DIVERSITY, DISTRIBUTION AND TAXONOMY OF VEGETABLE MITES OF SHIMLA AND SOLAN HILLS

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ABSTRACT: The present study was undertaken to record the mite diversity, distribution and taxonomy of mite fauna associated with important vegetables growing in Shimla and adjoining areas. Extensive survey of the region was conducted to record the diversity of mites. A total of seven species namely Aceria sp., Brevipalpusphoenicus (Geijskes), Panonychuscitri (McGregor), Tetranychusludeni (Zacher), Tetranychusurticae (Koch) and Amblyseius (Amblyseius) sp. were collected, preserved and identified with the help of earlier records of Acarology Research Laboratory, Department of Biosciences, Himachal Pradesh University, Shimla and later confirmed by Prof. B.N. Putatunda, Department of Zoology, CCS Haryana Agricultural University, Hisar.

Key Words: vegetable mites, acarology, phytophagous mites.

INTRODUCTION
The mites comprise a large group of Arthropoda, belonging to the subclass Acari of class Arachnida. Mites constitute a huge group of economically important invertebrate arthropods with rich diversity and a wide range of habitats. At present there are more than 40,000 species under about 1,800 genera (Evans, 1992). Mites are soft-skinned arthropods. They have a chitinous exoskeleton and body shows no differentiation into head, thorax and abdomen. The mites, in general, have four pairs of legs and lack eyes. Their body is however, divided into anterior gnathosma region comprising of mouth parts, and the posterior idiosoma region. The mites can be characterized by their extraordinary capacity to adapt and reproduce.

Mites occupy every habitat of life from lowest intertidal zones to top of mountains, salt and fresh water, pastures and aerable land, forests, orchards and crop fields. However, some of the minute organisms are ectoparasitic on animals both invertebrates and vertebrates, and others on plants, whereas certain species also serve as vectors for microorganisms (Chhillar and Kumar, 2001). As such, there is hardly any aspect of life where mites are not found.

The phytophagous mites are becoming a worldwide problem in agriculture as some species are polyphagous and are known to cause severe damage to a large number of crop plants and trees (Goyal et al., 1985). There are five major groups of phytophagous mites viz., Tetranychidae, Tenuipalpidae, Eriophyidae, Tarsonemidae and Tickerellidae. Of these, tetranychids are the most common phytophagous mites. Among these, TetranychusurticaeKoch, TetranychusludeniZacher, Eutetranychusorientalis Klein, OligonychusindicusHirst, Panonychuscitri (McGregor) and Panonychusulmi (Koch) are most important. In recent years, the tetranychid mites have become of great concern to agriculturists because either they have assumed serious pest status or are not being controlled by employing the usual chemical methods (Singh et al., 2000; Cuthbertson, 2004, 2005). The family Tenuipalpidae includes the mites known as false spider mites or tenuipalpid mites. In India, genera Brevipalpus and Tenuipalpus are of great economic importance and infest fruit trees, vegetable crops, ornamentals etc. (Ghai and Shenmhar, 1984). Mites of family Eriophyidae are exclusively plant feeders and are of great economic importance. They are commonly known as gall, rust, bud, blister and erineum or simply eriophyd mites (Keiferet al., 1982). The important eriophyd mites causing damage to the plants in India are the species of genus Aceria, Aculus and Eriophyes. Important mite pests of family Tarsonemidae is Polyphagotarsenemuslatus Banks, popularly known as broad mite, which feed on underside of young tender foliage (Smith, 1987). Mites of family Tuckerellidae are also phytophagous, but somewhat rare (Gupta, 2001).

The mites may cause serious damage to live stock, agricultural crops, fruit crops, ornamental plants and stored products (Woolley, 1988). In recent years, mites are gaining importance because they play an important role in agriculture, as many species are plant feeders causing various types of plant deformities and reduction in crop yield. Not all mites are harmful, but there are some species which are beneficial to mankind and predate upon phytophagous and other harmful species, thereby playing an important role in biocontrolprogrammes (Hughes, 1976; Krantz, 1978; Gupta, 1985).
MATERIAL AND METHODS

For the purpose of collection of mites and to find out occurrence, samples of infested leaves were collected from three canopies of plants. Leaves were brought to laboratory in the individual labeled polythene bags tied with a rubber band. Each time 30 leaves were taken from five selected plants randomly in the field. The leaves were then examined under stereo binocular microscope in the laboratory. Mites were directly picked up from leaves with the help of a needle or a camel hair brush and then preserved. The eriophyid mites were not preserved, but mounted on slides directly (Jeppson et al., 1975) and rest were preserved in the Oudeman’s fluid.

Clearing of soft bodied mites was also done in 35% lactic acid at 35º-40ºC in an oven for 2-3 days. After clearing, the mites were then mounted in Hoyer’s medium. For mounting, first of all lactophenol treated mite specimens were removed from lactophenol and rinsed in 3-4 changes of water in a porcelain spot plate. The washing process was continued until cloudy interface of water and lactophenol disappeared. A drop of Hoyer’s medium was then placed in the centre of a clean microscopic slide. Mite specimens were picked from spot plate with the help of fine forceps, or brush and then placed in a droplet of mountant. Mite was arranged along vertical axis with the help of minute entomological pin. The specimen was arranged dorsoventrally and legs were spread. Cover slip was placed over the specimen to allow full expansion. The slides were air dried for a week, sealed and preserved after labeling properly (Krantz, 1978; Gupta, 1985).

The various vegetable crops were studied for the abundance of mites on the foliage in and around Shimla hills. Acarological studies, in the present investigation, were conducted on ten vegetable crops and their details are given in the table below:

<table>
<thead>
<tr>
<th>S.no.</th>
<th>COMMON NAME</th>
<th>BOTANICAL NAME</th>
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<tbody>
<tr>
<td>1.</td>
<td>Beans</td>
<td>Phaseolus vulgaris L.</td>
</tr>
<tr>
<td>2.</td>
<td>Brinjal</td>
<td>Solanummelengena L.</td>
</tr>
<tr>
<td>3.</td>
<td>Bottle guard</td>
<td>Lagenariasinceraria L.</td>
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<tr>
<td>5.</td>
<td>Cucumber</td>
<td>Cucumissativus L.</td>
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<td>6.</td>
<td>Pumpkin</td>
<td>Cucurbitapepo L.</td>
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<tr>
<td>7.</td>
<td>Spinach</td>
<td>Spinaciaoleracea L.</td>
</tr>
<tr>
<td>8.</td>
<td>Tomato</td>
<td>Lycopersiconesulentum Mill.</td>
</tr>
<tr>
<td>9.</td>
<td>Potato</td>
<td>Solanumtuberosum L.</td>
</tr>
<tr>
<td>10.</td>
<td>Okra</td>
<td>Abelmoschusesesculentus L.</td>
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</tbody>
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RESULTS AND DISCUSSIONS

Acarological studies were conducted on various mites infesting different vegetable crops in 14 selected study sites of Shimla and Solan hills having different altitudes. Sites selected for the present studies were Phagli, Kufri, Navbahar, Dhanda, Theog, Shogi, Kandaghat, Nauni, Solan, Ghanahatti, Arki, Kunihar and Darlaghat. Mite samples were collected from vegetable crops.

Present studies revealed a total of 6 species of mites belonging to 5 genera spread over 4 families under 1 order. Of these 1 species was predatory and 6 were phytophagous.

PROSTIGMATIC MITES

1. Aceria sp. (Phytophagous)
2. Brevipalpusphoenicis (Geijskes), Phytophagous
3. Panonychuscitri (McGregor), Phytophagous
4. Tetranychusludeni Zacher (Phytophagous)
5. Tetranychus sp. (Phytophagous)

MESOSTIGMATIC MITES

6. Amblyseius(Amblyseius) sp. (Predatory)

The details of various mites found associated with different vegetable crops are as follows:

Aceria sp. (Fig: 1)
Locality: Solan, Kandaghat, Nauni, Phagli and Dhalli
Hosts: Tomato and Brinjal
Other Hosts: Litchi and Fig
Diagnostic Features: Creamish to yellow in colour; worm like body; dorsal shield setae situated on tubercles and arching backwards; rostrum short; abdominal rings undifferentiated; sides of shield with strokes; feather claw 5-rayed; coxae smooth; 2 long telosomal setae present.

Brevipalpus phoenicis (Geijskes) (Fig: 2)
Locality: Theog, Dhalli, Phagliand Dhanda
Hosts: Potato
Other Hosts: Apple, almond, guava, pomegranate, pear, plum and mango.

Distribution: Assam; Bihar, Uttar Pradesh, Jammu and Kashmir, Himachal Pradesh and Maharashtra
Elsewhere: Australia, Philippines, Kenya, Brazil, Florida, Columbia and California

Diagnostic Features: Body with 2 anterior pairs of legs extended forward and two posterior pairs backward; two sensory rods present on tarsus II; rostrum extended up to the middle of femur I; palpus four segmented with one sensory rod and two setae on terminal segment; propodosoma with reticulations which gradually faded away medially and laterally; 3 pairs of setae present on propodosoma; ventral and genital plates reticulated; leg segments were wrinkled; setae on tarsi not clear.

Panonychus citri (McGregor) (Fig: 3)
Locality: Dhanda, Dhalli, Kandaghat, Solan and Nauni
Hosts: Bottle guard
Other Hosts: Apple, papaya, apricot, cherry, lemon, peach and plum

Distribution: Manipur, West Bengal, Uttar Pradesh, Jammu and Kashmir and Himachal Pradesh
Elsewhere: Nepal, USA, China, New Zealand, Japan and South Africa

Diagnostic Features: The citrus red mite uniformly deep red in colour; female oval, longer; dorsum with long setae on strong tubercles; tips of tubercles red as that of body colour; transverse striae on genital plate; palpus with long terminal sensillum; medioventral setae of moderate size; tibia I and tarsus I with one sensory seta each; the adult male with long legs, tapering abdomen and smaller than the female; the aedeagus bent to form a narrow slender, sigmoid distal end.

Tetranychus ludeni (Zacher) (Fig: 4)
Locality: Phagli, Theog, Dhalli, Dhanda, Nauni and Kandaghat
Hosts: Beans and okra
Other Hosts: Apple, cherry, plum, pear, peach, citrus spp., number of pulses

Distribution: Assam, Bihar, Uttar Pradesh, Haryana, Himachal Pradesh Gujarat, Andhra Pradesh and Kerala
Elsewhere: Australia, New Zealand, South Africa and USA

Diagnostic Features: Body with small empodium spurs present; palpus with terminal sensillum; tibia I and tarsus I with one sensory seta each; dorsal idiosoma setae longer than the interval between their longitudinal bases; tibia II and tarsus II with two sensory setae each; transverse striae on genital flap; medioventral setae of moderate size.

Tetranychus sp. (Fig: 5)
Locality: Dhalli, Dhalli, Phagli, Nauni and Kandaghat
Hosts: Brinjal, cabbage, beans and pumpkin
Other Hosts: Apple, plum, cotton, citrus spp., coconut, orange and papaya

Distribution: Meghalaya, Bihar, Haryana, Delhi, Punjab, Rajasthan, Gujarat, Karnataka, Tamil Nadu and Kerala
Elsewhere: Angola, Zaire, Philippines, Thailand, New Zealand and Europe

Diagnostic Features: Female body oval somewhat elongated; dorsal Idiosoma setae longer than the interval between their longitudinal bases; a single pair of para anal setae present; empodium of female splits dorsally into ventrally directed hairs; genital flap with transverse striae; male smaller, tapering posteriorly; body setae long and tapering; aedeagus knob small; legs covered with dense setae; leg I longer than other three legs.

Amblyseius (Amblyseius) sp. (Fig: 6)
Locality: Dhanda, Dhalli, and Phagli
Hosts: Okra, Beans and Brinjal
Distribution: Himachal Pradesh

Diagnostic Features: Creamish fast moving mite with large oval Idiosoma; sternal plate as long as wide with 3 pairs of sternal setae; metasternal plate present with distinct seta; genital plate indistinct; ventrianal plate large and wide with 3 pairs of paraanal setae and one pair of perianal setae; posterior mediodorsal setae longest; macrosetae present on legs I, II and IV; macrosetae on genu IV longest; leg I and IV longer; chelicerae strongly dentate; peritreme extended up to the base of gnathosoma; dorsal shield smooth and armed with 17 pairs of setae.

The above reported mite fauna of Shimla and adjoining areas showed that 5 species were phytophagous and 1 species was predatory. The phytophagous mites were represented by 3 families only. Out of total 5 species of phytophagous mites, 3 species belonged to the family Tetranychidae, which contributed 57.14% of phytophagous mite fauna, 1 species represented the family Tenuipalpidae and constituted 14.28% and a single species belonged to the family Eriophyidae contributing 14.28% of phytophagous mite fauna of Shimla and adjoining areas.
Present investigations thus suggest that there is an utmost need to conduct detailed studies on mites of vegetables from different parts of Himachal Pradesh as well as other parts of the Indian sub-continent, so as to have a strong database on the biogeography and taxonomy of different mites.

LITERATURE CITED