CHAPTER 5
ECO-BIOLOGY OF RED VELVET MITE, T. grandissimum

5.1 INTRODUCTION:

The mites of the family Trombidiidae and related groups are the large red velvet mites commonly found in soil, litter and other terrestrial habitats. These mites belong to the Prostigmatid, suborder Parasitengony whose members have evolved a complex life cycle with few exceptions, the larvae are parasitic on insects and other invertebrates and are morphologically different from other free – living post larval stages, which are predators of small arthropods. Because their prey and hosts include insect and mite pests of economic importance these mites are considered to have potential as biological control agents (Elckwort 1983; Welbourn 1983; Zhang 1998). There are some previous review on the general biology and ecology of members of Trombidiidae. (Robaux 1974, Welbourn 1987, Zhang 1991 and 1999) However there is no detailed account of the eco-biology of T. grandissimum commonly seen in India.

5.2 MATERIAL AND METHODS:

During the months of November- December, (NorthEast monsoon) season, and June-July (South West) monsoon particularly after five or seven days of continuous rain and high humidity time, these mites are seen moving on the soil at the morning hours, (6-10AM). (Fig 5.1 a-d) They emerge out from soil and starts moving. In the present study, during November-December 2007, 500 red velvet mites were collected and taken to the experimental land (5 meters length, 4 meters width mini farm). The soil of this unit area was tilled well, humus (organic wastes from trees)
added and cow dung was applied (40kg) once in this area. The collected mites were left in that site and water was sprayed 4 times a day using a sprinkler. This helped to get cool condition and to enhance humidity. To the soil of the mini farm termites mounds were put so as to enable the mites to feed them. From this mini farm mites were taken out and observed for their behavioural acts, development, feeding etc. The mites make holes/burrows in the soil and after digging the hole it enters in to the hole. (Fig 5.2 a-c).

5.3 RESULTS AND DISCUSSION :

*T. grandissimum* shows sexual dimorphism (Fig 5.3 a-d). The female mites are having a broader abdomen and the male mites are having short and narrow abdomen. Further the male mites are smaller than the females. In the life cycle, these mites have the following stages egg- larva, nymph and adults. According to Zhang (1999) Trombidiidae mites have the following stages: egg, pre-larva, larva, protonymph, deutronymph, tritonymph and adult males and females. In the present study the different sub-stages of nymphs are very difficult to observe. The life cycle of *T. grandissimum* in the field is univoltine (one breeding cycle per year) as reported earlier (Dong *et al.*, 1996).
5.3.1 LARVAL AND NYMPH LIFE:

In the present study, the larval and nymph stages of *T. grandissimum* was found to lead ectoparasitic life. They were found associated with the black ant, *Camponotes compresses* as a parasite (fig 5.4). The black ants are living under soil in groups where the female laid eggs and the larvae are found attached to the dorsal side of the ants. According to Zhang (1998) the eggs of Trombidium mites are laid in the months of March – July in temperate countries and hatch after 1-2 months depending on the environmental conditions.

In the present study the larvae were found attached with the hosts during the months of June and October (Pre-monsoon seasons). The eggs were also noticed during the month of October, 2007. The larval ectoparasitic life on arthropod hosts lasted for 1 – 2 weeks. The larvae then detach from the host and moved into the soil. The nymphs were pale white in colour initially and latter they develop into minute, red advanced nymph or early adult stage At this stage, they started foraging on the soil surface and plants.(Fig 5.5).

In the present study aestivating male and female *T. grandissimum* were noticed in the rearing unit in the summer months, May 2008. (Fig 5.6) The mites that were introduced in the field in November (monsoon season) were found to exist in soil till the months of April-May in that field in aestivating stage. The aestivating mites were found in pairs in a particular niche. During aestivation, they were found reduced in size and were also looked pale in colour. Although they were in aestivating stage they were found in places where the eggs of the black ants were present, whether they feed the eggs or not is unknown.
As reported earlier (Robaux 1974), in the present study also the life cycle of *T. grandissimum* was found affected by the temperature, relative humidity (RH) and type of food availability. The eggs of *T. grandissimum* need an RH of nearly 95% for optimal development and survival. The eggs remain dormant in the soil before they hatch during the favourable rainy months either June – July (South West monsoon) or November – December (North East monsoon). The eggs are seen in places where the soil has cattle dungs. The eggs are seen as black coloured minute oval shaped structures. According to Saboori and Zhang, (1996) eggs of red velvet mite *Allothrombium pulvinum* failed to develop normally at RH lower than 80%. The optimal temperature for post-embryonic development, fall between 24–25°C. In the field, the development of egg to adult takes 2-3 months. The emergence of adult mites are associated with heavy continuous rains and the appearance of green grasses and small plants on the soil during the later period of rainy season.

### 5.3.2 HABITAT AND ACTIVITIES:

During their parasitic phase, the larvae are found on arthropod hosts like ants. When off the hosts, they are found in the soil humus, moss and litter.

The soil in which they live are often very dry and drought affected area during summer months. This soil has loose texture after rain. The adults were found moving on soil surface in some open very dry area during rainy months. (Fig 5.5). When the rain was poor in the rainy season, these mites become very rare to see. This indicate their capacity to live dormantly for more than one year and emerges out particularly in rainy seasons in areas where the humidity is high (95-100%). These mites forage only for a few days i.e. 5-7 days in the rainy period. However, sporadic movements
were noticed in that area for 10 – 15 days. (Fig 5.7,5.8) After the rain, when sun starts
to radiate or when the temperature increases; these mites hide themselves or gets
buried. The mites enter into the soil before the soil gets dried or hardened. Unless they
cling to the leaflets of grass in the soil, they are always seen moving non – stop or
foraging. The adult mites avoid hot sun. The emergence of *T.grandissimum* to the
surface depends on humidity, rainfall and sunshine, as reported by Robaux, (1974) for
other Trombidium species.

In the study area rainfall occurs twice in a year (June – July – South West
monsoon and November – December – North East monsoon). In the North East
monsoon, rainfall is high and cool climate prevails for over 2 months and during this
November – December period, the mites are available in plenty. In the month of June-
July the emergence of mites from soil depends only on good rainfall. If the rainfall in
this season is continuous for over 7 days, the mite s emerges out form the soil. Further
the emergence from the soil was not observed during raining time. When the rain
stops for a day after a heavy shower, the mites come out. In some areas where the
climate was cool, the mites were seen even at the evening time after 4pm. However,
their numbers were fewer and all the mites gets themselves burried before 6.30PM.

The mites were found to emerge out of the soil in groups. In each group 20- 25
mites were observed. Such groups may be from a same parent.

Further these mites were always seen in places where the soil is loose in
texture (sandy soil). They were not seen in hard non-porous soil and water logging
areas. They were often seen on open land, where little grasses are seen. The mites
move fast and it moves more than 50 – 100 yards during foraging. During foraging, they were killed by moving cattles or humans to a greater extent. When the mites are dead they are eaten by different types of ants (Fig 5.9 a–c). Black ants and these mites co- exist in many areas.

It was very interesting to observe that the mites were picked up by some of its predatory birds. When the mites emerge out and seen more on the field mynah, *Acaridotheres tristis* and crow starts collecting the mites. Field examination further showed that the mites generally avoid soil where earth worms are seen in plenty.

Annandale (1906) (not available only cross reference) reported the presence of *T.grandissimum* in all parts of India where the soil was sandy. The body cavity of the mites are filled with yellowish / red colour oil. This oil function as a hydrostatic skeleton in enabling the mite to burrow in to the soil,(Fig 5.2). Rather like an earthworm or bivalve mollusc, where the part contracting the soil first is made slim to facilitate insertion and then anchored by making it fattened with muscles pulling the body walls inward and working against the pressure of the body fluid.

### 5.3.3 TROMBDIUM GRANDISSIMUM AND FEEDING:

The adult *T.grandissimum* is having an arachnid type of feeding habits. The mouth is guarded with strong chelecerate appendage which help in attachment and holding the prey. The adult mites feed on other insects and insect eggs (fig 5.12 - 5.13 a-c).
The feeding habit of *T. grandissimum* is very interesting. During the emergence of red velvet mites from soil after rainy days, the co-emergence of the winged form (Alate form) of termites occur. After a short flight the termites settle down on the field and start crawling. The mites prefer this prey very much. The mites hold the prey and cut the termites and sucks all the contents in the abdomen. Newell and Tevis (1960) had reported that the red velvet mites are specialized predators. Several occasion it was noticed that the mites are taking the sap of the leaves of the grass (fig 5.14 a & b). Further, the mites also feed on the insects associated with the small plants and grass on the field. It was stated that velvet mite crawls on the underside of a leaf that was covered by a rust like fungus, but whether it was feeding on the fungus or if that was just coincidental, it come out of the soil to feed just after the rains. It eats termites (winged alate forms), other bugs and their eggs. This mite has 4 pairs of legs. The anterior pair of legs help to hold the prey. In the mouth it has lobster like claws to serve as mouth parts.

5.3.4 ABUNDANCE AND DYNAMICS OF POPULATION:

*T. grandissimum* spend most of their time in the soil. Their abundance and dynamics are a reflection of their activities. In the present study, the mites were seen on open fields and gardens. Usually they are seen on open fields and gardens. They are also seen in fields where cattle dungs are seen much. It prefers black sandy soil when compared to other soil types. The appearance of the mites in the study area is bi–seasonal. The mites appear during the North East and South West monsoon seasons. The North East monsoon starts in November – December months and South West monsoon showers occur during the months of June and July. In the South West monsoon season, the mites appear only when the rainfall occurs continuously for over
a week. Usually the population density of the mites during the South West monsoon season is less when compared to North East monsoon day although all the environmental factors are favourable. In the open field thousands of these mites were noticed during November – December period. A mean density of 3 – 4 adult mites / m² were observed in the field during rainy months (June – July season) but in the North East monsoon (November – December) times a mean density of 9 – 12 adults mites were seen in a meter square area.

Unlike the previous reports about the abundance of red velvet mites in orchards (Robaux 1974, Zhou et al., 1989, in the present study the red velvet mites, *T. grandissimum* is not seen much in orchards, but seen in plain open, barren lands. The mites are available on the soil surface in the morning and evening hours. Further, once they emerge out they can be seen walking on the soil for 7 – 10 days. After that they disappear. As these mites are having good market value, children and women, hand pick the mites and sell them to the traders (Rs 210 -250/kg). The mites were not noticed in flooded fields. The larvae of these mites parasitises black ants, beetles and other insects. In the elytra region of black ants 5-7 larvae were isolated. As the abundance of these mites is associated with the emergence of alate forms of termites, these two organisms are interrelated. Dong *et al.*, (1996) reported on the seasonal dynamics of another red velvet mite, *Allothrombium ovatum* larvae on cotton aphids; these mites are higher on alate hosts than an apterous hosts during the first half of May and decreased from an initial ten per alate host to zero in early June.
5.3.5. MATING AND REPRODUCTION:

*T. grandissimum* is bisexual. The females are inseminated before oviposition. On many occasions, it was very interesting to observe the male and female mites chasing each other. In our observation, the number of males in a particular field are less when compared with females. The male female ratio on the open field was 1: 1. Robaux (1974) reported that the male female ratios vary from 1: 0.75 - 1: 1.75 in different species of red velvet mites. During mating, the males and females perform encircling movement under a small plant or hiding places (fig 5.10). According to Robaux (1974) adult mites release their sperm on small twigs or stalks and the male lay down an intricate silken trail to the sperm. Female spot these trails, then seek out the individual male. If he is to her liking she sits in the sperm. According to Moss (1960) the males and females of trombid mites perform encircling dances, during which they pair. Dance signaling threads are deposited by the males and the females come along the sperm thread to capture them.

The eggs are laid in masses in soil, humus, and leaf litter (fig 5.11). Fecundity in *T. grandissimum* varies between 50 -100 eggs, fecundity was also related to the size of the female and climatic conditions.

5.3.6 ENEMIES OF *T. GRANDISSIMUM*:

*T. grandissimum* mites have few natural enemies. Robaux (1974) had reported cannibalism in Trombidiid mites. In the present study this habit was not observed. Few entomophagous birds like crow, mynah, *Acridotheres tristis* and sparrows were observed. *Dicrurus macrocerus* take this mites as prey. But most of the other animals
reject this prey due to its warning colour and distastefulness due to oil content in the body. But cattles and human gatherers of the mites pose threat to these mites.

5.3.7 ROLE IN BIOLOGICAL CONTROL:

Howard (1918) and Welbourn (1983) had reported that these mites are potential biocontrol agents of aphids. Hence in the present study, the cotton pest *A. gossypii* was offered to the mites in special chamber. The mites ate the prey but very slowly. So it is not the most suitable one in biological control.
Fig. 5.1(a-d). Photo showing humid cloudy day (a) and emergence of red velvet mites from soil (b). The mites were seen in gregarious forms (c) and (d).
Fig. 5.2. Photograph showing hole digging process of red velvet mite (a,b) and another photograph showing entrance of mite into a hole (c).
Fig 5.3.a. Photograph showing the body length of the male & female *T. grandissimum*.

Fig 5.3.b. Vertical view of the male & female *T. grandissimum*.

Fig 5.3.c. Vertical view of the male & female red velvet mite *T. grandissimum* during aestivalion.
Fig 5.3.d. Female red velvet mite *T. grandissimum* Koch.

Fig 5.4. Photograph showing the black ants and their eggs associated with red velvet mites niches.

Fig 5.5. *T. grandissimum* foraging in a field where cattle dungs are seen.
Fig 5.6. Aestivating male and female *T. Grandissimum* in which the hairs on the skin are fallen.

Fig 5.7. *T. Grandissimum* on foraging activity.

Fig 5.8. Mites are seen foraging in the field.
Fig 5.9. Red velvet mite attached to grass (a). Dead mites were eaten by different types of ants (b-c).
Fig. 5.10. Photograph showing a female mite moving towards the female (a). Female follow the sperm thread laid by a male mite (b).

Fig. 5.11. Female *T. grandissimum* laying eggs in masses.
Fig 5.12. Red velvet mite *T. grandissimum* feeding on *Termites, Odontoteres formosanus.*

Fig 5.13.a-c. Red velvet mite *T. grandissimum* is pouncing upon the prey termites with fully stretched out mouth parts (a-c).
Fig 5.14 (a-b) Red relvet mite, *T.grandissimum* sucking sap from grass