Acari diversity and their importance as foes and friends

Salil Kumar Gupta
Medicinal Plants Research and Extension Centre, Rama Krishna Mission Ashrama Narendrapur, Kolkata – 700103, India
E-mail address: salil_zsidumdum@yahoo.com

ABSTRACT

The present paper reviews the acarine diversity of India focussing their early history, habits, habitats and economic importance of those relating to agricultural, veterinary and public health aspects. This provides an up-dated data regarding status of Indian acarines.

Keywords: Acarine diversity, Foes & friends, Indian scenario, Tetranychidae, Tenuipalpidae, Tarsonemidae

1. INTRODUCTION

Among the non-insect pests of agricultural crops, mites are gaining increasing importance throughout the world as some act as foes, being injurious pests of agricultural crops and do substantial economic loss to the growers, while some act as friends, being effective and potential predators, helping enormously to bring down the pest mite population below economic injury level. Likewise, there are many mites and ticks which are pests of veterinary animals, poultry birds and human beings and are responsible for causing various types of disease related to bacteria, virus, protozoa, rickettsia, spirochaete, etc. In addition, they also cause inconvenience, irritation, itching, inflammation, anaemia, paralysis, etc. to the hosts. Hence, those have tremendous importance in medical, veterinary and public health aspects. Some mites occur in house dust and are responsible for causing various types of respiratory allergic
disorders. Mites also occur in water bodies (fresh water and salt water) and some act as indicator species for detecting water pollution. The mites inhabiting stored products including stored grains cause substantial damage to the grains making those unsuitable for human consumption and even for germination. Those mites which inhabit soil help enriching soil fertility by forming humus as well as act as indicator species for soil health and soil pollution. Gupta (1985, 2010, 2012), Gupta & Gupta (1999) summarized the available information on Indian Acarines.

Considering the above stated manifold importance, the Acari, comprising mites and ticks, have received world attention since last several hundred years and works on diverse aspects have been done. So far as India is concerned, a reasonably good amount of work has been done and the present paper provides an overview of that highlighting their importance as foes and friends.

2. EARLY HISTORY OF ACARINES

A tick transmitted fever was reported in ancient Egyptian papyrus in as early as 1550 BC. Homer mentioned in 850 BC the occurrence of a tick on dog of Ulyses. Aristotle described a parasitic mite collected from body of a locust. Hippocrates, Pliny and others reported mites/ticks several hundred years back. Until 1660, mites were referred as “lice” or “beetles” and it was only in 1860, the term “Acari” or “Akari” was used which meant headless creatures. After World War-II, the importance of acari increased further as many of those were related to transmission of diseases on one hand and also on the other hand due to random uses of broad spectrum pesticides like DDT, BHC, etc. which aggravated the agricultural mite problem further.

3. HABITAT AND SPECIES DIVERSITY OF ACARINES

Acari are rival to insects regarding habitat diversity. Hardly any habitat on earth is known where these creatures do not occur. Their occurrence has been reported from bottom of ocean to top of mountain and from hottest desert to arctic region as well as snow-clad mountains. Upto 1970, only 30,000 species were known from the world (Krantz, 1970). Upto 2000, as many as 55,000 species under 5500 genera were known (Walter & Proctor, 1999). As per guess estimate, presently about 0.5-1.0 million species exist. Of these, the estimated plant feeding mites are 0.4 million and vertebrate parasitic mites are 0.12 million. It is believed that if all possible habitats are explored, the number of Acari will exceed the number of insects.

4. ACARI AS FOES

Mites act as important pests of agri-horticultural crops, stored products and do enormous economic loss. Many ticks and some mites attack various veterinary animals, poultry birds as well as man causing a number of diseases besides causing inconvenience, nuisance, loss of blood, paralysis, scabies, mange etc. Many ticks cause protozoan, rickettsial, viral, bacterial, spirochaete diseases causing loss of life. All these invited world attention for conducting diverse studies on Acari.
5. ACARI AS FRIENDS

Some mites act as predators of crop pests and stored grain pests while some others like aquatic mites feed on mosquito larvae. Some parasitize insect pests of crops, house flies etc. By these, they contribute towards biological control. The soil mites help enriching soil fertility by forming humus. Some mites even help determining post-mortem interval. Even there are instances where the tribal people have been reported to use mites in preparing some traditional medicines for treatment of human ailments.

6. PROGRESS OF INDIAN ACARINE STUDIES IN FAUNAL EXPLORATION

Table 1. Indian Acarine Diversity

<table>
<thead>
<tr>
<th>First report of Acarine from India (Tick)</th>
<th>One Tick species on Elephant (<em>Acarus elephanticus</em>)</th>
<th>Linnaeus, 1758</th>
</tr>
</thead>
<tbody>
<tr>
<td>First report of Acarine from India (Mite)</td>
<td>One Mite species on tea (<em>Tetranychus bimaculatus</em>)</td>
<td>Peal, 1868</td>
</tr>
<tr>
<td>Known species up to 1899</td>
<td>3 spp. (Mites)</td>
<td>Prasad, 1982</td>
</tr>
<tr>
<td>Known species up to 1950</td>
<td>35 spp. (Mites)</td>
<td>Gupta &amp; Gupta, 1999</td>
</tr>
<tr>
<td>Known species up to 1964</td>
<td>65 spp. (Mites)</td>
<td>Ghai 1964 Gupta &amp; Gupta, 1999</td>
</tr>
<tr>
<td>Known species up to 1974</td>
<td>769 spp. (only Mites)</td>
<td>Prasad, 1974</td>
</tr>
<tr>
<td>Known species up to 1999</td>
<td>1800 spp. (Mites)</td>
<td>Gupta &amp; Gupta, 1999</td>
</tr>
<tr>
<td>Known species up to 2012</td>
<td>1400 spp. (Mites)</td>
<td>Gupta 2012</td>
</tr>
<tr>
<td>Known species up to 2016</td>
<td>3365 spp. (Total Acari)</td>
<td>Updated Data</td>
</tr>
<tr>
<td></td>
<td>3255 (Mites)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>110 (Ticks)</td>
<td></td>
</tr>
</tbody>
</table>

7. HABITAT-WISE STUDIES ON INDIAN ACARINES

1. Plant Mites –
**Habitats** - These mites occur in all kinds of agri-horticultural crops/plants

**Nature of damage** - The mites damage plant tissues, suck plant sap and make the plants weak, causing retardation of growth and development and yield. Often they kill the plants. They produce different types of damage symptoms like chlorosis, blistering, russeting, curling, bronzing of leaves, defoliation, gall formation, deformation, of plant parts, and act as vectors of viral diseases. All these cause economic loss from 5-100%.

**Number of spp. from India** - 1490 spp.

Phytophagus- 1213 spp., 110 genera, 6 families, Predatory- 277 spp., 80 genera, 18 families.

2. **Vertebrate associated mites** –

**Vertebrates attacked** - These mites occur as ecto/endo parasites of all vertebrates from fish to mammals.

**Nature of injury** - Their biting and sucking of blood cause anaemia, itching, irritation, inflammation, dermatitis, rashes, scabies disease, scrub typhus disease, rickettsial disease, etc.

**Extent of mortality** - 5-50%.

**Total species known from India** - 350 spp., 110 genera, 40 families.

**Some important spp.** - *Sarcoptes scabiei*, *Neotrombicula deliense*, *Psoroptes* spp.

3. **Invertebrate associated mites** –

**Invertebrates attacked** - These mites attack insects, millipedes, centipedes, mussels, slugs, snails, cray fish, scorpion, hermit crab, etc.

**Nature of association** - Phoretic, commensals, haemolymph feeder, parasitic, predators, often act as good bio-control agents of insect/ mite pests. Some cause virulent disease to honey bees.

**No. of species known from India** - 155 spp., 58 genera, 22 families.

**Important species** - *Acarapis woodi*, *Varroa jacobsoni*, *Eutrombidium trigonum*, etc.

4. **Soil mites** –

**Habitat** - These mites occur in soil, leaf litter under logs, etc.

**Nature of association** - They act as decomposer of soil organic matter to form humus for increasing soil fertility. They also help soil aeration/dissemination of fungal spores and bacteria, while some feed on algae, mosses, etc.

**No. of spp. known from India** - 707 (Mesostigmata- 170, Prostigmata-17, Astigmata- 20, Cryptostigmata- 500).

5. **Water mites** –

**Habitats** - These mites occur in fresh water, marine water and oceanic bottom.
Nature of association - Some fresh water mites act as good bio-control agents of mosquito and house fly larvae
Number of spp. known from India - 245 spp., 60 genera, 25 families.

6. Stored product mites –

Stored Products attacked - These mites infest grains/ dried fish/ powder milk/ dry fruits/ various food & food products/ drugs/ farinaceous products/ cheese/ hide /seeds/ potato chips/ spices, etc.
Nature of damage - They make the infested articles unsuitable for human and animal consumption/ grains become unsuitable for germination. They also invite fungal attack.
Extent of damage - 5-20% loss.
Total species known from India - 93 species, 50 genera, 20 families.
Important species - Acarus siro/ Tyrophagus putrescentiae, Tyrolichus casei, Caloglyphus berlesei, Lardoglyphus konoi, Rhizoglyphus echinopus, Cheyletus eruditus, C. malaccensis.

7. Nest associated mites –

Habitats - These mites occur in bird and rodent nests. The nest acarine fauna shows succession of species in different nesting stages like- nest building/ egg laying/ hatchlings/ deserting of nest
Importance - These mites often invade human houses, bite man and cause irritation, itching, dermatitis and also may act as vectors of different diseases.
Number of spp. known from India - 92 spp.

8. Dust mite –

Habitats - These mites occur in both floor and bed dust, more in dampy and non-airy houses and also in those houses occupied by respiratory allergic patients
Importance - They cause respiratory allergic disorders (Asthma, Rhinitis), contract urticaria, etc. Some feed on human semen present in bed, if any, and are suspected to be carriers of Hepatitis-B, HIV, CMV, etc.
Number of spp. known from India - 123 spp., 43 genera, 25 families (Gupta, 2010).

9. Ticks (Soft & Hard ticks) –

Habitats - These ticks occur in all vertebrates
Nature of association - These are exclusively blood feeders causing diseases like anaplasmosis, babesiosis, piroplasmosis, theileriasis, typhus, encephalitis, anaemia, paralysis, leucocytozoonosis, etc.
Number of spp. known from India - 110 spp., 12 genera, 2 families.
8. MAJOR GROUPS OF PLANT MITES

Spider mites (Family – Tetranychidae):

These mites are exclusively plant sap feeders. They are variously coloured, 8 legged, occur on under-surface of leaves (some may occur on upper surface also), make colonies there and cover that with thin webs like spiders (hence called spider mites). Many species are important pests of agri-horticultural crops. Size – 350-450 microns.

False Spider mites (Family – Tenuipalpidae):

These mites are flat, pear shaped, 8 legged, brightly coloured, colonize on under-surface of leaves, also on twigs, fruits. These are plant sap suckers and some cause plant viral diseases. They never cover their colonies with webs (hence called false spider mites). Size – 300-350 microns.

Yellow mite/Broad mite (Family – Tarsonemidae):

These tiny mites are yellowish white, move fast, 8 legged, plant sap suckers and occur on under-surface of leaves preferably on young apical leaves, causing curling of leaves. Size – 250-300 microns.
Gall mite / Erineum mite (Eriophyoidea):

These mites are tiny, whitish, light brownish, 4 legged only, look worm-like and occur on under-surface of leaves/fruits, causing erineum/gall formation. Size – 200 microns.

9. DIVERSITY OF DAMAGE SYMPTOMS CAUSED BY PLANT MITES

Since these mites are exclusively plant sap suckers, they puncture the leaves with their stylet-like chelicerae and suck plant sap. While feeding, they damage tissues, chlorophyll and due to this they produce various types of damage symptoms, the photographs of some of those are provided
Photographs showing damage symptoms caused by mites
10. DIVERSITY OF PREDATORY MITES

As there are pest mites, there are also predatory mites which belong to Phytoseiidae, Cunaxidae, Anystidae, Stigmeidae, etc. And those contribute in biological control of pest mites. The photographs of some of the mites are given
Phytoseiulus persimilis feeding on different stages of two spotted spider mite, *Tetranychus urticae*
11. EXTENT OF CROP LOSS DUE TO MITE PEST ATTACK ON VARIOUS CROP LOSS

Information regarding extent of damage on various crops caused by mites is given below (Gupta 2012) -

- Mango malformation mite- 50-80%
- Litchi erineum mite- 30%
- Paddy white mite- 20-25%
- Sugarcane red mite- 20-30%
- PPSM –15-30%
- Cotton 2- Spotted spider mite- 20-30%
- Vegetable mite- 10-15%
- Tea Red Spider Mite- 5-11%
- Ber gall mite- 20-25%
- Brinjal Red mite- 13-31%
- Bhendi mite- 23-27%
- Chilly leaf curl mite- 27-29%
- Total crop failure- Mango malformation and PPSM
- Coconut 10-20%- 50-60%

Loss in terms of money-Rs. 8616.63/ ha in case of brinjal 2-spotted mite

12. HOST PREFERENCE AND VARIETAL RESISTANCE

Some of the information regarding studies on these aspects are given below (Gupta, 2012)-

**Morphological**

Leaf texture- Rough surface- more mite
Leaf venation- Deeper Midrib- more mite
Leaf thickness- Thick leaves- less mites
Leaf webbing- more webbing- more mite
Leaf age- Matured leaves- more mite

**Biochemical factors**

<table>
<thead>
<tr>
<th></th>
<th>Susceptible var.</th>
<th>Resistant var.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starch content</td>
<td>higher</td>
<td>lesser</td>
</tr>
<tr>
<td>Free Amino Acid</td>
<td>more</td>
<td>lesser</td>
</tr>
<tr>
<td>N</td>
<td>more</td>
<td>higher</td>
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<tr>
<td>Na</td>
<td>more</td>
<td>lesser</td>
</tr>
<tr>
<td>K</td>
<td>lower</td>
<td>higher</td>
</tr>
<tr>
<td>Protein</td>
<td>lower</td>
<td>higher</td>
</tr>
<tr>
<td>Phenolics</td>
<td>higher</td>
<td>lesser</td>
</tr>
</tbody>
</table>
Plant volatiles play important role in causing susceptibility/resistance of plants (not always true), (Gupta, 2012)

13. TICKS / MITES CAUSING DIFFERENT DISEASES OF MEDICAL, VETERINARY, AND PUBLIC HEALTH IMPORTANCE

The ticks and mites are responsible for causing different diseases of medical, veterinary and public health importance and some of those are listed in the following tables – (as per Gupta, 2010)

<table>
<thead>
<tr>
<th>Disease Man</th>
<th>Pathogen</th>
<th>Vector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tick paralysis</td>
<td>Tick toxin</td>
<td><em>Dermacentor andersoni</em></td>
</tr>
<tr>
<td>Tularabia</td>
<td>Bacterial</td>
<td><em>Dermacentor andersoni</em></td>
</tr>
<tr>
<td>Rocky mountain spotted fever</td>
<td>Rickettsial</td>
<td><em>Dermacentor andersoni</em></td>
</tr>
<tr>
<td>Q fever</td>
<td>Rickettsial</td>
<td><em>Dermacentor andersoni</em></td>
</tr>
<tr>
<td>Relapsing fever</td>
<td>Spirochaetal</td>
<td><em>Ornithodoros moubata</em></td>
</tr>
<tr>
<td>Langet encephalitis</td>
<td>Viral</td>
<td><em>Ixodes persulcatus</em></td>
</tr>
<tr>
<td>CCHF</td>
<td>Viral</td>
<td><em>Hyalomma marginata</em></td>
</tr>
<tr>
<td>Tick borne Haemorrhagic fever</td>
<td>Viral</td>
<td><em>Haemaphysalis spinigera</em></td>
</tr>
<tr>
<td>Rickettsial pox</td>
<td>Rickettsial</td>
<td><em>Allothermanyssus sanguineus</em></td>
</tr>
<tr>
<td>Encephalitis</td>
<td>Viral</td>
<td><em>Ornithonyssus sylviam</em></td>
</tr>
<tr>
<td>KFD</td>
<td>Viral</td>
<td><em>Haemaphysalis spinigera</em></td>
</tr>
<tr>
<td>Scabies/ Itch mite</td>
<td>Mite toxin</td>
<td><em>Sarcoptes scabiei</em></td>
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<td></td>
<td></td>
<td><em>Phtomotes ventricosus</em></td>
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<tr>
<td>Scrub typhus</td>
<td>Rickettsial</td>
<td><em>Neotrombicula deliense</em></td>
</tr>
<tr>
<td>Lyme disease</td>
<td>Spirochaetal</td>
<td><em>Ixodes persulcatus</em></td>
</tr>
<tr>
<td>Respiratory allergies</td>
<td>Mite toxin</td>
<td><em>Dermatophagoides farinai</em></td>
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<td></td>
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<td><em>D. pteronyssinus</em></td>
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<tr>
<td></td>
<td></td>
<td>Orchard mites</td>
</tr>
<tr>
<td>Veterinary Animals</td>
<td>Poultry birds</td>
<td></td>
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<td>-------------------</td>
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</tr>
<tr>
<td>Babesiosis</td>
<td>Protozoan</td>
<td>Fowl spirochaetosis</td>
</tr>
<tr>
<td>Anaplasmosis</td>
<td><em>Anaplasma marginale</em></td>
<td>Scaly leg of fowl</td>
</tr>
<tr>
<td>Tick paralysis</td>
<td>Tick toxin</td>
<td>Depluming mite</td>
</tr>
<tr>
<td>Bilary fever</td>
<td>Protozoan</td>
<td>Tropical Fowl mite</td>
</tr>
<tr>
<td>Mange mite</td>
<td>Mite toxin</td>
<td>Red mite of Poultry</td>
</tr>
<tr>
<td>Louping ill</td>
<td>Viral</td>
<td>Relapsing fever</td>
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<tr>
<td>Tick typhus</td>
<td>Rickettsial</td>
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</tbody>
</table>

**Scabies**

- Mites burrow under the skin and lay eggs.
- Mite toxin and feeding cause itching and skin irritation.

![Image of Scabies](image.png)
Acarine Diseases in Cattle

Anaplasmosis

Chorioptic Mange

Thellemosis

Scrub typhus

Neotrombicula deliense

Scrub Typhus
Etiology, Epidemiology
Signs and Symptoms
Pathogenesis, Diagnosis
and Treatment
Psoroptic Mange in Cattle

Some Tick Borne Diseases

Colorado Tick Fever

Rocky Mountain Spotted Fever (RMSF)

- *Rickettsia rickettsii*
- Zoonosis —
- Reservoir: mammals
- Vector: ticks
- Characteristic hemorrhagic rash — maculopapular — starts on palms and soles (unlike measles!)
- Can damage vital organs
Tick Typhus

Babesiosis in Cattle
Sarcoptic Mange

13. MITES OCCURRING IN DIFFERENT HABITATS

Stored Product Mites
Dust Mites

Reptile and Rodent Associated Acarines

Rodent Mites

Rodent Nest

Ticks on Snake
Insect Associated Acarines (Mites)

Mites in Different Habitats

Aquatic Mites

Saprophagus Mite

Soil Mites

Nasal Passage Mite
Mites on Birds and Bird Nest

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References


