



ON A COLLECTION OF MITES INFESTING HERBS USED AS SPICES AND OIL SEEDS IN INDIA WITH SPECIAL REFERENCE TO WESTERN GHAT AREAS

ARUN GUPTA, M. CHATTOPADHYAY AND S. K. GUPTA*

Zoological Survey of India, M-Block, New Alipore, Kolkata.700053, India

* *IC/10 Anandam Housing Complex, 7, K.B. Sarani, Kolkata-700080, India*

INTRODUCTION

Since the ancient time India is famous for having rich collection of plants used as spices and hence India has a good export market of these plants. The states in India, which are known to grow spices in large quantities and contribute a major share in the export market are Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Maharashtra, West Bengal, Sikkim and Madhya Pradesh. Spices like black pepper, cardamom, zinger, garlic, turmeric, chili, cumin, etc. are grown in large quantities in Southern States. Though the insect pests of spice plants have been explored but information on mites infesting spices are not well documented barring some stray reports (Gupta, 1985, 2002, 2003), Gupta (2005), in his book on insects and mites of medicinal plants of India reported some mites on spices plants which are also known to have medicinal values apart from their uses as spices. Since, no consolidated published account dealing with mites infesting spices in India is available, it was thought desirable to explore this fauna from spice growing areas of India like Kerala, Karnataka, Tamil Nadu and Maharashtra during 2007 to 2011 and the present report is based on collection and study of those materials.

A total of 53 species belonging to 27 genera, 13 families under 2 orders are reported herein, of those, 10 are phytophagous belonging to 7 genera

and 3 families and 41 are predatory belonging to 19 genera and 9 families and 1 belong to fungivorous group. Most of the host/habitat records reported here were earlier unknown for the spices dealt with here.

Apart from giving collection records, diagnosis, etc, distribution, pest/predatory importance, wherever observed, have also been discussed. This document forms the first consolidated account on mites infesting spices in India.

MATERIAL AND METHODS

The mite specimens included in this paper were collected from leaves of spice plants of Kohzikode, Wayannad, Munner and Kumily of Kerala State, Madikeri, Mudegere, Chickmagalore, Shimoga and Sirsi of Karnataka State, Chandrapur, Satara, Malvan, Dapoli of Maharashtra State and Sirumalai, Alagumandai of Tamil Nadu State. The infested leaves were examined under a 10x lens in the field itself and the mites were picked up by a fine sable-hair brush moistened with alcohol (75%). The specimens were mounted first in lactic acid for identification and later mounted in Heinze's medium for making permanent slides. All measurements given here are in microns.

The specimens were examined under a research microscope. The entire material is deposited in the National Collection of the Zoological Survey of India.

SYSTEMATIC ACCOUNT**PHYTOPHAGOUS MITES**

Order-1 PROSTIGMATA

Family1 TETRANYCHIDAE Donnadieu

1. *Tetranychus ludeni* Zacher

1913 *Tetranychus ludeni* Zacher, Mitt. Kais. Biol. Anst. Land. U.Forstw, **14**: 40.

1959. *Tetranychus ludeni*, Puttarudriah & Channa basavanna, Proc. Ist. All India Congr. Zool. p. 530

1994. *Tetranychus ludeni*, Gupta & Gupta, Mem. zool. Surv. India, **18**(1): 27-28.

Diagnosis: Aedeagal knob very small, no posterior angulation, in female, palpus with terminal sensillum as long as broad, tibia I with 1 sensory and 9 tactile setae, tarsus- I with 1 sensory and 4 tactile setae.

Collection Records: KARNATAKA: Bettadamanne, Mudigere, 5 ♀♀, *Elettaria cardamomum*, 8.12.2008; MAHARASHTRA: Jangao, Chandrapur, 1 ♀, *-Sesamum indicum*, 10.10.2010; Mazra, Chandrapur, 9 ♀♀, 1 ♂, *Glycine max*, 11.10. 2010.

Remarks: This species mostly attacks vegetable crops and is not known to damage on other crops. However, though a good infestation was seen on cardamom but no noticeable damage done by this mite was observed. It is known to occur on over 50 host plants in India, but its occurrence on cardamom is rather an uncommon one.

2. *Tetranychus urticae* Koch

1836. *Tetranychus urticae* Koch, Deu, Crust. Myr. Arach. Fasc., **1**: 10

1994. *Tetranychus urticae*, Gupta & Gupta, Mem. zool. Surv. India, **18** (1): 139-140.

Diagnosis: Greenish yellow/ reddish with 2 large black spots on dorsum, Axis of aedeagal knob parallel with axis of shaft. In female, palpus with terminal sensillum 2 times as long as broad. Tibia I with 1 sensory and 9 tactile setae, tarsus I with 1 sensory and 3 tactile setae.

Collection Records: MAHARASHTRA: Surla, Chandrapur, 3 ♀♀, 2 ♂, *Glycine max*, 10.10.2010.

Remarks: This is a cosmopolitan species and is known to occur on over 200 plants and often the damage caused by this mite becomes very serious. The infestation noticed in the present study was not of any serious nature and damage was insignificant.

3. *Tetranychus* sp.

Collection Records: MAHARASHTRA; Surla, Chandrapur, 2 ♀♀, *Glycine max*, 10.10.2010.

Remarks: Since no male of this species could be collected, the specific identity could not be done.

4. *Schizotetranychus* sp.

Collection Records: MAHARASHTRA; Parsuda, 1 ♀, *Glycine max*, 11.10.2010.

Remarks: For lack of male specimen, the specific identity could not be ascertained.

5. *Eotetranychus* sp.

Collection Records: MAHARASHTRA: Khairgaon, Chandrapur, 1 ♀, *Glycine max*, 11.10.2010.

Remarks: This mite was in badly damaged condition. Further identification was not possible as no male could be collected.

6. *Porcupinychus* sp (?)

Collection Records: TAMIL NADU; Sirumalai, *Elettaria cardamomum*, 10.4.2011.

Remarks: This probably belongs to genus *Porcupinychus*, as appears from the setal pattern. This needs further study as the pertaining literature is unavailable.

Family 2 TENUIPALPIDAE Berlese

7. *Dolichotetranychus floridanus* (Banks)

1900. *Stigmaeus floridanus* Banks, U.S. Dept. Agr. Div. Int. Tech. Ser., **8**: 77.

1938. *Dolichotetranychus floridanus*, Sayed, Bull. Mus. natn. Hist. Nat. Paris, (2)**10**(6): 606.

1985. *Dolichotetranychus floridanus*, Gupta: 133.

Diagnosis: It is bright red, elongated, slender,

hysterosoma with 2 pairs of dorsocentrals, one pair of dorso-sublateral and 5 pairs of dorsolaterals.

Collection Records: Kerala: Keller, 1 ♀, *Elettaria cardamomum*, 25.10.2007.

Remarks: It feeds on tender tissues of host and causes the appearance of reddish spots. Its damage on pineapple is more serious than on Cardamom. Earlier it was known from Karnataka.

8. *Brevipalpus euphorbiae* Mohanasundaram

1982. *Brevipalpus euphorbiae* Mohanasundaram, *Entomon*, 7(4): 427-429.

1985. *Brevipalpus euphorbiae*, Gupta: 127.

Diagnosis: Reddish mite, rostrum extends beyond middle of femur I. Reticulation present on middle of hysterosoma, with 5 pairs of dorsolaterals, 1 pair of humerals and 3 pairs of dorsocentrals.

Collection Records: KARNATAKA: Gajanur Spice Garden, Shimoga. 3 ♀ ♀, *Elettaria cardamomum*, 12.12.2008.

Remarks: This mite caused no noticeable damage on cardamom plant and its occurrence on under surface of leaves was of casual nature.

9. *Brevipalpus* sp.

Collection Records: KARNATAKA: Gajanur Spice Garden, Shimoga 3 ♀ ♀, *Elettaria cardamomum*, 12.12.2008 MAHARASHTRA: Dapoli Krishi Vidyapeeth, 1 ♀, All spice, 19.10.2010.

Remarks: One species of this genus was collected on all spice (*Pimenta dioica*) plant but its specific identity could not be ascertained.

Family 3 ERIOPHYIDAE Nalepa

10. *Aceria* sp.

Collection Records: MAHARASHTRA: Surla, 1 ♀, *Glycine max*, 10.10.2010.

Remarks: Some specimens belonging to *Aceria* could be collected as vagrants on under surface of leaves but their identity could not be ascertained.

PREDATORY MITES

Order-2 MESOSTIGMATA

Family 4 PHYTOSEIIDAE Berlese

11. *Amblyseius herbicolus* (Chant)

1959. *Typhlodromus (Amblyseius) herbicolus*, Chant; *Can. Ent.*, 91: 84-85.

2000. *Amblyseius (Amblyseius) herbicolus*, Gupta; In: *Fauna of Tripura, State Fauna Series*, 7(Part-2), p. 21-22

2003. *Amblyseius (Amblyseius) herbicolus*, Gupta, *Mem. zool. Surv. India*, 20(1): 18-20.

2007. *Amblyseius herbicolus*, Chant & McMurtry, *Illustrated keys and diagnosis for the genera and sub genera of the Phytoseiidae of the world (Acari: Mesostigmata)*, 78.

Diagnosis: It is a whitish mite with 3 pairs of long setae, while the others being small. Measurements of setae J₁-25, J₃-33, s₄-107, Z₅-205, Z₄-125. Others measure between 5-10 microns long. Ventrianal shield pitcher shaped. Macrosetae on legs IV. genu-129, Tibia-90, basitarsus-70.

Collection Records: KERALA: Sugandagiri, Wayanad, 4 ♀ ♀. *Piper betle*, 23.10.2007; 3 ♀ ♀ Karadpara, Munner, *Piper betle*, 26.10.2007; 16 ♀ ♀, 4 ♂, 1 nymph. Keller, Munnar, *Elettaria cardamomum*, 25.10.2007; 9 ♀ ♀, 2 ♂, Thekkdi, Kumily, *Elettaria cardamomum*, 29.11.2008.

KARNATAKA: I.S.R.I. Appangala, 2 ♀ ♀, 1 ♂, *Cinnamomum verum*, 03.12.2008; 4 ♀ ♀, 2 ♂ Handi Estate, *Piper betle*, 09.12.2008; 2 ♀ ♀, 3 ♂ Handi Estate, *Elettaria cardamomum*, 09.12.2008; 1 ♂, Madikeri, Chettali, *Scinams cowa*, 05.12.2008; 3 ♀ ♀, 2 ♂, Sirsi, *Piper betle*, 14.12.2008; Chickmagalore, 3 ♀ ♀, *Piper betle*, 10.12.2008; Sirsi, Sandy's Garden, 3 ♀ ♀, *Elettaria cardamomum*, 14.12.2008. MAHARASHTRA: Chandrapur, Garoli, 1 ♀, *Arachis hypogaea*, 13.10.2010; 1 ♀, Dr. B.S. Kokan Krishi Vidyapeeth, Vengurle *Syzygium aromaticum*(L), 16.10.2010; 3 ♀ ♀, 2 ♂, Agricultural University Campus, Dapoli, *Cinnamomum verum*, 18.10.2010.

TAMIL NADU: Sirumalai, 1 ♀, *Elettaria cardamomum*, 10.04.2011.

Remarks: This species was originally described from Citrusin Floride and later could be collected on several fruit trees from many parts of India (West Bengal, Tripura, Mizoram, Sikkim, Tamil Nadu, Maharashtra, Kerala, Karnataka) and outside Thailand, China, Taiwan, Papua, New Guinea, Australia, Japan, Madagascar, South Africa, Mexico, Brazil. Earlier it was known to feed upon tea purple mite, Citrus scarlet mite, bamboo Spider mite, 2-Spotted spider-mite on vegetables, etc. Presently, it was seen in field in association with *Brevipalpus* sp. on cardamom, but its feeding was not observed. This is otherwise a very common species and could be collected from a large number of plants, in association with Tetranychid and Tenuipalpid mites (Gupta, 2003).

12. *Amblyseius largoensis* (Muma)

1955. *Amblyseiopsis largoensis* Muma, *Ann. Ent. Soc. Am.* **48**: 206.
 1997. *Amblyseius largoensis*, Wei-nan, *Economic Insect Fauna of China*: Phytoseidae, p.39.
 2003. *Amblyseius (Amblyseius) largoensis*, Gupta, *Mem. zool. Surv. India*, **20**(1): 22.
 2007. *Amblyseius largoensis*, Chant & McMurtry, **78**.

Diagnosis: It is very close to *Amblyseius herbicolus* but differs in the shape of spermatheca which is with fundibular cervix in *A. herbicolus* and in case of *A. largoensis* cervix is tubular with parallel sides. The long setae measure, j_1 -35, j_3 -50, s_4 -100, Z_5 -250, Z_4 -100, Macrosetae on leg IV, genu-100, tibia-75, basitarsus-50.

Collection Records: KERALA: Spring Valley, 3 ♀♀, *Elettaria cardamomum*, 28.10.2007; 1 ♀, Chullikode. *Piper betle*, 28.10.2007; 1 ♀, Puliakode, *Piper betle*, 21.10.2007; 4 ♀♀, Kumily, *Piper betle*, 30.11.2008; 3 ♀♀, 1 ♂ Kumily, *Myristica fragrans* Houtt, 30.11.2008. KARNATAKA: 4 ♀♀, Chickmagalore, *Elettaria cardamomum*, 10.12.2008; 6 ♀♀, Sirsi, *Elettaria cardamomum*, 15.12.2008. MAHARASHTRA: 1 ♀, Dr. B.S. Kokan Krishi Vidyapeeth, Vengurle, *Piper betle*, 16.10.2010; 1 ♂, 1 nymph, Kokan Krishi Vidyapeeth, Vengurle, *Vanilla planifolia*,

16.10.2010; 1 ♀, Kokan Krishi Vidyapeeth, Vengurle, *Cinnamomum verum*, 16.10.2010; 1 ♀, Dapoli Krishi Vidyapeeth, *Myristica fragrans* Houtt, 18.10.2010; 1 ♂, 1 nymph, Dapoli Krishi Vidyapeeth, *Vanilla planifolia*, 19.10.2010.

Remarks: This is another very common species and in the present study it could be collected from a wide range of spices plants as given in the collection data. It is also a very good predator, and was seen feeding upon immatures of 2- spotted spider mite, avoiding the adults. Earlier, it was reported from almost throughout India, feeding upon Citrus brown mite, (*Eutetranychus orientalis*), mango spider mite (*Olionychus mangiferus*), Citrus red mite (*Panonychus citri*) and tenuipalpid mite on calotropis (Gupta,2003). This appears to be a potentially important predatory mite.

13. *Amblyseius indirae* Gupta

1985. *Amblyseius (Amblyseius) indirae* Gupta, *Entomon.*, **10**(3): 209-211.
 1999. *Amblyseius (Amblyseius) indirae* Gupta & Chatterjee, *Sci. & Cult.*, **65**: 161
 2003. *Amblyseius (Amblyseius) indirae* Gupta, *Mem. zool. Surv. India*, **20**(1): 20-22
 2007. *Amblyseius indirae*, Chant & McMurtry, 78.

Diagnosis: This is a slow moving whitish mite, Setae measure: j_1 -33, j_3 -35, s_4 -105, Z_5 -235, Z_4 -100; other setae minute. Leg IV macrosetae: genu- 115, tibia-100, basitarsus-70, spermatheca with long duct.

Collection Records: MAHARASHTRA; Dapoli Krishi Vidyapeeth, 8 ♀♀, *Myristica fragrans* Houtt, 19.10.2010; 1 ♀, 1 ♂, Dapoli Krishi Vidyapeeth, *Piper betle*, 19.10.2010; 1 ♀, Dapoli Krishi Vidyapeeth, *Cinnamomum verum*, 19.10.2010.

Remarks: This is rather an uncommon species and could be collected from Cinnamon and *Piper betle*, It was described from Karnataka it is being reported here for the first time on this host. Economic importance of this species is unknown.

14. *Amblyseius neorykei* Gupta

1977. *Amblyseius neorykei* Gupta, *Ent.mon. Mag.*, **112**: 56.
1996. *Amblyseius (Amblyseius) neorykei*, Chatterjee & Gupta, *J. Beng. nat. Hist. Soc.*, (NS) **15**(2): 25.
2007. *Amblyseius neorykei*, Chant & McMurtry, p. 80.

Diagnosis: Dorsal shield with long setae measure j_1 -30, j_3 -45, s_4 -95, Z_5 -135, Z_4 -85. Leg IV macrosetae: genu-70, tibia-50, basitarsus-72.

Collection Records: KERALA: Poovachuli 2 ♀ ♀, *Myristica fragrans*, 22.10.2007.

Remarks: This species was earlier known from West Bengal, Arunachal Pradesh and Sikkim and is reported here for the first time from Kerala. The economic importance of this species is unknown.

15. *Amblyseius muraleedharani* Gupta

1986. *Amblyseius (Amblyseius) muraleedharani* Gupta, *Fauna of India: Phytoseiidae*: 57-59.
1987. *Amblyseius (Amblyseius) muraleedharani* Gupta, *Rec. zool. Surv. India, Occ. Pap.*, **95**: 13-14
2003. *Amblyseius (Amblyseius) muraleedharani* Gupta, *Mem. zool. Surv. India*, **20**(1): 25
2007. *Amblyseius muraleedharani* Gupta, Chant & McMurtry : 80.

Collection Records: TAMILNADU: Sirumalai, 2 ♀ ♀, 1 protonymph, *Piper betle* 10.04.2011.

Remarks: This species appears to be very close to *Amblyseius muraleedharani*, but slightly differs in setal length of the dorsal shield which may be treated as variation. No predator importance was observed.

16. *Amblyseius shoreae* Gupta

1977. *Amblyseius shoreae* Gupta, *Ent. Mon. Mag.*, **112**: 57.
1986. *Amblyseius (Amblyseius) shoreae*, Gupta, *Fauna of India: Phytoseiidae*, p. 65-67.
2003. *Amblyseius (Amblyseius) shoreae*, Gupta, *Mem. Zool. Surv. India*, **20**(1): 28.
2007. *Amblyseius shoreae*, Chant & McMurtry: 81.

Diagnosis: The long setae on dorsal shield measure j_1 -27, j_3 -50, s_4 -60, Z_5 -95, Z_4 -60. Macrosetae on leg IV: genu-70, tibia-45, basitarsus-55.

Collection Records: KARNATAKA: Bettadamanne, 1 ♀, *Pimenta dioica* (L) Merr. 08.12.2008.

Remarks: This species was described from West Bengal, and so far not known from outside West Bengal. So, Karnataka, where from this species was collected in the present study, forms new record. The economic importance of this species is unknown. The Allspices wherefrom it was collected also forms new habitat record.

17. *Amblyseius channabasavannai* Gupta & Daniel

1978. *Amblyseius channabasavanni* Gupta & Daniel., *Oriental Ins.*, **12**: 328-330.
1995. *Amblyseius (Amblyseius) channabasavannai* Gupta, In: *Fauna of Meghalaya, State fauna Series*, **4** (Part 2):
2003. *Amblyseius (Amblyseius) channabasavannai*, Gupta, *Mem. zool. Surv. India*, **20**(1): 15
2007. *Amblyseius channabasavannai*, Chant & McMurtry: 78.

Diagnosis: This is a fast moving white mite, the long setae on dorsal shield measure j_1 -26, j_3 -40, s_4 -80, Z_5 -250, Z_4 -110. Spermatheca with long cervix and thick major duct. Leg IV macrosetae, genu-90, tibia-65, basitarsus-55.

Collection Records: MAHARASHTRA: Dapoli Krishi Vidyapeeth, 2 ♀ ♀, 1 ♂, 2 nymph, *Piper betle*, 19.10.2010.

Remarks: From India it was known from both Eastern States (West Bengal, Meghalaya, Arunachal Pradesh, Sikkim) as well as from southern states (Tamil Nadu, Kerala). This is widely available in southern states and appears to be a promising predator upon spider mites as it was seen feeding upon immatures of *Tetranychus* sp.

18. *Amblyseius mcmurtryi* Muma

1967. *Amblyseius mcmurtryi* Muma, *Fla. Ent.*, **50**: 270.
1999. *Amblyseius (Amblyseius) mcmurtryi*, Gupta & Chatterjee, *Sci & Cult.*, **65**: 162.
2003. *Amblyseius (Amblyseius) mcmurtryi*, Gupta, *Mem. zool. Surv. India*, **20**(1): 23.
2007. *Amblyseius mcmurtryi*, Chant & McMurtry: 80.

Diagnosis: The dorsal shield with long setae measure j_1 -25, j_3 -35, s_4 -60, Z_5 -140, Z_4 -60. Spermatheca short with tubular cervix. Macrosetae on leg IV: genu-50, tibia 40, basitarsus-45

Collection Records: Kerala: Sugandagiri hill, 1 ♀, *Elettaria cardamomum*, 23.10.2007.

Remarks: Earlier, in India, it was reported from Assam, Meghalaya, Lakshadwip and therefore Kerala forms a new record.

19. *Amblyseius paraaerialis* Muma.

1967. *Amblyseius paraaerialis* Muma, *Fla. Ent.*, **50**: 270-271.

1995. *Amblyseius (Amblyseius) paraaerialis*, Gupta, In: *Fauna of Meghalaya, State Fauna Series*, **4**(Part 2): 31.

2003. *Amblyseius (Amblyseius) paraaerialis* Gupta, *Mem. zool. Surv. India* **20**(1): 27.

2007. *Amblyseius paraaerialis*, Chant & McMurtry: 80.

Diagnosis: Dorsal shield with long setae measure j_1 -27, j_3 -50, s_4 -72, Z_5 -161, Z_4 -90. Macrosetae on leg IV, genu-70, tibia-45, basitarsus-55. Spermatheca characteristically with looped elongated cervix.

Collection Records: KERALA: Spring Valley, Kumily 1 ♀, *Elettaria cardamomum*, 28.10.2007.

Remarks: Earlier it was known from Assam, Arunachal Pradesh, Meghalaya, Sikkim, Kerala. The Cardamom forms new habitat record. No predatory importance was observed in the field.

20. *Euseius coccineae* (Gupta)

1975. *Amblyseius coccineae* Gupta, In: *J. Acarol.*, **1**: 30.

2000. *Amblyseius (Euseius) coccineae* Gupta, In: *Fauna of Tripura, State Fauna Series*, **7**(Part-2): 23.

2003. *Amblyseius (Euseius) coccineae* Gupta, *Mem. zool. Surv. India*, **20**(1):35.

2007. *Euseius coccineae*, Chant & McMurtry: 120.

Diagnosis: Measurements of setae on dorsal shield - J_1 -25, j_4 - j_5 -15 each, J_2 -15, J_5 -6, j_3 -30, z_2 -20, z_4 -20, s_4 -35, Z_1 -12, S_2 -20, S_4 -22, S_5 -24, Z_5 -60, Z_4 -13, z_5 -9, Spermatheca bell shaped. Macrosetae on leg IV genu- 45, tibia-35, basitarsus-50.

Collection Records: KARNATAKA; I.S.R.I.,

Appangala, Madikeri, 1 ♀, *Cinnamomum verum*, 03.12.2008.

Remarks: This is a widely distributed species in India but was not known from Karnataka wherefrom the present specimens were collected. *Cinnamomum* also forms a new habitat record. Though earlier report indicated its feeding on eggs of *Oligonychus mangiferus* and found associated with *Tetranychus urticae* but no feeding on spider mites in the field was observed during the present study.

21. *Euseius alstoniae* (Gupta)

1975. *Amblyseius alstoniae* Gupta, *Internat. J. Acarol.*, **1**(2): 31-32.

2000. *Amblyseius (Euseius) alstoniae*, Gupta, In: *Fauna of Tripura, State Fauna Series*, **7**(Part 2) : 22.

2003. *Amblyseius (Euseius) alstoniae*, Gupta, *Mem. zool. Surv. India*, **20**(1): 32.

2007. *Amblyseius (Euseius) alstoniae*, Chant & McMurtry: 120.

Diagnosis: Measurements of setae j_1 -25, j_4 -10, j_5 -10, j_6 -25, J_2 -30, J_5 -6, j_3 -28, z_2 -25, z_4 -30, s_4 -50, Z_1 -20, S_2 -26, S_4 -20, S_5 -30, Z_5 -55 (serrate), Z_4 -30, spermatheca with narrow elongated cervix and bulging vesicle. Macrosetae on leg IV, genu-50, tibia-35, basitarsus-70.

Collection Records: MAHARASHTRA: Chandrapur, Mazra, 3 ♀ ♀, *Gossypium herbaceum*, 11.10.2010; 1 ♀, Chandrapur, Mazra, *Glycine max*, 11.10.2010.

Remarks: Though this is a widely distributed species and has been recorded from different states of India on diverse plants, mostly fruit trees and vegetables, but its record from Maharashtra was unknown. It is a good predator but in the present study its predatory behaviour was not seen in the field.

22. *Scapulaseius eucalypticus* (Gupta)

1978. *Typhlodromalus eucalypticus* Gupta, *Oriental Ins.*, **12**: 330-331.

1987. *Amblyseius (Typhlodromalus) eucalypticus*, Gupta, *Rec. zool Surv. India, Occ. Paper*, **95**: 53.

2003. *Amblyseius (Typhlodromalus) eucalypticus*, Gupta, *Mem. zool. Surv. India*, **20**(1): 66-67.

2007. *Scapulaseius eucalypticus*, Chant & McMurtry: 67.

Diagnosis: Measurements of setae j_1 -24, j_3 -20, s_4 -28, Z_5 -65, Z_4 -25, the other dorsal setae small. Spermatheca with narrow funnel shaped cervix. Macrosetae on leg IV genu-60, basitarsus-60.

Collection Records: KERALA: Tushergiri, 1 ♀., *Piper betle*, 18.10.2007.

Remarks: Its earlier record was from Karnataka and the present record from Kerala forms new distributional record. No economic importance of this species is known.

23. *Euseius ovalis* (Evans)

1953. *Typhlodromus ovalis* Evans, *Ann. Mag. Nat. Hist.*, **6**: 458-461.

1994. *Amblyseius (Euseius) ovalis*, Gupta, In: *Contributions to Acarological Researches in India*, p. 442.

2000. *Amblyseius (Euseius) ovalis*, Gupta, *Mem. zool. Surv. India*, **20**(1): 42.

2007. *Euseius ovalis*, Chant & McMurtry: 121.

Diagnosis: Dorsal shield with all the setae small or minute, excepting J_1 and Z_5 Which are 30 and 50 respectively, Macrosetae on leg IV genu-35, tibia-30, basitarsus-50, Spermatheca bellshaped.

Collection Records: TAMILNADU: Alagumadi, 3 ♀ ♀. *Piper betle*, 12.04.2011.

Remarks: This is a widely distributed species and a good predator of spider mites (*Oligonychus coffeae*, *Tetranychus neocaledonicus*) (Gupta, 2003). In the present investigation no such predatory behavior was noticed.

24. *Euseius rhododendronis* (Gupta)

1970. *Amblyseius rhododendronis*, Gupta, *Oriental Ins.* **4**: 187-188.

2000. *Amblyseius (Eusius) rhododendronis*, Gupta, In : *Fauna of Tripura, State Fauna Ser.*, **7**(Part-2) : 24.

2003. *Amblyseius rhododendronis*, Gupta, *Mem. zool. Surv. India*, **20**(1): 44.

2007. *Euseius rhododendronis*, Chant & McMurtry: 123.

Diagnosis: Measurements of setae of dorsal shield: j_1 -27, j_4 , j_5 -8 each, J_6 , J_2 -10 each, j_3 -18, z_2 , z_4 -12 each, s_4 -25, Z_1 -8, S_2 -12, Z_5 -55, Z_4 -10. Macrosetae on leg IV-genu-40, tibia-30, basitarsus-40.

Collection Records: TAMILNADU: Sirumalai, 5 ♀ ♀., *Elettaria cardamomum*, 10.04.2011.

Remarks: The occurrence of this species is rather rare and in the present study it was collected on *Elettaria cardamomum*, which forms a new habitat record.

25. *Euseius* sp. nov. (?)

Collection Records: KARNATAKA: Sirsi, 1 ♂, *Myristica fragrans* Houtt, 14.12.2008; TAMIL NADU: Sirumalai, 3 ♀ ♀, 9 ♂ ♂, *Elettaria cardamomum*, 10.04.2011.

Remarks: Some unidentified species of *Euseius* were recorded from Nutmeg, Cardamom, which do not tally with any of the known described species and hence appear to be undescribed ones. Further investigation to ascertain their novelty is on and final decision will be taken later.

26. *Neoseiulus cynodonae* (Gupta)

1977. *Amblyseius cynodonae*, Gupta, *Oriental. Ins.*, **11**: 626-627.

1987. *Amblyseius (Neoseiulus) cynodonae* Gupta, *Rec. zool. Surv. India, Occ. pap.*, **95**: 36.

2003. *Amblyseius (Neoseiulus) cynodonae* Gupta, *Mem. zool. Surv. India*, **20**(1): 51.

2007. *Neoseiulus cynodonae*, Chant & McMurtry: 29.

Diagnosis: Measurements of setae on dorsal shield: j_1 -17, j_4 - J_5 -5 each, J_2 -10, j_3 -12, z_2 , z_4 -10 each, s_4 -25, Z_1 -10, S_2 -16, S_4 -12, S_5 -10, Z_5 -67, Z_4 -36. Spermatheca with funnel shaped tubular cervix. Leg IV macrosetae, genu-40, tibia-18, basitarsus-55.

Collection Records: KERALA: Pozhuthana, 1 ♀, *Piper betle*, 23.10.2007.

Remarks: Earlier it was known from Andaman-Nicobar Islands and its present report from Kerala forms new distributional record.

27. *Typhlodromips syzygii* (Gupta)

1975. *Amblyseius syzygii* Gupta, *Interna. J. acarol.* **1**(2): 44-45.

2003. *Amblyseius (Typhlodromips) syzygii* Gupta, *Mem. zool. Surv. India*, **20**(1): 82.

2007. *Typhlodromips_syzygii*, Chant & McMurtry, **63**.

Diagnosis: This is whitish brown mite, with dorsal shield reticulated, Measurements of setae. j_1 -16, j_4 - j_6 , J_2 -6-8 each long, j_3 -15, Z_2 - Z_4 -10 each, s_4 -22, Z_1 -15, S_2 , S_4 , 10-12, S_5 10-12, S_5 - Z_5 65(serrate), Z_4 -35. Spermathica with long duct and cup shaped cervix. Macrosetae on leg IV: genu- 45, tibia-30, basitarsus-45.

Collection Records: KARNATAKA: Chickmagalore, 3 ♀ ♀, *Elettaria cardamomum*, 10.12.2008.

Remarks: This species was earlier known from West Bengal, Tripura, Orissa, Meghalaya, Bihar, Sikkim, Mizoram, Uttar Pradesh and the present report from Karnataka forms the new record. *Elettaria cardamomum*, also forms new habitat record. Outside India, it has been reported from Thailand. This is also a good predator and found associated with *Dolichotetranychus floridanus* infesting the same host.

28. *Typhlodromus himalayensis* Gupta

1981. *Typhlodromus himalayensis* Gupta, *Indian J. Acar.*, **5**(1-2): 32-33.
1999. *Typhlodromus (Amblydromella) himalayensis* Gupta & Chatterjee, *Sci. & cult.*, **65**: 162.
2003. *Typhlodromus (Amblydromella) himalayensis* Gupta, *Mem. zool. Surv. India* **20**(1): 123.
2007. *Typhlodromus (Anthosius) himalayensis* Chant & McMurtry: 155.

Diagnosis: Measurements of setae j_1 -12, j_4 -10, j_5 -12, j_6 -16, J_2 -16, J_5 -8, Z_5 -8, J_3 -14, z_2 -18, z_3 -16, z_4 -16, s_4 -20, s_6 -24, S_2 , S_4 -24 each, S_5 -17, Z_5 -40 (serrate, knobbed), Z_4 -24. Macroseta on leg IV-basitarsus-36.

Collection Records: KERALA: Karadipara, 1 ♀, *Piper beetle*, 26.10.2007; 1 ♀, Sugandagiri, *Elettaria cardamomum*, 23.10.2007.

Remarks: This was earlier known from Himachal Pradesh, Uttar Pradesh, Jammu & Kashmir, Lakshadwip and the present one forms new report from Kerala with new habitat record.

29. *Typhlodromus* sp.

Collection Record: Maharashtra : Chandrapur, Jalgaon, 1 ♀ *Sesamum indicum*, 10.10.2010.

Remarks: An undetermined species of *Typhlodromus* was recorded from Jalgaon Chandrapur in Maharashtra. The specific identity could not be ascertained as the specimen was in damaged condition.

Family 5 ASCIDAE Voigts & Oudemans

30. *Asca* sp.

Collection Records: Kerala: Sugandagiri, 1 ♀, *Piper beetle*, 23.10.2007.

Remarks: One undetermined species of *Asca* was collected from the host as mentioned in collection records but its specific identity could not be ascertained due to lack of literature.

ORDER 3 PROSTIGAMATA

Family 6 ANYSTIDAE Oudemans

31. *Anystis baccarum* (Linn.)

1758. *Acarus baccarum* (Linn.), *Systema Naturae* 10th ed., 106.
2002. *Anystis baccarum*, Gupta, *Mem. zool. Surv. India*, **19**(2): 18-19.

Diagnosis: Propodosomal shield rounded anteriorly, indented posteriorly opisthosoma with 8 pairs of setae, anogenital region with many short serrate setae. Palp tibia with 3 claws.

Collection Records: KERALA: Kumely 1 ♀, *Syzygium aromaticum* (L.), 28.10.2007.

Remarks: This is a good predatory species and is known earlier from India from Jammu & Kashmir, Punjab, feeding on tetranychids. This is the first record of this species from Kerala while *Syzygium aromaticum* forms new habitat record.

Family 7 BDELLIDAE Grandjean

32. *Bdellodes* sp. nr. *angustifolius* (Gupta)

1991. *Bdella angustifolius* Gupta, *Rec. zool. Surv. India*, **88** : 201.
2002. *Bdellodes angustifolius* Gupta, *Mem. zool. Serv. India*, **19**(2): 31-32.

Collection Records: MAHARASHTRA: Lasorne, Satara, 1 ♀, Sunflower, 14.10.2010; 1 ♀, Dr. B.S. Kokan Krishi Vidyapeeth, Vengurle, *Pimenta dioica* (L.), 16.10.2010.

Remarks: This species is very close to *Bdellodes angustifolius* (Gupta) but differs in hypostomal striation pattern and chaetotaxy of dorsum. The members of this family are known to be good predators but in the present case, no predation was observed. Although the present specimen has been tentatively identified as near to *Bdella angustifolius* but there are some differences which are evaluated and final discussion regarding its identity will be taken later.

33. *Bdellodes* sp.

Collection Records: KERALA: Puliakode, Dist. Malapuram, 1 ♀, *Piper betle*, 21.10.2007; 1 ♀, Karadipara, Munnar, *Piper betle*, 26.10.2007.

Remarks: This species of *Bdellodes* could not be identified upto species level for want of literature. However, it does not tally with any of the known species of this genus from India.

34. *Bdella* sp.

Collection Records: KERALA: Keller, 1 ♂, *Elettaria cardamomum*, (L.), 25.10.2007.

Remarks: This genus is known from India only by 2 species one from Maldah and the other from Arunachal Pradesh. However, this is different from both the species. Final specific identification is kept pending till further literature are available.

35. *Bdella* sp. nr. *maldahensis* Gupta

1992. *Bdella maldahensis*, Gupta, In: *Fauna of West Bengal, State Fauna Ser.*, 3(Part 3): 12.

1999. *Bdella maldahensis*, Gupta, *Sci. & Cult.*, **65**: 161.

2003. *Bdella maldahensis*, Gupta, *Mem. zool. Surv. India*, **20**(1): 27.

Collection Records: TAMILNADU: Sirumalai, 1 ♀, *Piper betle*, 10.04.2011.

Family 8 CHEYLETIDAE

36. *Eucheyletia* sp.

Collection Records: KARNATAKA: Chickmagalore, 1 ♀, *Elettaria cardamomum*, 10.12.2008.

Remarks: This species is different from the only known species of this genus from India, i.e. *Eucheyletia reticulate* Cunliffe by the number

and shape of idiosomal setae and number of teeth on outer and inner combs. Till availability of additional material, the final decision on its identity is kept in abeyance.

Family 9 CUNAXIDAE Thor

37. *Dactyloscirus* sp. nov.

Collection Records: MAHARASHTRA: Dr. B.S. Kokan Krishi Vidyapeeth, Vengurle, 1 ♀, Cinnamonum verum, 16.10.2010; KARNATAKA: Bettadamann, Mudigere, 1 ♀, *Elettaria cardamomum*, 8.13.2008.

Remarks: This genus is known from India only by 2 species, viz., *Dactyloscirus machairodus* (Oudemans) and *Dactyloscirus bengalensis* Gupta. However, it differs from both in setation pattern of palp femur, as well as in setation of hysterosomal region. The decision regarding its novelty is kept pending till availability of further material.

38. *Cunaxoides* sp.

Collection Records: TAMIL NADU: Sirumalai, 1 ♀, *Piper betle*, 10.4.2011.

Remarks: This specimen of *Cunaxoides* was damaged while mounting. Therefore, its identity could not be ascertained.

Family 10 ERYTHRAEIDAE Robineau-Desvoidy

39. *Leptus* sp. nr. *indicus* Khot

1964. *Leptus indicus* Khot, *Acarologia*, **6**: 682.

2002. *Leptus indicus*, Gupta *Mem. zool. Serv. India*, **19**(2): 89.

Collection Records: MAHARASHTRA: Lasurne, Satara, 2 ♀ ♀, *Glycine max*, 14.10.2010; KARNATAKA: Sirsi 1 ♀, *Piper betle*, 14.12.2008.

Remarks: This genus is known from India by only 4 species viz., *Leptus samsungensis*, Gupta, *Leptus poonaensis* Khot, *Leptus giganticus* Khot and *Leptus indicus* Khot. However, this is close to only *Leptus indicus* from which it differs in setation of dorsum. The specific identity has been kept pending till further material becomes available.

Family 11 STIGMAEIDAE Oudemans.

40. *Agistemus obscura*, Gupta.

1991. *Agistemus obscura* Gupta, *Rec. zool. Surv. India*, **88**: 210-211.
1997. *Agistemus obscura*, Gupta & Chatterjee, *Sci. & Cul.*, **65**(5-6): 161.
2002. *Agistemus obscura*, Gupta, *Mem. zool. Surv. India*, **19**(2): 108.

Diagnosis: Setae on propodosoma ae/ae-ae = 1.6, be/be-be-1.1, ce/ce-ce-o.4, all setae on medium shield barbed. A-50, b-60, la-64, lm-65, c-65.

Collection Records: KERALA, Spring Valley 1 ♀, *Cinnamomum verum*, 28.10.2007.

Remarks: Earlier this was known from Manipur and hence, Kerala forms new distributional record and *Cinnamomum* forms the new habitat record.

41. *Agistemus heterophylla* Gupta

1991. *Agistemus heterophylla* Gupta, *Rec. zool. Surv. India*, **88**: 211-214.
1996. *Agistemus heterophylla*, Chatterjee & Gupta, *J. Beng. nat. Hist. Soc.*, (NS), **15**(2): 27.
2002. *Agistemus heterophylla* Gupta, *Mem. zool. Surv. India*, **19**(2): 104.

Diagnosis: Measurements of setae: ae-40, be-79, ce-58, ae/ae-ae-1.2, be/be-be-1.2. Palp tarsus as long as palptibial claw. a-58, la-70, b-55, lm-65, c-65.

Collection Records: TAMIL NADU, Sirumalai 1 ♀, *Elettaria cardamomum*, 10.04.2011.

Remarks: This was earlier known from Arunachal Pradesh and West Bengal. Its present record on Cardamom from Tamil Nadu forms new habitat and distributional records, respectively.

42. *Agistemus aramatai* Gupta

1991. *Agistemus aramatai* Gupta, *Rec. zool. Surv. India*, **88**: 210.
2002. *Agistemus aramatai*, Gupta, *Mem. zool. Surv. India*, **19**(2): 99.

Diagnosis: Propodosomal setae ae-50, be-48, ce-50, ae/ae-ae-3.1, ae-be-26, be-ce-40, a-50, b-35, c-50, la-55, lm-34, a/a-a-1.5.

Collection Records: TAMIL NADU, Sirumalai 1 ♀, *Piper betle*, 10.04.2011.

Remarks: This species was earlier known from Arunachal Pradesh, Assam, Mizoram, Lakshadwip. Hence, Tamil Nadu forms new distributional record.

43. *Agistemus industani* Gonzalez. Rodriguez

1965. *Agistemus industani*, Gonzalez. Rodriguez, *Univ. Calif. Pub. Ent.*, **41**: 40.
1999. *Agistemus industani*, Dhooria, *J. Acar*, **14**: 88-89.
2002. *Agistemus industani*, Gupta, *Mem. zool. Surv. India*, **19**(2): 104-105.

Diagnosis: Measurements of setae ae-56, ae-ae-26, ae/ae-ae-2.1.be-70, be-ce-70, a-b-65, c-68, la-68, lm-67, e-38.

Collection Records: MAHARASHTRA, Pursuda, 1 ♂, *Curcuma longa* L, 11.10.2010.

Remarks: This species was previously known from Arunachal Pradesh, Mizoram, Nagaland, Tamil Nadu, Uttar Pradesh, Punjab, Tamil Nadu, Karnataka. Hence its present record from Maharashtra forms new distributional record as well as the plant, *Curcuma longa*, on which it was recorded forms new habitat record.

44. *Agistemus fleschneri* Summers

1960. *Agistemus fleschneri* Summers, *Proc. ent. Soc. Wash.*, **62**: 237-240.
2000. *Agistemus fleschneri*, Gupta, In: *Fauna of Tripura, State Fauna Ser.*, **7**(Part 2): 18.
2002. *Agistemus fleschneri*, Gupta, *Mem. zool. Surv. India*, **79**(2): 101-102.

Diagnosis: Measurements of setae ae-44, ae/ae-ae-2.5, be-69, be/be-be-2.00, ce-60, ce-ce-60, a-50, b-46, c-52, la-47, lm-50.

Collection Records: TAMIL NADU: Allagumadai, 1 ♀, *Piper betel*, 12.04.2011.

Remarks: It is widely distributed in India like Arunachal Pradesh, Assam, Meghalaya, Manipur, Sikkim, Tripura, West Bengal, Delhi, Haryana, Punjab, Andaman & Nicobar Islands. However, its report from Tamil Nadu on *Piper betle* forms new distributional and habitat records.

45. *Ledermuelleria* sp.

Collection Records: KARNATAKA: Chickmagalore, 1 ♀, *Elettaria cardamomum*, 10.12.2008.

Remarks: One species of this genus could be collected but its placement to species level could not be done for the damaged condition of the specimen.

Family 12 TYDEIDAE Kramer

46. *Pronematus fleschneri* Baker

1968. *Pronematus fleschneri* Baker, *Ann. Ent. Soc. Amer.*, **61**(5): 1092-1093.

2000. *Pronematus fleschneri*, Gupta, In: *Fauna of Tripura, State Fauna Ser.*, **7**(Part 2): 18-19.

2002. *Pronematus fleschneri*, Gupta, *Mem. zool. Surv. India*, **19**(2): 126.

Diagnosis: Propodosomal striation longitudinal with minute lobes. Setae D_1 - D_3 , L_1 subequal in length, tibia I shorter than tarsus I, solenidion on tarsus I extends beyond the tip of segment.

Collection Records: KERALA: Spice Research Institute, Peruvannamuzhi, 1 ♀, *Myristica fragrans* Hoult, 17.10.2007.

Remarks: This is a widely distributed species and is known from West Bengal, Tripura, Sikkim, Bihar, Delhi, Punjab, Uttar Pradesh, Andaman-Nicobar Islands, Kerala forms new distributional record. It has been reported to be feeding upon *Tetranychus neocaledonicus* and *Oligonychus mangiferus* (Gupta, 2002) but such feeding behaviour could not be seen in the field.

47. *Pronematus elongatus* Baker

1968. *Pronematus elongatus* Baker, *Ann. Ent. Soc. Amer.*, **61**: 1093-1094

1993. *Pronematus elongatus*, Rather, *J. Acerol.*, **15**: 20.

2002. *Pronematus elongatus*, Gupta, *Mem. zool. Surv. India*, **19**(2): 124.

Diagnosis: Propodosoma with fine longitudinal striation. Hysterosoma with transverse striation, over dorsocentral area, except V-like between D_1 - D_3 . Tarsus I longer than tibia I, solenidion on tarsus I short and rounded.

Collection Records: KERALA: Balusseri, 1 ♀, *Piper betle*, 17.10.2007.

Remarks: Earlier it was known only from Jammu & Kashmir. So Kerala forms new distributional record.

48. *Pronematus* sp.

Collection Records: KARNATAKA: Chickmagalore, 1 ♀, *Piper betle*, 10.12.2008.

Remarks: One undetermined species of *Pronematus* was collected which did not tally with any of the known species of this genus from India. However, for lack of some recent literature further identification was not possible.

49. *Parapronematus ferox* Gupta

1991. *Parapronematus ferox* Gupta, *Rec. zool. Surv. India*, **88**: 231.

2002. *Parapronematus ferox*, Gupta, *Mem. zool. Surv. India*, **19**(2): 123.

Diagnosis: Forked seta 1.5 times as long as width of segment, solenidion on tarsus I present on middle of segment, setae measure P_1 -25, S-31, D_3 -22, D_4 -31.

Collection Records: MAHARASHTRA: Dr. B.S.Kokan Krishi Vidyapeeth, Vengurle, 1 ♀, *Piper betle*, 16.10.2010.

Remarks: It was described from West Bengal and its present record on Cardamom from Kerala forms new distributional and habitat records.

50. *Parapronematus* sp.

Collection Records: KARNATAKA: Sirsi, 1 ♀, *Elettaria cardamomum*, 15.12.2008. This species could not be identified beyond generic level for want of literature.

51. *Tydeus* spp.

Collection Records: KERALA: Keller, 1 ♀, *Syzygium aromaticum* (L), 25.10.2007; *Cinnamomum verum*; 1 ♀, 1 ♂, 25.10.2007. KARNATAKA: Sirsi, 5 ♀, *Elettaria cardamomum*, 14.12.2008. Donigal, Bettadamanne, 1 ♀, *Cinnamomum verum*; 08.12.2008; Chickmagalore, 2 ♀, *Vanilla panifolia*, 10.12.2008, Chettali, Madikeri, 1 ♀, *Garcinea* sp., 05.12.2008.

Remarks: Some specimens of this genus were collected but could not be placed to any of the known species due to difference in striation pattern on dorsum and dorsal chaetotaxy. Most likely one or two might be new species.

FUNGUS FEEDING MITES

Family 13 EUPODIDAE Koch.

52. *Eupodes sigmoidensis* Strandtmann & Goff.1978. *Eupodes sigmoidensis* Strandtmann & Goff. *Pacific Insects*, **19**(2): 91.

Collection Records: KERALA: Tushargiri, 1 ♀, *Piper beetle*, 28.10.2007; KARNATAKA: 1 ♀, Indian Institute of Spice Research, Appangala, *Myristica fragrans*, 4.12.2008; TAMIL NADU: Sirumalai, 1 ♀, *Piper beetle*, 10.4.2011; Sirumalai, 1 ♀, *Elettaria cardamomum*, 10.4.2011.

Remarks: Earlier records of this species are from West Bengal, Mizoram, Sikkim and Lakshadwip from India. The present one forms new distributional record. It is known to be associated with fungus and phytophagous mites but its relation with the latter is not known with certainty.

53. *Eupodes* sp.

Collection Records: KERALA: Tushargiri, 1 ♀, *Curcuma longa* L, 18.10.2007; Sugandagiri, 1 ♀, *Piper beetle*, 23.10.2007; 2 ♀ ♀, Spring valley, *Piper beetle*, 28.10.2007

Remarks: Another species of this genus was collected which was different from the earlier

one but because of its fragile nature, the correct identification remained doubtful.

SUMMARY

The present paper documents a total of 53 species belonging to 27 genera under 13 families and 2 orders, of those 10 belong to phytophagous group, 41 to predatory group and one to fungal feeding group. All the species are listed giving relevant references, diagnosis, collection records and biological observations made in the field. This forms a first consolidated account of mites infesting plants used as spices in India.

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REFERENCES

- Chant, D.A. and McMurtry, J.A. 2007. *Illustrated keys and diagnosis for the genera and a sub-genera of the Phytoseiidae of the world (Acari: Mesostigmata)*. Indira Pub. House, Michigan. U. S. A.: 1-220.
- Gupta, S.K. 1985. *Handbook. Plant mites of India*. Zoological Survey of India, Calcutta: 1-520 pp.
- Gupta, S.K. 2002. A Monograph on plant inhabiting predatory mites of India, Part I, Orders: Prostigmata, Astigmata and Cryptostigmata, *Mem. zool. Surv. India*, **19**(2): 1-183.
- Gupta, S.K. 2003. A Monograph on plant inhabiting predatory mites of India, Part II: Order: Mesostigmata *Mem. zool. Surv. India*, **20**(1): 1-185.
- Gupta, S.K. 2005. *Insects and mites infesting medicinal plants in India*. Ramakrishna Mission Ashrama, Narendrapur, 214 pp + Plates.
- Gupta, S.K. & Gupta, Y.N. 1994. A taxonomic review of Indian Tetranychidae (Acari : Prostigmata) with descriptions of new species, re-descriptions of known species and keys to genera and species. *Mem. zool. Surv. India*, **18**(1): 1-196.