

A new predatory mite species of the genus *Agistemus* (*Agistemus Layyahensis*) *stigmaeidae*: acari from Punjab, Pakistan

Abstract

Stigmaeidae (Acari), the largest family within Raphignathoidea and are well recognized predators against the phytophagous mites and other small soft bodied insects. A survey was conducted to explore the predatory mite fauna from Punjab-Pakistan and a species of the genus *Agistemus* was collected and described. The drawings and measurements of different body parts were made with the help of an ocular grid and the specimen were compared with the already world described species. Ceremonial description, illustration of main body parts, host range and comparison remarks are also given. Sixteen (16) paratype (females) were collected from different localities of Jhang and Toba Tek Singh (Punjab). All specimens were deposited in the Acarology Research Laboratory, Department of Entomology, University of Agriculture, Faisalabad, Pakistan.

Keywords: acari, new species, predatory mite, *agistemus*, *stigmaeidae*

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Introduction

Mites are microscopic organisms which comprise a large group of Arthropod belonging to subclass Acari of the class Aracnida. Mites belonging to family *Stigmaeidae* constitute a large cosmopolitan cluster of almost 500 species grouped into 32 valid genera including the genus *Agistemus* considering as the richest one having 85 described species.¹ The genus *Agistemus* are considered good predators against plant feeding mite families like *Tenuipalpidae*, *Eriophidae* and *Tetranychidae* and also known to feed on the eggs of white-flies and scale insects.²⁻⁶ The genus *Agistemus* was erected by Summers⁷ based on type species *Caligonus terminalis* Quayle, 1912. Ehara⁸ described *Agistemus summersi* and *Agistemus lobatus* from Japan. Gonzales⁹ reviewed the genus *Agistemus* and prepared a key comprehensively for all species up to (1965) and added 16 new species. Major research contributions in systematics and biology of stigmaeid mites were made by Oudemans,¹⁰ Baker et al.,¹¹ Wood,¹² Summers,¹³ Wood,¹⁴ Chaudhri et al.,¹⁵ Yousaf et al.,¹⁶ Chaudhri et al.,¹⁷ Gupta,¹⁸ Yue et al.,¹⁹ Siqin et al.,²⁰ Fan et al.,²¹ Fan et al.,²² Fan et al.,²³ Devis et al.,²⁴ Faraji et al.,²⁵ Meyer^{26,27} described 3 new species from South Africa and also transferred *Zetzellia subreticulata* Wood^{28,29} to this genus. Chaudhri et al.,³⁰ described 4 new species from Pakistan and prepared the Key of these species. Siqin et al.,²³ added one new species in the genus *Agistemus* from China. The goal of this publication was to search the biological control agents for phytophagous mites from Punjab, Pakistan.

Family *Stigmaeidae* Oudemans¹⁰

Type genus: *Stigmaeus* Koch³¹

Diagnosis of species

Chelicerae not fused together, Palptibial claw well developed, accessory claw present. Palptarsus with *sensillum trifid*. Seta vi absent, Eyes 1 pair; Postocular bodies, 1 pair; Dorsal setae, 12 pair; Dorsal shields; 1 propodosomal, 1 median, Intercalary plates obvious,

Median shield having 5 pairs of setae. Paragenital setae 1-2 pair, Ventral Idiosoma with 3-4 setae, h3 absent.

Materials and methods

Mite of the genus *Agistemus* (*Agistemus layyahensis*) *Stigmaeidae*:³² Acari were collected from the leaves of bitter gourd (*Momordica charantia*) by adopting sieve collection method. Permanent slides were prepared by using Hoyer's medium and the identification/ description of species was done with the help of phase contrast microscope. Grandjean's system of terminology³³ with modifications and additions made by Summer⁷ and Gonzalez⁹ has been used in this work. All the measurements are presented in micrometres (μm) and the measurements of the holotype are followed by ranges of the paratypes in parentheses.

Results and discussion

Agistemus layyahensis n.sp.

Adult female Dorsum: (μm)

Body robust 338 long without gnathosoma (335-340), 280 wide (276-283), chelicera 95 long (92-98), stylets 48 (46-50), tibial claw well developed, accessory claw present, palp tarsalpeg equal in length with tibial claw having 2 setae, tip without *trifid sensillum* (Figure 1). Main dorsal shield in completely reticulated. Area immediately behind median propodosomal shield without transverse striations (Figure 2). Metapodal shield not wider as propodosomal shield. Eyes 1 pair, postocular bodies large covers the setal area between sci and sce. Seta c2 is present but without any platelet. Twelve 12 dorsal setae minutely barbed on entire shaft. Seta e2 longer than all dorsal setae; ratio length/distance separating setae of pair $ve=1.50$ (1.48-1.52); Seta sci equal in length with the distance sci-sce. The ratio $c1/c1-c1=1.80$ (1.77-1.83); $c1-c1$ shorter than $e1-e1$; seta d1 equal with $d1-e1$. Seta d1 closer to e2 than e1; seta d2 smaller than $d2-e2$; seta f1 single pair present on very pointed shape intercalary platelets; a band of few

striations passing within the intercalary shield and area of seta h1 and h2 without any striations; Seta h2 is shorter than seta h1; ratio $h1/h2=1.50(1.48-1.53)$. Mesal setae of genus I no longer than its segment length. The respective length of dorsal setae were calculated and given here with their ranges in parenthesis; *ve* 3(37-39), *sci* 75(72-77), *sce* 44(42-46), *c2* 55(52-58), *c1* 52(51-53), *d1* 65(63-67), *e* 60(59-61), *d2* 64(63-65), *e2* 72(70-73), *f1* 60(58-62), *h1* 58(57-59), *h2* 40(38-41).

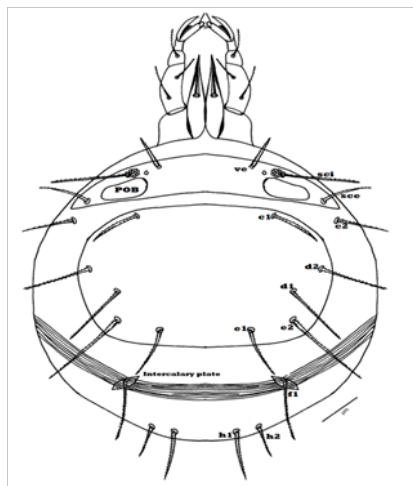


Figure 1 Dorsal of *Agistemus layyahensis* n.sp.

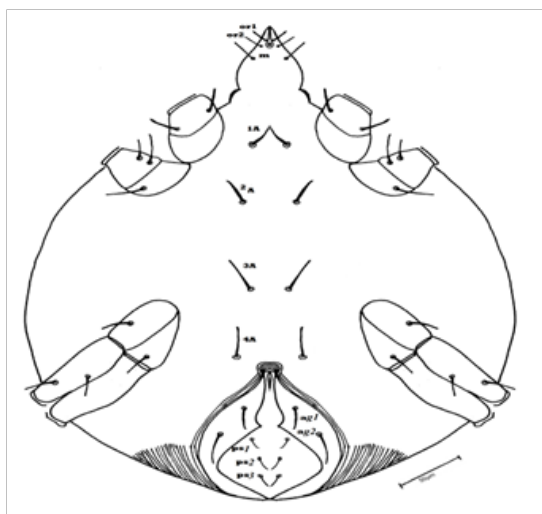


Figure 2 Ventral of *Agistemus layyahensis* n.sp.

Venter

Ventral gnathosomal sub-capitulum with only one pair of seta m and seta n is absent, two pairs of sub terminal adoral setae or1 & or2, seta elcp on subcapitulum not visible, Ventral idiosoma provided with 4 setae (1A-4A) without conspicuous platelets. 2 pairs of paragenital setae and 3 pairs of smooth anogenital setae (Figure 3).

Legs

Legs are slightly vary in their respective length and specialized setae like elcp, ω , ρ , k and \emptyset not included in the setal numbers. Setae and solenidia are collectively counted on legs I-IV as Figure 4 coxae

0-1-1-1; trochanters 2-2-1-1; femora 2-2-1-0; genua 3-0-0-0; tibiae 3-4-4-4 and tarsi 7-6-6-4.

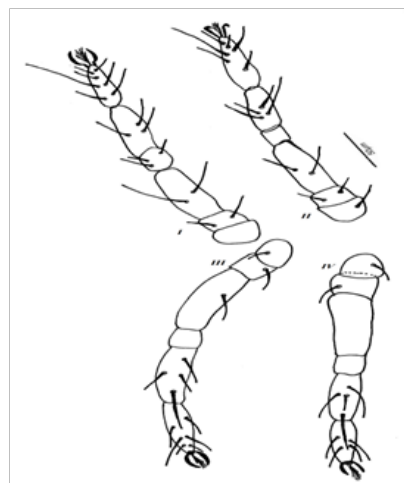


Figure 3 Legs I-IV of *Agistemus layyahensis* n.sp.

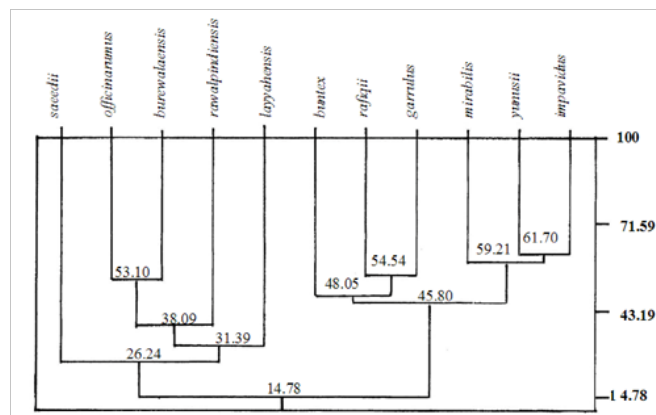


Figure 4 Dendrogram of 11 species of the genus *Agistemus* (*Stigmaeidae*, *Acari*) from Punjab, Pakistan.

Etymology

This new species is named on locality name from where it was collected from Punjab, Pakistan.

Adult male

Unknown.

Type

Holotype female collected from bitter gourd crop from the area of 283-Layyah and deposited in acarology research laboratory, Department of Entomology, University of Agriculture, Faisalabad, Pakistan. Sixteen (16) paratype (females) were collected from Jhang & TT Singh on cotton and bitter gourd crop respectively.

Key to genus agistemus form Punjab, Pakistan

- i. Main shield reticulated; ventral opisthosoma without platelets; coxa IV with 1 seta.....
..... *impavidus* Chaudhri

- Main shield not reticulated, ventral opisthosoma with platelets; coxa IV with 2 seta..... 2
- ii. Postocular body small; ratio $ve/ve-ve$ more 3 (3.60); ratio $sci/sci-sce=2.70$
mirabilis Chaudhri
- iii. Postocular body large; ratio $ve/ve-ve<3$; ratio $sci/sci-sce$ less than 2.00 3
- iv. Ratio $ve/ve-ve=2.40$; coxa III with 1 seta; mesal seta on genu I shorter than segment length
yunusii Chaudhri
- v. Ratio $ve/ve-ve<2$; coxa III with 2 seta; mesal seta on genu I not shorter than segment
- vi. ngth..... 4
- vii. Seta h2 absent; propodosomal shield broader than metapodal shield; genu I & II with 3 and 1 setae respectively.....
buntex Chaudhri
- viii. Seta h2 present; propodosomal shield not broader than metapodal shield; genu I & II not provided with 3 and 1 setae respectively..... 5
- ix. Femur I provided with 5 setae; femur II provided with 4 setae; tibia II with 4 setae
garrulus Chaudhri
- x. Femur I not provided with 5 setae; femur II not provided with 4 setae; tibia II less than 4 setae 6
- xi. Ventral gnathosoma with more than 3 pairs of setae; ventral idiosoma with complete striations; tibia-III with 6 setae
rafiqii
- xii. Ventral gnathosoma not provided with more than 3 pairs; ventral idiosoma not with complete striations; tibia-III not with 6 setae..... 7
- xiii. Palp peg with 2 setae; ventral idiosoma with 4 pairs of setae; paragenital setal length not equal; anogenital setae with 3 pairs; coxa I without seta
- xiv.
layyahensis (n.sp.)
- xv. Palp peg not with 2 setae; ventral idiosoma not with more than 3 pairs of setae; paragenital setal length equal; anogenital setae not with 3 pairs; coxa I provided with 2 seta 8
- xvi. Palptarsus shorter than main claw; propodosomal shield triangular in shape; dorsal setae comparatively thick; postocular body present
- xvii.
rawalpindiensis
- xviii. Palptarsus not shorter than main claw; propodosomal shield not triangular in shape; dorsal setae not thick; postocular body absent 9
- xix. Trifid sensillum present; propodosomal shield provided with pores; palpfemur with 1 seta; seta h1 absent; trochanter II provided with 2 setae.....
burewalaensis (n.sp.)
- xx. Trifid sensillum absent; propodosomal shield not provided with pores; palpfemur not with 1 seta; seta h1 present; trochanter II not provided with 2
- xxi. etae..... 10
- xxii. Main dorsal shield with few striations; eyes present; humeral shield dorsally visible; palpgenu provided with more than 1 seta; intercalary shield present; anogenital plate with incomplete striations.....
saeedii (n.sp.)
- xxiii. Main dorsal shield reticulated; eyes present; humeral shield dorsally absent; palpgenu provided with 1 seta; intercalary shield absent; anogenital plate without striations
-
officinarumus (n.sp.)

Remarks: (1)

This new species closely related to *Agistemus impavidus* Chaudhri and can be separated from it due to following concerns.

- i. Seta e2 longer than all other dorsal setae while in *impavidus* seta *sci* was the longest.
- ii. Seta *sci* equal in length with distance *sci-sce* in this new species while in *Agistemus impavidus* 1.30 times length of *sci*.
- iii. Mesal seta of genu I no longer than its segment length whereas in *impavidus* it was longer.
- iv. Ratio $e/le=1.45$ in it and in *impavidus* it was 1.60.
- v. Ratio $h1/h2=1.45$ in it and in *impavidus* it was 1.60.
- vi. Note: e/le must be replaced with $h1/h2$
- vii. Three (3) pair of ps setae in this n.sp. while four (4) in *A. impavidus*.
- viii. Differences in number of setae on coxae, femora, genua, tibiae, tarsi in both species.
- ix. Pointed oval shape intercalary shield in this n.sp. while a regular one in *A. impavidus*.
- x. *Palp tarsalpeg* having 2 setae where as in *impavidus* it is without seta.
- xi. *Palp tarsalpeg* without *trifid sensillum* in this species whereas in *impavidus* it was present.

Remarks: (2)

This new species can also be separated from *Agistemus rawalpindiensis* due to following features.

- i. The length of seta $h_2=28 \mu\text{m}$ in *Agistemus rawalpindiensis* while 40 in this new species.
- ii. Seta d_2 smaller in length with the distance between setae d_2-e_2 in this species, but in *A. rawalpindiensis* setae d_2 equal in distance between d_2-e_2 .
- iii. Ratio of $ve/ve-ve$ 1.50 in this new species but it was 2.20 in *A. rawalpindiensis*.
- iv. *Palp tarsalpeg* is equal to claw in this new species while slightly shorter in *A. rawalpindiensis*.
- v. *Palp tarsalpeg* having 2 setae without *trifid sensillum* in this new species of *layyahensis* while 4 setae with single *trifid sensillum* in *A. rawalpindiensis*.
- vi. Area immediately behind the propodosomal shield with transverse striations in *A. rawalpindiensis* while striation absent in this new species.
- vii. Ratio $h_1/h_2=1.50$ in it and in *rawalpindiensis* it was 1.66.
- viii. Differences are recorded in number of setae on coxae, femora, genua, tibiae, and tarsi in both species.

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Novelty statement

The identification and description of a new predatory mite species (acari) as bio-control agent will play an immense role in integrated pest management program against different pest species from Pakistan.

Conflict of interest

The author declares no conflict of interest.

References

1. Stathakis T, Kapaxidi E, Papadoulis G. A new record and a new species of the genus *Agistemus* Summers (Acari: *Stigmaeidae*) from Greece. *Zootaxa*. 2014;3780:153–170.
2. Hafez SM, Rasmy AH, Elswawi SA. Influence of prey species and stage on predatory efficiency and development of the stigmaeid mite *Agistemus exsertus*. *Acarologia*. 1983;24:281–283.
3. Osman A, AM Zaki. Studies on the predation efficiency of *Agistemus exsertus* on the eriophyid mite *Aculops lycopersici* (Masse). *Anz Schdlingskd Flanz Umweltschutz*. 1986;59:135–136.
4. Abou Awad BA, Elswawi SA. Biology and life table of the predacious mite, *Agistemus exsertus* Gonz. (Acari: *Stigmaeidae*). *Anzeiger Fur Schadlingskunde*. 1993;66(5):10–103.
5. Momen FM. Effect of diet on the biology and life tables of the predacious mite *Agistemus exsertus* (Acari: *Stigmaeidae*). *Acta-Phytopathologica-et-Entomologica Hungarica*. 2001;36(1&2):173–178.
6. Ferla NJ, Moraes GJ. Biologia de *Agistemus floridanus* Gonzalez (Acari, *Stigmaeidae*). *Revista Brasileira de Zoologia*. 2003;20(2):261–264.
7. Summers FM. Several stigmaeid mites formerly included in *Mediolata* re-described in *Zetzellia* Oudemans and *Agistemus*, new genus. *Proc Ent Soc Wash*. 1960;62:233–247.
8. Ehara S. Some mites of the families *Phytoseiidae* and *Blattisociidae* from Japan (Acari: Mesostigmata). *J Fac Sci Hook Univ (ser 6) Zool*. 1946;15:378–394.
9. Gonzalez RH. A taxonomic study of the genera *Mediolata*, *Zetzellia* and *Agistemus* (Acari: *Stigmaeidae*). *Univ Calif Publ Ent*. 1965;41:64.
10. Oudemans AC. Acarologische Aanteekeningen 108. *Ent Ber Nederl*. 1931;8:251–263.
11. Baker EW, GW Wharton. *An introduction to acarology*. The Macmillan Co New York, USA; 1952.
12. Wood TG. A new species and records of *Stigmaeidae* (Acari: Prostigmata) from New Zealand. *NZJ*. 1981;8(3):369–377.
13. Summers FM. Genera of the mite family *Stigmaeidae* Oudemans (Acari). *Acarologia*. 1966;8:230–250.
14. Wood TG. A new species of *Cheylostigmaeus willmann* (Acari: *Stigmaeidae*) from New Zealand. *NZJ Sci*. 1968;11:276–279.
15. Chaudhri WM, S Akbar, A Rasool. Studies on the predatory leaf inhabiting mites of Pakistan. *UAF Tech Bull*. 1979;1:234.
16. Yousaf AA, MA Zaher, AM A El-Hafiez. Effect of prey on the biology of *Amblyseius gossypi* Elbadry and *Agistemus exsertus* Gonzales (Acari: *Phytoseiidae*, *Stigmaeidae*). *Z Angew Entomol*. 1982;93(5):453–456.
17. Chaudhri WM, Akbar S. Studies on biosystematics and control of mites of field crops, vegetables and fruit plants in Pakistan. *UAF Tech Bull*. 1985;2:314.
18. Gupta SK. *Handbook of plant mites of India*. Calcutta, India: Sri Aurobindo Press; 1985. 520 p.
19. Yue B, CC Childers, AH Fouly. A comparison of selected plant pollens for rearing *Euseius mesembrinus* (Acari: *Phytoseiidae*). *Int J Acarol*. 1994;20(2):103–108.
20. Siqin HU, X Chen, L Huang. A new species and a new record of the genus *Agistemus* from China. (Acari: *Stigmaeidae*). *Syst Appl Acarol Sci*. 1997;1:1–4.
21. Fan, QH, X Liu. New species of *Ledermulleriopsis* Willmann and *Pseudostigmaeus* Wood from China (Acari: Prostigmata: *Stigmaeidae*). *Syst Appl Acarology*. 1999;4(1):153–158.
22. Fan, QH, DE, et al. A review of the genus *Ledermuelleriopsis* willmann (Acari: Prostigmata: *Stigmaeidae*). *Invert Syst*. 2003;17(4):551–574.
23. Fan, QH, DE, Walter. *Mediostigmaeus genn* (Acari: *Stigmaeidae*) with description of a new species from USA. *Zootaxa*. 2005;1036:21–29.
24. Devis RM, JG Demoraes, MR Bellini. Effect of air humidity on the egg viability of predatory mites (Acari: Phytoseiidae, *Stigmaeidae*) common on rubber trees in Brazil. *Exp Appl Acarol*. 2006;38(1):25–32.
25. Faraji, Ueckermann. A new species of *Mediolata* Canestrini from Spain (Acari: *Stigmaeidae*), redescription of *M. chanti* and a key to the known species of *Mediolata*. *Zootaxa*. 2006;1151:27–39.
26. Meyer, M K P. Some *Stigmaeidae* mites from South Africa (Acari: Trombidiformes). *Acarologia*. 1969;11(2):207–217.
27. Meyer MKP, Ryke PAJ. Mites of the superfamily *Raphignathoide* (Acari: Prostigmata) associated with South African plants. *Ann Mag Nat Hist*. 1959;13:209–234.

28. Wood TG. New Zealand mites of the family *Stigmaeidae* (Acari: Prostigmata). *Trans Roy Soc NZ Zool.* 1967;9(9):93–139.
29. Wood TG. *Stigmaeidae* (Acari: Prostigmata) from Campbell Island. *Acarologia.* 1970;12:677–683.
30. Chaudhri, Wali M. Taxonomic studies of the mites belonging to the families Tenuipalpidae, Tetranychidae, Tuckerellidae, Caligonellidae, *Stigmaeidae* and Phytoseiidae. *Tech Bull.* 1974;1:250.
31. Koch, CL, Herrich-Schäffer, Gottlieb August Wilhelm. *Deutschlands Crustaceen, Myriapoden und Arachniden.* Ein Beitrag zur Deutschen Fauna. Regensburg, F Pustet, German; 1836.
32. Tseng, YH. Mites of the family *Stigmaeidae* of Taiwan with key to genera of the world (Acari: Prostigmata). *Phytopathologist and Entomologist NTU.* 1982;9:1–52.
33. Grandjean F. Observations sur les acariens de la famille des *Stigmaeidae*. *Arch Sci Phys Nat.* 1944;26:103–131.