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Laboratory studies on biology of false spider mite, *Brevipalpus californicus*

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Abstract
The present investigation entitled 'Laboratory studies on Biology of False spider mite, *Brevipalpus californicus'* was conducted in the Acarology Laboratory, Department of Entomology, Assam Agricultural University, Jorhat during the year 2015 and 2016 This false spider mite belongs to the family Tenuipalpidae has been reported to cause extensive damage to the flowering crops like gerbera. They are called false spider mite because they do not spin web unlike other spider mite. The biology study was conducted at a temperature 22.5^{0}C±2^{0}C and relative humidity 80±2% on *Gerbera jamesonii*. Four distinct life stages of *B. californicus* were observed which pass through larva, protonymph, deutonymph and adult. The life cycle completed in 49.5-72.5 days.

Keywords: *Brevipalpuscalifornicus*, Tenuipalpidae, Biology, *Gerbera jamesonii*

1. Introduction
Tenuipalpidae, also called flat mites or false spider mites are a family of mites that are slow moving and feed on upper and lower surface of the leaf, but large number of them was found on the underside of the leaves and they aggregate along the vein. This destructive pest caused deformed, scorched and rough leaves. *Gerbera jamesonii* is one of the suitable host for false spider mite, *Brevipalpus californicus.* Yellow pale spots were seen on the leaves which later on turn brown. The false spider mite was present throughout the crop season causing eighty per cent infestation. They do not spin web on the leaves. The *B.californicus* has parthenogenetic (thelytokous) type of reproduction and hatches from egg. The life cycle of *B.californicus* consist of four active stages: larva, protonymph, deutonymph and adult.The total number of eggs laid by adult female ranged from 19-22.5 with an average of 1-2 numbers of eggs per female per day. The adult female lay eggs singly on the under surface of the gerbera leaves. Considering the substantial damage caused by the mite present investigation was carried out to manage the mite population at appropriate stage.

2. Materials and Methods
Brevipalpus californicus was reared at temperature 22.5^{0}C±2^{0}C and relative humidity 80±2% on *Gerbera jamesonii.* The method includes putting the gerbera leaves on mulberry leaves that were further placed on a foam tray saturated with water so that mites cannot moves out of the leaf arena. The gerbera leaf should be smaller than the mulberry leaf .The gerbera leaves were cut in square shape in such a way that each gerbera leaf contains one adult female. After egg laying the adults were removed and only the eggs were maintained in each leaves placed in the tray. To keep the humidity at constant limit, water was added when needed. At regular intervals mites were transferred to fresh leaves during the period of study as the gerbera leaf dries up easily (at two days interval). Upon oviposition, females were removed and only five eggs were maintained for taking observation on the life history of the mite. Incubation period was observed. Eggs per female per day and fecundity of female mite were recorded. To study the lifecycle, the time taken by the mite for its development from egg to adult and longevity of female adults were recorded. Ten observations were made for every parameter. All the observations were done under the stereo zoom binocular microscope at 4x magnification.

3. Results
a. Duration of Developmental stages
i. Fecundity and incubation period
The *B.californicus* has parthenogenetic (thelytokous) type of reproduction and hatches from egg. The total number of eggs laid by adult female ranged from 19-22.5 with an average of 1-2 numbers of eggs per female per day. The adult female lay eggs singly on the under surface of the gerbera leaves. The average incubation period was found to be 10.2±1.64 days. The eggs of *B.californicus*are round or oval in shape, shiny, orange red in colour. They generally prefer under side of the leaves to lay their eggs.

ii. Larval stage
a. Active larval stage
The newly hatched larvae are oval, wide, dark red in colour. Legs are not distinct in the larval stage. They move slowly as compared to the adults. The larvae are the almost the size of the eggs and have six legs at this stage. The average active larval duration was found to be 7.8±1.005 days.

b. Quiescent larval stage
This stage is physiologically active but they do not show any movement. The average quiescent larval stage was found to be 3.1±0.91 days.

iii. Protonymphal stage
a. Active protonymphal stage
Protonymph are wide, less oval and red in colour. The average active protonymphal duration was found to be 7.55±1.84 days.

b. Quiescent protonymphal stage
This stage is physiologically active but they do not show any kind of movement. The average duration was found to be 3.2±1.05days.

iv. Deutonymphal stage
a. Active deutonymphal stage
Deutonymph are wide and dark red. It is the last stage before the adult stage and it has eight legs. The average active deutonymphal duration was found to be 5.65±1.13 days.

b. Quiescent deutonymphal stage
This stage also like other quiescent stages is physiologically active but they do not show any kind of movement. They are sessile. The average duration was found to be 4.05±1.09 days.

v. Adult stage
Adults are flat, pear shaped with dark red pattern on the middle of the body. No males are present only females are present. Adults are morphologically different from the immature stages. The dorsal surface shows reticulation when observed under microscope. All the legs are well developed with two pairs of short legs at the front of the body and two pairs of short legs flanking the narrow abdomen. Adults are slow moving. The average duration of adult longevity was found to be 19.9±1.41 days. The total duration of life cycle was found to be 41.5±2.79 days.

Table 1: Duration of different developmental stages of false spider mite, *Brevipalpus californicus* under laboratory condition.

Stage	Pooled Mean (2015-16)	
	Range	**Mean±SD**
Incubation period (days)	8-12.5	10.2±1.64
Larval period (days)		
Active	6.5-9	7.8±1.005
Quiescent	2-4.5	3.1±0.91
Protonymphal period (days)		
Active	5.5-10	7.55±1.84
Quiescent	2.5-4	3.2±1.05
Deutonymphal period(days)		
Active	4.5-7.5	5.65±1.13
Quiescent	2.5-5	4.05±1.09
Adult longevity(days)		
Female	18-22.5	19.9± 1.41
Eggs/female/day	1-2	1.15±0.36
Total eggs/female	19-22.5	20.6±1.26
Duration of life cycle(days)	49.5-72.5	41.5± 2.79

Data are mean of 10 observations

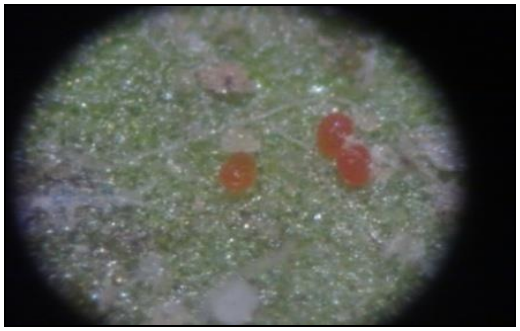

Fig 1: Egg

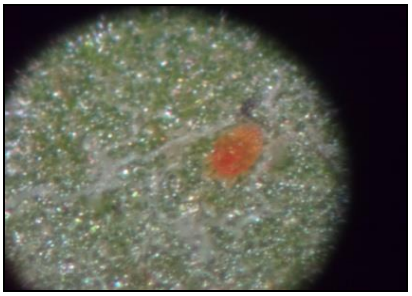

Fig 2: Larva

Fig 3: Adult

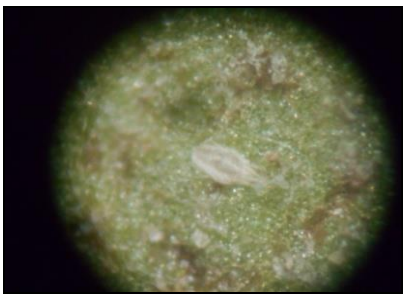

Fig 4: Remnant after hatching

4. Discussion
The life cycle of *Brevipalpus californicus*(Banks)was studied in the laboratory at temperature 22.5^{0}C±2^{0}C and RH 80±2%. A typical life cycle of *B. californicus* consist of four active stages (i.e larva, protonymph, deutonymph and adult). Between each active stage a quiescent developmental stage was observed. Similar findings were also reported by Childers *et al.* (2003) [2]

Duration of Developmental stage
The present study showed that the eggs are laid singly on the lower surface of the leaves and they remain attach to the leaf surface. Similar findings were reported by Oomen, (1982) [5] in tea. The eggs are round or oval in shape and shiny orange red in colour. Similar finding were also reported by Pritchard and Baker (1953) [6].The total number of eggs laid by adult female ranged from 19-22.5 with an average of 1-2 numbers of eggs per female per day. The average incubation period ranged from 8 to 12.5 days. The newly hatched larva was oval, wide and dark red. The active larval period ranged from 6.5 to 9 days. The average quiescent larval stage ranged from 2 to 4.5 days. Protonymph was wide, less oval and red in colour. The active protonymphal period ranged from 5.5 to 10 days. The average quiescent protonymphal stage ranged from 2.5 to 4 days. Deutonymph are wide and dark red in colour.It is the last stage before the adult and it has eight legs. The active deutonymphal period ranged from 4.5 to 7.5 days. The average quiescent deutonymphal stage ranged from 2.5 to 5

days. Adult are flat, pear shaped with dark red pattern on the middle of the body. No males are present only females are present. Similar findings were reported by Childers *et al*. (2001) [1] that thelytoky is commonly observed in *Brevipalpus* mite, since female offspring consist in females and rarely males are found. The average adult stage ranged from 18 to 22.5. Similar findings were reported by Manglitz and Cory (1953) [3] that duration of the developmental stages for *B. californicus* were 8.6 days for the larva, 6.2 daysfor the protonymph, 7.0 days for the deutonymph, and the quiescent stages required 3.6 days. Similarly Nehru and Bhagat (2006) [4] reported that incubation period of *B.californicus* varied from 5.5 to 10.3 days, active larval period ranged from 4.5 to 13.2 days, protonymphal and deutonymphal stage ranged from 2.9 to 7.9 and 2.8 to 8.7 days, quiescent period for each stage was 1.6 to 4.9 and 2.0 to 4.1 days respectively. These differences may be due to change in temperature, relative humidity and different host plants.

5. **Conclusion**

The false spider mite, *Brevipalpus californicus*undergo four life stages and also quiescent stages that were physiologically active but do not show any kind movement. They cause severe damage to flower crops as well as yield losses but they are neglected or mostly go unidentified for their minute size. Therefore their identification and thorough study is essential to combat the damages caused by them to different crops.

6. Acknowledgement

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