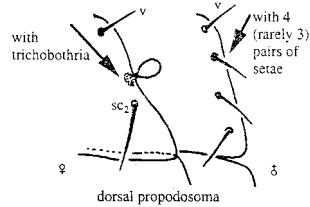
KEY TO TARSONEMIDAE OF NEW ZEALAND

- 2a **Male & female:** parasitic on bees;
female: prodorsal trichobothria absent;
male: prodorsum with 2 pairs of setae
 ...subfamily **Acarapinae**
 One genus in New Zealand:
 *Acarapis* Hirst..... 3



Three species are known in New Zealand and two are keyed here (one of them, *A. vagans* Schneider, was inadequately described and specimens are lacking. This species is considered as *nom. dubium* by Delfinado-Baker & Baker 1982. It cannot be keyed).

- 2b **Male & female:** usually not parasitic on insects;
female: prodorsal trichobothria present;
male: prodorsum with 4 pairs of setae
 ...subfamily **Tarsoneminae** 4

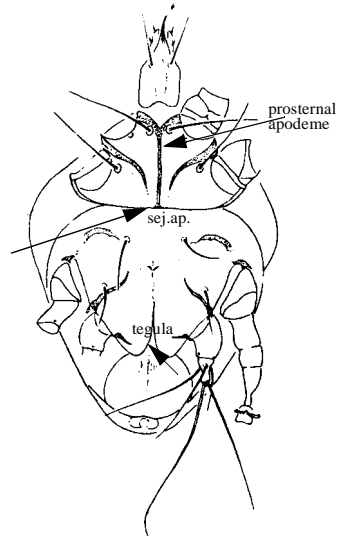


KEY TO TARSONEMIDAE OF NEW ZEALAND

- 3a **Male & female:** usually found in the dorsal groove between mesoscutum and mesoscutellum of the host;
female: prosternal apodeme (p.ap.) developed posteriorly and reaching sejugal apodeme (sej.ap.); tegula deeply incised, bilobed

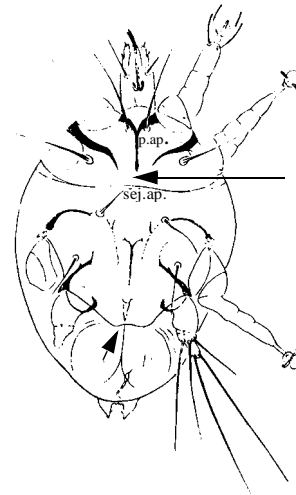
..... *A. dorsalis* Morgenthaler.

See Appendix 2 for more information



- 3b **Male & female:** usually found on membranes between posterior region of head and thorax, in posterior tentorial pits, or on neck region;
female: prosternal apodeme not developed posteriorly and not reaching sejugal apodeme; tegula gently rounded or sinuate
 *A. externus* Morgenthaler.

See Appendix 3 for more information.

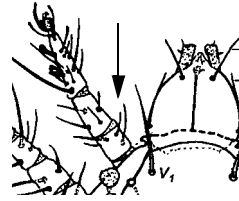


KEY TO TARSONEMIDAE OF NEW ZEALAND

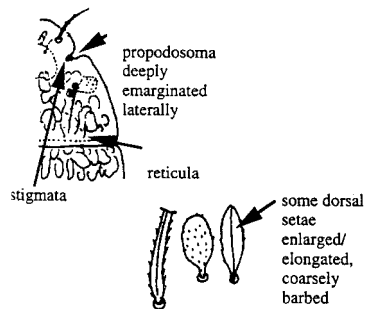
4a **Female:** femora I and II with only one seta
Genus *A* near *Eotarsonemus* (one species only)

See Appendix 4 for more information.

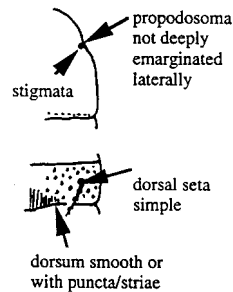
4b **Female:** femora I and II with at least 2 setae
 (usually 3-4 setae).....4.5



4.5a **Female:** dorsal shield ornamented with reticulated pattern; prodorsal shield deeply emarginated at the level of stigmata;
Male and female: at least some dorsal setae of idosoma strongly modified: coarsely barbed and long or expanded (lanceolate, capitate clavate)...
 *Daidalotarsonemus* De Leon.... 5



4.5b **Female:** dorsal shield smooth or with puncta or striae; prodorsal shield not deeply emarginated at level of stigmata;
Male and female: dorsal setae of idosoma strongly smooth, slightly barbed, or finely pilose, short to long, tapered and usually simple, slender.....6



KEY TO TARSONEMIDAE OF NEW ZEALAND

- 5a **Female:** dorsomedial setae *f* of idiosoma (see fig 1a for location of this seta) greatly expanded, maximum diameter about half of length

.....*Daidalotarsonemus* sp. **A** (ex apricot)

See Appendix 5 for more information.

- 5b **Female:** maximum diameter of setae *f* about 1/3 of length

.....*Daidalotarsonemus* sp. **B** (ex peach)

See Appendix 6 for more information.



- 5c **Female:** maximum diameter of setae *f* about 1/4 of length; terminal tarsal setae of leg IV subequal to leg IV in length.....

.....*Daidalotarsonemus* sp. **C** (ex Kowhai)

See Appendix 7 for more information.

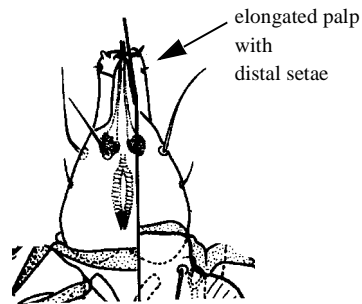
- 5d **Female:** maximum diameter of setae *f* about 1/4 of length; terminal tarsal setae of leg IV more than 1.5 length of leg IV

.....*Daidalotarsonemus* sp. **D** (ex stone fruit)

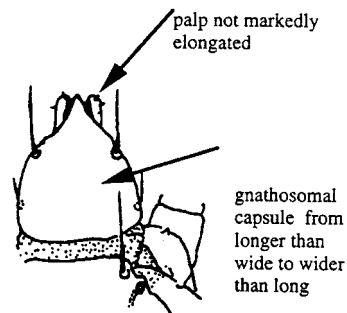
See Appendix 8 for more information.

KEY TO TARSONEMIDAE OF NEW ZEALAND

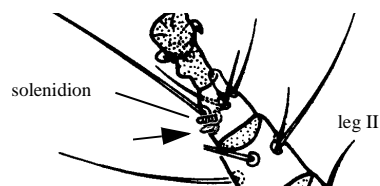
- 6a **Female and male:** gnathosomal capsule much longer than wide, conspicuously beaklike anteriorly, with palpi markedly elongate (palpi over 1/3 as long as gnathosomal capsule), bearing minute setae near diatal end7



- 6b **Female and male:** gnathosomal capsule variable in length:width ratio but not conspicuously beaklike anteriorly, with palpi not markedly elongate, bearing one seta near mid length and another near diatal end15



- 7a **Female and male:** tarsus II with spine-like posterolateral seta *pl*'' near solenidion; **Female:** sejugal apodeme vestigial....8



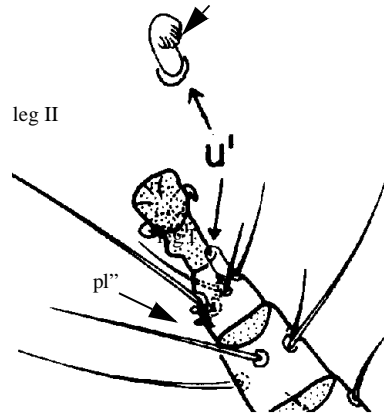
- 7b **Female and male:** tarsus II without spine-like seta *pl*'' near solenidion; **Female:** sejugal apodeme present....*Rhyncotarsonemus* Beer...9

KEY TO TARSONEMIDAE OF NEW ZEALAND

- 8a **Female and male:** dorsomedian apodeme vestigial on gnathosoma; poststernal apodemes vestigial; tarsus II with seta *pl''* a simple spine (pointed by arrow in lower part of figure) smaller than and unsimilar to apically ridged subunguinal seta of tarsus I and unguinal seta *u'* of tarsus II (pointed by arrow in top-middle of figure)
 ...*Suskia* Lindquist.....

....*S. mansoni* Lindquist (single species in the genus).

See Appendix 9 for more information.



- 8b **Female and male:** dorsomedian apodeme well-developed on gnathosoma; poststernal apodemes present; tarsus II with seta *pl''* similar to subunguinal seta of tarsus I and unguinal seta *u'* of tarsus II
Genus **Z** near *Phytonemus*10

- 9a **Female:** caudal setae *h* much greater than setae *e* and *f*; setae *sc2* about distance *sc2-sc2* ...
*Rhyncotarsonemus* sp. **A**

See Appendix 10 for more information.

- 9b **Female:** caudal setae *h* much smaller than setae *e* and *f*; setae *sc2* about 2/3 of distance *sc2-sc2* ...
*Rhyncotarsonemus* sp. **B**

See Appendix 11 for more information.

KEY TO TARSONEMIDAE OF NEW ZEALAND

10a **Female:** posterior portion of tergites *C*, *D* and *EF* (see couplet 1a for illustrations) with longitudinal striations (refer to the lower figure in couplet 4b); dorsal gnathosoma with a pair of divergent apodeme arising from union of dorsomendian apodeme and circumcapitular apodeme 11

10b **Female:** posterior portion of tergites *C*, *D* and *EF* without longitudinal striations; dorsal gnathosoma without a pair of divergent apodeme arising from union of dorsomendian apodeme and circumcapitular apodeme
.....Genus **Z** sp **A**

See Appendix 12 for more information.

11a **Female:** distance *h-h* 3 times as long as length of *h*; coxal seta *1a* about 2/3 length of coxal setae *2b*; apodeme 4 reaching beyond insertions of setae *3b*; distance from tarsal solenidion on leg I to proximal end of tibiotarsus I 3 times length of solenidion ...
....Genus **Z**. sp. **B**

See Appendix 13 for more information.

11b **Female:** distance *h-h* 3.5-5.0 times as long as length of *h*; coxal seta *1a* about 1/2 or less length of coxal *2b*; apodeme 4 not extending beyond insertions of setae *3b*; distance from tarsal solenidion on leg I to proximal end of tibiotarsus I twice as long as length of solenidion12

KEY TO TARSONEMIDAE OF NEW ZEALAND

- 12a **Female:** apodeme 4 reaching insertion of setae *3b*; leg IV with tibiotarsus as long as femorogenu; coxal seta *3a* as long as *3b* ...13
- 12b **Female:** apodeme 4 not reaching insertion of setae *3b*; leg IV with tibiotarsus 0.8 as long as femorogenu; coxal seta *3a* $\frac{2}{3}$ as long as *3b* ...14

- 13a **Female:** distance between stigmata opening and seta *v1* $\frac{1}{3}$ of the distance between stigmata and setae *sc2*; setae *d* short (7-8 μ m), $\frac{1}{5}$ to $\frac{1}{4}$ as long as distance *d-d*; cheliceral stylets $\frac{1}{3}$ as long as gnathosomal capsule ... Genus **Z** sp. **C**

See Appendix 14 for more information.

- 13b **Female:** distance between stigmata opening and seta *v1* $\frac{1}{6}$ of the distance between stigmata and setae *sc2*; setae *d* longer (10 μ m), $\frac{1}{4}$ to $\frac{1}{3}$ as long as distance *d-d*; cheliceral stylets over $\frac{1}{2}$ as long as gnathosomal capsule
.....Genus **Z** sp. **D**

See Appendix 15 for more information.

KEY TO TARSONEMIDAE OF NEW ZEALAND

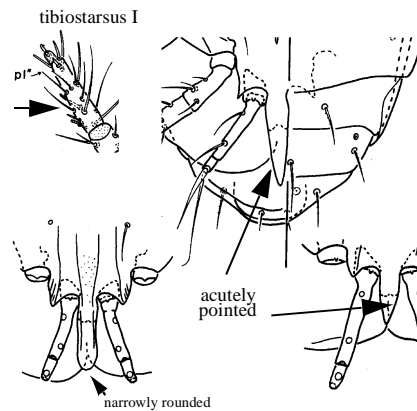
- 14a **Female:** distance between stigmata opening and seta *v1* 1/5 of the distance between stigmata and setae *sc2*; setae *d* short (6µm), <1/5 as long as distance *d-d*; distance *v2-sc2* half the distance *v2-v1*...
Genus **Z** sp. **E**

See Appendix 16 for more information.

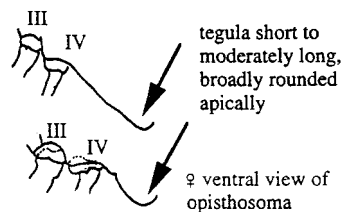
- 14b **Female:** distance between stigmata opening and seta *v1* 1/3 of the distance between stigmata and setae *sc2*; setae *d* longer (8µm), >1/4 as long as distance *d-d*; distance *v2-sc2* 1/3 of the distance *v2-v1*...
Genus **Z** sp. **F**

See Appendix 17 for more information.

- 15a **Female:** tegula moderately or conspicuously elongate, narrowly rounded or acutely pointed apically; tarsal solenidion of tibiotarsus I inserted about the level of two tibial setae ..
*Xenotarsonemus* Beer...16



- 15b **Female:** tegula short or moderately long, broadly rounded apically; tarsal solenidion of tibiotarsus I inserted distal to level of tibial setae17



KEY TO TARSONEMIDAE OF NEW ZEALAND

- 16a **Female:** large, over 200µm long; tegula twice as long as wide, narrowly rounded apically.
.....*Xenotarsonemus* sp **A**

See Appendix 18 for more information.

- 16b **Female:** small, about 160µm long; tegula 4 times as long as wide, pointed apically ...
.....*Xenotarsonemus* sp **B** nr *viridis*

See Appendix 19 for more information.

- 17a **Female and male:** femur I with 3 setae; tarsus II without spinelike setae *pl*'' near solenidion; tibia I with one solenidion ...
..*Dendroptus* Kramer (a single species from bark of apricot)

See Appendix 20 for more information.

- 17b **Female and male:** without the combination of the loss of a seta on femur I, the loss of the spinelike setae *pl*'' near solenidion on tarsus II and the loss of a solenidion on tibia
.....18

- 18a **Female and male:** tarsi II elongate, longer than combined length of genu and femur II,
Female: setae *sc2* located anterolateral to stigmata; trichobothria located posterior to setae *sc2*

..*Fungitarsonemus* Cromroy18.1

- 18b **Female and male:** tarsi II not elongate, less than combined length of genu and femur II,
Female: setae *sc2* located posterior to stigmata; trichobothria located anterior to setae *sc2*18.5

KEY TO TARSONEMIDAE OF NEW ZEALAND

18.1a **Female:** seta *c*1 subequal in length to *c*2 (25 µm)

...*Fungitarsinemus* sp. A.

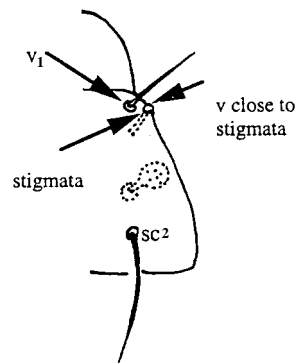
See Appendix 21 for more information.

18.1b **Female:** seta *c*1 (50µm) more than twice as long as *c*2 (20µm)

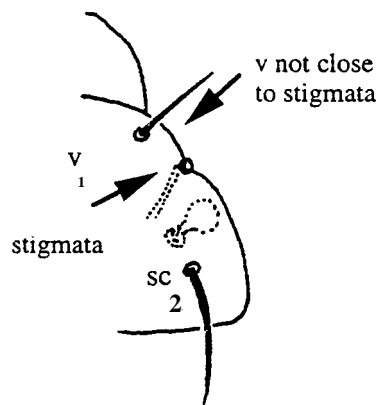
...*Fungitarsinemus* sp. B.

See Appendix 22 for more information.

18.5a **Female:** stigmata opening close to setae *v*1 (i.e. distance between the two slightly greater than the diameter of stigmata) and
Male and female: spinelike subunguinal setae of tarsi I and unguinal setae *u*' of tarsi II bifid or truncate ...
 19



18.5b **Female:** stigmata opening usually not close to setae *v*1, if close then
Male and female: spinelike subunguinal setae of tarsi I and unguinal setae *u*' of tarsi II not bifid or truncate, usually bluntly pointed ... 22



KEY TO TARSONEMIDAE OF NEW ZEALAND

- 19a **Female & male:** gnathosomal capsule longer than wide; palpi elongate; cheliceral stylets not curved strongly basally, attached to cheliceral levers not occupying nearly entire width of capsule
Female: tarsus II without spinelike *pl*'' but tibiotarsus I with 2 tibial solenidia
Male: leg IV with tibia and tarsus fused...
... Genus **B**19.5
- 19b **Female & male:** gnathosomal capsule semicircular or subquadrate, as wide as long or wider than long; palpi short; cheliceral stylets curved strongly basally, attached to cheliceral levers occupying nearly entire width of capsule
Female: tarsus II with spinelike *pl*'' but tibiotarsus I with only one tibial solenidion
Male: leg IV with free tibia and tarsus ...
... *Stenotarsonemus* Beer.....20
- 19.5a **Female:** dorsal shields *C, D, EF* with longitudinal striations near posterior margins; dorsal seta *d* of femur I and anterolateral seta *l'* of genu II with several short barbs
....Genus **B** sp. **A** (ex blackcurrant)

See Appendix 23 for more information.

- 19.5b **Female:** dorsal shields *C, D, EF* without longitudinal striations near posterior margins; dorsal seta *d* of femur I and anterolateral seta *l'* of genu II with one pair of barbs near middle length
....Genus **B** sp. **B** (ex *Nothofagus*)

See Appendix 24 for more information.

KEY TO TARSONEMIDAE OF NEW ZEALAND

- 20a **Female:** prodorsal trichobothria setiform, forked apically ...
...*Steneotarsonemus* sp. A

See Appendix 25 for more information.

- 20b **Female:** prodorsal trichobothria capitate
..... 21

- 21a **Female:** stigmata opening anteromedial of insertions of setae v1; trichobothria with capitate portion twice as long as wide; sejugal apodeme absent in the middle but developed laterally ...
Steneotarsonemus sp. B nr *spinifex*

See Appendix 26 for more information.

- 21b **Female:** stigmata opening posteromedial of insertions of setae v1; trichobothria with capitate portion 1 and 1/4 as long as wide; sejugal apodeme absent ...
Steneotarsonemus sp. C

See Appendix 27 for more information.

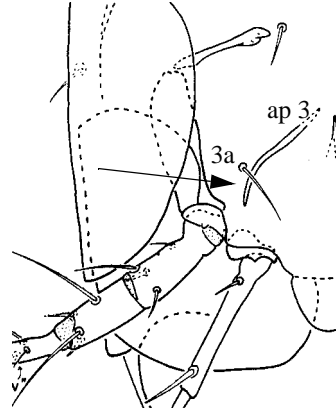
KEY TO TARSONEMIDAE OF NEW ZEALAND

22a **Male and female:** sejugal apodeme lacking;

Female: apodeme 3 (ap 3) extending beyond insertions of setae *3b* ...

....*Phytonemus pallidus* (single species in this genus; many hosts and locations).

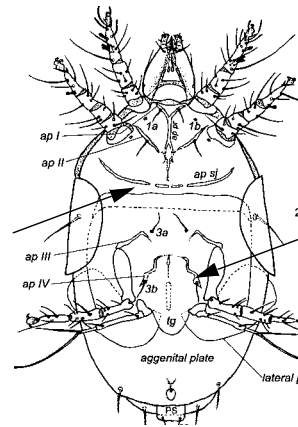
See Appendix 28 for more information.



22b **Male and female:** sejugal apodeme present, sometimes weakly developed only medially;

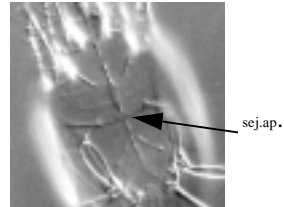
Female: apodeme IV usually not extending beyond insertions of setae *3b* ...

... *Tarsonemus* Canestrini & Fanzago23



KEY TO TARSONEMIDAE OF NEW ZEALAND

- 23a **Female:** sejugal apodeme (sej.ap.) posteriorly displaced beyond insertions of coxal setae *3a* ...24



- 23b **Female:** sejugal apodeme normally placed and far from insertions of coxal setae *3a*...
...29

- 24a **Female:** sejugal apodeme interrupted in the middle but prosternal apodeme (p.ap.) continuous
.....*Tarsonemus* sp. **N**

See Appendix 29 for more information.

- 24b **Female:** sejugal apodeme not interrupted in the middle but prosternal apodeme interrupted or not joining with apodeme I anteriorly25

- 25a **Female:** pharynx very strongly developed, about as long as gnathosomal capsule and about 1/3 as wide as maximum width of capsule; spinelike posterolateral setae absent on tarsus II ...
.....*Tarsonemus* sp. **Y**.



See Appendix 30 for more information.

- 25b **Female:** pharynx not strongly developed, much shorter than gnathosomal capsule and less than 1/4 as wide as maximum width of capsule; spinelike posterolateral setae present on tarsus II ...26

KEY TO TARSONEMIDAE OF NEW ZEALAND

- 26a **Female:** tibiotarsus IV tiny (4µm), about 1/4 of femorogenu IV ...
...*Tarsonemus* sp. **D**.

See Appendix 31 for more information.

- 26b **Female:** tibiotarsus IV twice or more as long as in sp. **D** and obviously more than 1/4 of femorogenu IV27

- 27a **Female:** tergite *C* strongly developed, more than twice as long as the idiosoma ...
.. *Tarsonemus* sp **B**.

See Appendix 32 for more information.

- 27b **Female:** tergite *C* not strongly developed, less than half as long as the idiosoma ... 28

- 28a **Female:** prodorsal setae *sc2* about as long as distance *sc2-sc2*; tarsal solenidion of tibiotarsus small, about 1/5 as long as its distance from proximal end of tibiotarsus I ...
...*Tarsonemus* sp. **O**

See Appendix 33 for more information.

- 28b **Female:** prodorsal setae *sc2* less than 2/3 long as distance *sc2-sc2*; tarsal solenidion of leg I well developed, more than 2/5 as long as distance from proximal end of tibiotarsus I .
..*Tarsonemus* sp. **W** (ex *Plagianthus betulinus*)

See Appendix 34 for more information.

KEY TO TARSONEMIDAE OF NEW ZEALAND

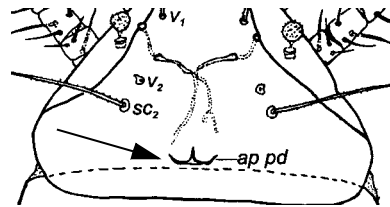
29a **Female:** pharynx very strongly developed, about as long as gnathosomal capsule and about 1/3 as wide as maximum width of capsule; ...

..*Tarsonemus* sp **S.** near *myceliophagus*

See Appendix 35 for more information.

29b **Female:** pharynx not strongly developed, usually shorter than gnathosomal capsule and less than 1/4 as wide as maximum width of capsule.....30

30a **Female:** prodorsum with a characteristic trifid apodeme posteromedially (ap pd)....31



30b **Female:** prodorsum with a simple short rod like apodeme posteromedially or without posteromedial apodeme....34

KEY TO TARSONEMIDAE OF NEW ZEALAND

- 31a **Female:** sejugal apodeme continuous, although slightly weaker in the middle; capitate portion of trichobothria (*sc1*) ovoid-elongate; setae *sc2* shorter than distance *sc2-sc2*; posterolateral spinelike setae present on tarsus II
...*Tarsonemus* sp. **F**

See Appendix 36 for more information.

- 31b **Female:** sejugal apodeme interrupted around and/or in the middle; capitate portion of trichobothria (*sc1*) more or less-round, not elongate; setae *sc2* 1.5-2.0 times as long as distance *sc2-sc2*; posterolateral spinelike setae absent on tarsus II ... 32

- 32a **Female:** prodorsal setae *sc2* about twice as long as distance *sc2-sc2*; femur I with 2 setae ...
...*Tarsonemus waitei* Banks

See Appendix 37 for more information.

- 32b **Female:** prodorsal setae *sc2* 1.5-1.6 times as long as distance *sc2-sc2*; femur I with 3 setae33

- 33a **Female:** dorsal setae *d* and *e* bluntly pointed, different from attenuated *c1*; tibia I with only one solenidion
... *Tarsonemus* sp **G** nr *parawaitei*

See Appendix 38 for more information.

- 33b **Female:** dorsal setae *d* and *e* similarly attenuated as *c1*; tibia I with 2 solenidia ...
...*Tarsonemus parawaitei* Kim *et al.*

See Appendix 39 for more information.

KEY TO TARSONEMIDAE OF NEW ZEALAND

34a **Female:** sejugal apodeme interrupted near and/or in the middle ...35

34b **Female:** sejugal apodeme continuous, sometimes emarginated or dented near and/or in the middle....38

35a **Female:** sejugal apodeme interrupted around and in the middle; tibiostarus IV half as long as femorogenu IV
...*Tarsonemus* sp **R**.

See Appendix 40 for more information.

35b **Female:** sejugal apodeme interrupted near the middle or in the middle but not both; tibiostarus IV less than half as long as femorogenu IV36

36a **Female:** sejugal apodeme interrupted around the middle and with strong lateral extensions directed anteriorly
...*Tarsonemus* sp. **Z** near *lacustris*

See Appendix 41 for more information.



36b **Female:** sejugal apodeme interrupted in the middle and without strong lateral extensions37

KEY TO TARSONEMIDAE OF NEW ZEALAND

- 37a **Female:** tarsus I with a spinelike posterolateral seta near solenidion; femur II with 3 setae; poststernal apodeme forked anteriorly.
 ...*Tarsonemus*.sp. **J**.

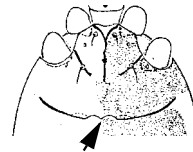
See Appendix 42 for more information

- 37b **Female:** tarsus I without a spinelike posterolateral seta near solenidion; femur II with 2 setae; poststernal apodeme not forked anteriorly.
*Tarsonemus* sp. **K**.

See Appendix 43 for more information

- 38a **Female:** sejugal apodeme emarginated symmetrically around the middle....
*Tarsonemus confusus* Ewing

See Appendix 44 for more information



- 38b **Female:** sejugal apodeme emarginated only in the middle...39



- 38c **Female:** sejugal apodeme broadly rounded in the middle or slightly truncate, not with obvious emarginations.....42

- 39a **Female:** setae *sc2* about as long as or shorter than distance *sc2-sc2*; setae *c2* shorter than *c1*40

- 39b **Female:** setae *sc2* longer than distance *sc2-sc2*; setae *c2* longer than *c1* ...
*Tarsonemus* sp. **P** nr *bilobatus*

See Appendix 45 for more information

KEY TO TARSONEMIDAE OF NEW ZEALAND

- 40a **Female:** peritremes of even width, without an enlarged atrium along their length; tarsal solenidion of tibiotarsus I well developed (7µm), slightly more than 1/2 distance from proximal end of tibiotarsus I ...
.....*Tarsonemus talpae* Schaarschmidt

See Appendix 46 for more information

- 40b **Female:** peritremes going through an enlarged atrium along its length; tarsal solenidion of leg I slightly less than 1/2 distance to proximal end of tibiotarsus I ...
41

- 41a **Female:** setae *c2* shorter than *c1*; setae *v1* shorter than distances *v1-v1*.
..... *Tarsonemus* sp **I**. near *talpae* (nectarine, NC).

See Appendix 47 for more information

- 41b **Females:** setae *c2* longer than *c1*; setae *v1* longer than distance *v1-v1*.

..... *Tarsonemus* sp **H**. near *talpae* (nectarine, CO).

See Appendix 48 for more information

- 42a **Female:** dorsal setae *d* and *e* similarly attenuated as *c1* ...43

- 42b **Female:** dorsal setae *d* and *e* bluntly pointed, different from attenuated *c1*..... 44

KEY TO TARSONEMIDAE OF NEW ZEALAND

- 43a **Female:** setae *sc2* as long as distance *sc2-sc2*; *v1* as long as distances *v1-v1*; tibia I with one solenidion ..
...*Tarsonemus* sp. **V.** (ex *Mystacina* guano, Northland)

See Appendix 49 for more information

- 43b **Female:** setae *sc2* much shorter than distance *sc2-sc2*; *v1* much shorter than distance *v1-v1*; tibia I with 2 solenidia ..
...*Tarsonemus* sp. **U.**

See Appendix 50 for more information

- 44a **Female:** sejugal apodeme with strong lateral extensions directed anteriorly; trichobothria more or less round-capitate
...*Tarsonemus* sp. **T**

See Appendix 51 for more information

- 44b **Female:** sejugal apodeme without strong lateral extensions directed anteriorly; trichobothria obviously ovoid-elongate ...45

- 45a **Female:** setae *sc2* less than 1/2 of the distance *sc2-sc2* ...
...*Tarsonemus* sp **E**

See Appendix 52 for more information

- 45b **Female:** setae *sc2* more than 1/2 of the distance *sc2-sc2*46

KEY TO TARSONEMIDAE OF NEW ZEALAND

46a **Female:** poststernal apodeme forked anteriorly47

46b **Female:** poststernal apodeme not forked anteriorly
...*Tarsonemus* sp. **C** (pasture, Nelson).

See Appendix 53 for more information

47a **Female:** prosternal apodeme not interrupted
...*Tarsonemus* sp. **X** (ex mango, Karikeri)

See Appendix 54 for more information

47b **Female:** prosternal apodeme interrupted ..
....48

48a **Female:** caudal setae *h* attenuated, more than twice as long as bluntly pointed setae *d*, *e* and *f* ...
....*Tarsonemus* sp **L**

See Appendix 55 for more information

48b **Female:** caudal setae *h* bluntly pointed, similar to setae *d*, *e* and *f* in length and structure ..49

KEY TO TARSONEMIDAE OF NEW ZEALAND

- 49a **Female:** coxal setae *1a* very short (5-6 μ m), half as long as setae *2a*; tibiostarsus IV 1/4 as long as femorogenu IV; setae *c2* longer than *c1*
...*Tarsonemus* sp. **A** near *ellipticus* (pasture, Nelson)

See Appendix 56 for more information

- 49b **Female:** coxal setae *1a* ca 10-12 μ m, more than half as long as setae *2a*; tibiostarsus IV more than 1/3 as long as femorogenu IV; setae *c2* shorter than *c1*
...*Tarsonemus* sp. **M** near *fusarii*

See Appendix 57 for more information