

Biology of *Tetranychus urticae* Koch (Acarina: Tetranychidae) on carnation under laboratory conditions

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ABSTRACT

Biology of *Tetranychus urticae* Koch was studied under laboratory at $27.79 \pm 4.40^\circ\text{C}$ temperature and 79 ± 5.75 per cent RH during Sept. 2008. The finding showed that life cycle of *T. urticae* consisted of five stages viz., eggs, larva, protonymph, deutonymph and adult and one short inactive stage called quiescent stage. The eggs incubation period of *T. urticae* was 3.29 ± 0.62 days. The larval body measured 0.14 ± 0.01 mm in length and 0.10 ± 0.01 mm in width and lived for 1.79 ± 0.64 days in male and 2.71 ± 0.57 days in female. The mature larva entered in a quiescent stage (nymphochrysalis). The total developmental period was longer in female (10.61 ± 1.21 days) as compared to male (8.44 ± 1.75 days). Mated female lived for longer time and laid higher number of eggs than unmated female. Mated female produced progeny consisting of both sexes, whereas, unmated female invariably gave rise to male progeny.

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INTRODUCTION

Carnation holds a prominent place among the cut flowers in Gujarat, India. It can be grown successfully under greenhouse conditions for ornament purposes and it has adequate market value. *Tetranychus urticae* Koch is a pest of greenhouse crops, including carnation (Kumar *et al.*, 1996). Both nymph and adult feed with chelicerate type mouthparts which pierce and suck the cell sap from epidermis of leaves. The leaf develops characteristic whitish or yellowish stippling. Heavy damage may cause carnation leaves turning first yellowish then bronze and the plant may be covered with webbing with stunting growth, reducing yield and quality of marketable flowers (Pal, 1966; Sandhu and Gupta, 1977). Hence, it was felt necessary to undertake studies on mite under poly house conditions. However, some

of this work of this species on carnation may be of importance for the knowledge of its biology and for future pest management programmes.

MATERIAL AND METHODS

Biology of the spider mite, *T. urticae* on carnation was carried out in Post Graduate Laboratory, Department of Agriculture Entomology, N.M. Collage of Agriculture, Navsari at 16.8°C to 32.3°C temperature (avg. $27.79^\circ \pm 4.40$) and 60.3 to 90.7 per cent relative humidity (avg. 79.84 ± 5.75 % RH) during the period of September-October, 2008. To ensure the availability of host plant (carnation) for biology study, the carnation cv. Beaumonde were raise in poly house and standard agronomic practices were followed.

A method described by Rodriguez (1953) and Gilstrap

(1977) of confining individual mite on leaf bit was adopted throughout the life span with little modification. The detail studies on the biology of mite was carried out on excised bits of carnation leaf kept upside down on wet filter paper overlying a wad of cotton in Petri dishes. Lanolin was applied on edges of the leaf to prevent the migration of mites. Water was added periodically so as to keep cotton saturated and maintain leaf disc in turgid condition. The leaf bits were replaced every alternate day to avoid leaf deterioration and consequent poor nutrition. The measurement of length and breadth of various stages was done under stereoscopic binocular microscope.

Fifty gravid females taken from mass culture were released on a fresh leaf in a Petri dish in the evening in order to collect the eggs. On next morning, the mites were removed from the leaf and eggs were counted and marked for subsequent development. The incubation period was recorded after egg hatching. The newly emerged hexapod larvae were carefully lifted and kept on the leaf bits (@ 1 larvae/leaf bit). Critical observations on behaviour, shape, size, colour as well as duration of different stages were made under stereo binocular microscope twice a day (8.00 a.m. and 4.00 p.m.) until the death of individual mite. For studying the fecundity, a pair of adult mites was separately released after emergence on the Petri plate having leaf bits. Similarly, the number of eggs laid by mated and unmated female were also recorded. Simultaneously, pre-oviposition, oviposition and post-oviposition periods were also recorded during the present study. The longevity of the male and mated and unmated female was also recorded.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under the following heads :

Biology :

The results on biology indicated that *T. urticae* passed

through a larval and two nymphal stages *viz.*, protonymph and deutonymph. Each of these feeding stages was followed by a short period of quiescent stage termed as nymphochrysalis, deutochrysalis and teleochrysalis. The details of mean length, width and developmental period of various stages of *T. urticae* are presented in Tables 1 and 2.

Egg:

The eggs were laid singly, mostly on the lower surface of leaves which were covered by webs later on giving the appearance of egg colony covered by webbings. Freshly laid eggs were smooth, soft, round and translucent white an average of 0.13 ± 0.01 mm in length. Later on the eggs turned brownish in colour. Two red spots on egg surface corresponding to simple eyes of the developing embryo were clearly visible under high magnification. On eclosion, the tiny larva from the upper end of the egg crawled by first loosened the egg's anterior margin at mid dorsal line with the help of chelicerae and pedipalp and later with two pairs of leg.

The incubation period ranged from 2.50 to 5 days with average of 3.36 ± 0.56 days. The shape, size, colour and pattern of eggs laying recorded under the study were more or less similar to finding of Sejalina *et al.* (1993) who reported egg size and incubation period of *T. cinnabarinus* on green gram and Singh and Singh (1993) reported the incubation period of *T. cinnabarinus* on lady's finger.

Larva:

The newly hatched six legged larvae were spherical, whitish straw colour and finally, it became dark green after feeding. Two bright prominent eye spots were evident on each side near the margin of dorsal propodosomal region over the second coxae. The body measured 0.14 ± 0.01 mm length and 0.10 ± 0.01 mm in width with the period of 1.79 ± 0.64 days in male and 2.79 ± 0.53 days in female. These findings are confirmed by the results of Mondal and Ara (2006) who recorded it on French bean, while Kasap (2004)

Stages	No. observed	Length (mm)			Width (mm)		
		Min.	Max.	Avg. \pm SD	Min.	Max.	Avg. \pm SD
Eggs	25	0.11	0.14	0.13 ± 0.01	-	-	-
Larvae	25	0.13	0.16	0.14 ± 0.01	0.08	0.11	0.10 ± 0.01
Nymphochrysalis	25	0.17	0.19	0.18 ± 0.01	0.10	0.12	0.11 ± 0.01
Protonymph	25	0.17	0.22	0.19 ± 0.01	0.11	0.13	0.12 ± 0.01
Deutochrysalis	25	0.18	0.23	0.22 ± 0.01	0.12	0.14	0.13 ± 0.01
Deutonymph	25	0.26	0.36	0.30 ± 0.03	0.12	0.18	0.14 ± 0.01
Teleochrysalis	25	0.25	0.38	0.37 ± 0.02	0.15	0.19	0.16 ± 0.02
Adult							
Male	25	0.36	0.47	0.41 ± 0.03	0.18	0.20	0.19 ± 0.01
Female	25	0.45	0.50	0.48 ± 0.01	0.20	0.24	0.22 ± 0.01

found similar type of finding on apple.

Nymphochrysalis:

The mature larva entered in quiescent stage by anchoring itself to the leaf surface. The colour was dark green. On an average, it measured 0.18 ± 0.01 mm in length and 0.11 ± 0.01 mm in width. The male quiescent stage lasted for 0.59 ± 0.35 day and 0.64 ± 0.35 day in female.

Protonymph:

The protonymph possessed four pair of legs, amber in colour when freshly formed and changed to greenish in colour after feeding. Two red spots were also observed on either side of cephalothorax. The sex could be distinguished in this

stage. The male protonymph had a roughly triangular body with pointed opisthosoma while the female had an ovoid body with broad opisthosoma. The length and width of protonymph were 0.19 ± 0.01 mm and 0.12 ± 0.01 mm, respectively. This stage lived for 2.54 ± 0.50 day in male and 2.97 ± 0.51 day in case of female.

Deutochrysalis:

As protonymph matured, it entered into quiescent stage by suspending all its activities of feeding and shrunken its body and legs and reduced in size. Thus, it was the second inactive stage in the development of this mite. The body measured 0.22 ± 0.01 mm in length and 0.13 ± 0.01 mm in width and the life period existed 0.73 ± 0.41 day in male

Table 2 : Life period of various stages of *T. urticae*

Stages	No. observed	Duration (days)			
		Minimum	Maximum	Avg. \pm S.D.	
Incubation period	35	2.50	5.00	3.36 ± 0.56	
Larval period	Male	14	1.00	2.50	1.79 ± 0.64
	Female	35	1.00	4.00	2.79 ± 0.53
Nymphochrysalis period	Male	14	0.20	1.20	0.59 ± 0.35
	Female	35	0.20	1.50	0.64 ± 0.35
Protonymphal period	Male	14	2.00	3.50	2.54 ± 0.50
	Female	35	2.00	4.00	2.97 ± 0.51
Deutochrysalis period	Male	14	0.20	1.40	0.73 ± 0.41
	Female	35	0.20	1.50	0.92 ± 0.43
Deutonymphal period	Male	14	1.00	3.00	2.11 ± 0.79
	Female	35	2.00	4.00	2.80 ± 0.63
Teleochrysalis period	Male	14	0.20	1.00	0.70 ± 0.26
	Female	35	0.30	1.10	0.77 ± 0.24
Total developmental period	Male	14	4.60	10.92	8.44 ± 1.75
	Female	35	8.49	14.14	10.89 ± 1.10
	Male	14	9.00	15.00	11.57 ± 1.79
Adult period	Unmated female	10	8.00	14.00	11.10 ± 2.07
	Mated female	35	10.00	16.00	12.60 ± 1.40
Pre-oviposition period	Unmated	10	2.00	6.00	3.15 ± 1.20
	Mated	35	2.00	5.00	2.69 ± 0.68
Oviposition period	Unmated	10	3.50	7.00	5.45 ± 1.34
	Mated	35	5.00	11.00	7.79 ± 1.68
Post-oviposition period	Unmated	10	1.00	4.00	2.20 ± 1.03
	Mated	35	1.00	7.00	2.26 ± 1.11
Rate of egg laying/females/day	Unmated	10	2.00	8.00	4.20 ± 1.81
	Mated	35	2.00	11.00	5.62 ± 1.36
Fecundity	Unmated	10	15.00	45.00	28.00 ± 10.60
	Mated	35	38.00	106.00	76.80 ± 16.38
Total life period	Male	14	18.60	24.20	22.28 ± 1.54
	Female	35	24.33	29.80	26.85 ± 1.15
Sex ratio: Bi-sexual	49		1: 2.5		
Sex ratio: parthenogenesis	45		100: 00		

0.92 ± 0.43 day in female.

Deutonymph:

The protonymph to the second stage is known as deutonymph. It was larger and broader being more plumpy than the protonymph. Two red spots either side of cephalothorax were also visible in this stage. Sexual dimorphism became perceptible after the development of palps and claws on the first pair of the legs. In addition to the pointed body, the male had light yellowish spots, while the female had dark grey colour spots. The length and width of deutonymph was 0.30 ± 0.03 mm and 0.14 ± 0.01 mm, respectively. This stage lasted for 2.11 ± 0.79 days in male and 2.80 ± 0.63 days in female.

Teleochrysalis:

The deutonymph stage was proceed by the quiescent stage before it moulted into an adult stage. It remained inactive by anchoring itself to leaf surface. The moulting of quiescent deutonymph resulted in the emergence of adult mite. It was measured 0.37 ± 0.02 mm in length and 0.16 ± 0.02 mm in width. The teleochrysalis period was observed 0.70 ± 0.26 days in male while, 0.77 ± 0.24 day in female. The period of development of spider mite from egg to adult inclusive of quiescent period was 8.44 ± 1.75 days and 10.89 ± 1.10 days for male and female, respectively. Hence, the male emerged as an adult a bit earlier than females in all cases and were observed to rest near or on the top of teleochrysalis or pharat female for her emergence.

Such less or more results for immature and developmental stages were also found in the findings of Singh and Singh (1993) for *T. cinnabarinus* on lady's finger, Sejalía *et al.* (1993) for *T. macfarlanei* on okra, Kasap (2004) for *T. urticae* on apple and Rajkumar *et al.* (2005) for *T. urticae* on jasmine.

Adult:

The newly emerged female was bright red in colour with broad body and blunt posterior ends; having four pair of legs on their propodosomal region of the body. Later, it changed to dark red with continuous feeding. The mature males had a narrow body with distinctly pointed abdomen when compared to female and the first pair of legs were longer than the fourth pair while, the second and third pairs were of similar size but shortest. They were rarely observed feeding and mostly found moving around or waiting near a quiescent female deutonymph (teleochrysalis). The average length and width of male were 0.41 ± 0.03 mm and 0.19 ± 0.01 mm, while of female were 0.48 ± 0.01 mm and 0.22 ± 0.01 mm, respectively. The mated female lived longer than male and unmated progeny. This valuation of bionomics was found accordance with the observations of Sejalía *et al.* (1993) for

T. macfarlanei and Singh and Singh (1993) for *T. cinnabarinus* on lady's finger.

Sexual behaviour:

Mating between male and female usually took place soon after shedding of the last nymphal skin. Male usually emerged a little bit earlier than female and were observed waiting near quiescent female deutonymph for her emergence. In the act of mating, the male crawled underneath the female from behind and raised the female opisthosoma slightly. Mating lasted for 2.5 to 4 minutes. A male has been observed to mate with 2 to 3 females.

Mated female produced progeny consisting of both the sexes, whereas unmated females invariably gave rise to male progeny. Thus, the spider mite, *T. urticae* reproduced both bisexually and parthenogenetically. The male to female ratio of bisexually reproduced population was worked out as 1: 2.5, while the sex ratio of parthenogenetically reproduced population found to be 100 per cent male. Almost similar sexual and mating behaviour has been reported in case of *T. macfarlanei* as reported by Sejalía *et al.* (1993).

Pre-oviposition period was longer for 2.69 ± 0.68 days in mated female and 3.15 ± 1.20 days in unmated female. Both sexual and parthenogenetic types of reproduction were found in *T. urticae* and the period of mated female was 7.79 ± 1.68 days, while in the unmated female it was 5.45 ± 1.34 days.

Fecundity:

The mated female laid 2.00 to 11.00 eggs per day and unmated female laid 2.00 to 8.00 eggs per day with an average of 4.20 ± 1.81 eggs per day. The average fecundity per mated female was 76.80 ± 16.38 eggs and unmated female fecundity was 15.00 to 45.00 eggs with an average of 28.00 ± 10.60 eggs. The post-oviposition period lasted for 2.26 ± 1.11 days and 2.20 ± 1.03 days in mated and unmated females, respectively.

These type of adults pre-fecundity and post-fecundity development is more or less in confirmation with the reports of Sejalía *et al.* (1993), Kasap (2004), Rajkumar *et al.* (2005) and Sekhar *et al.* (2008).

The total life period occupied by *T. urticae* varied from 18.60 to 24.20 days with average of 22.28 ± 1.54 days in male and 24.33 to 29.80 (avg. = 26.85 ± 1.15) days in female at the room temperature during Sept.–Oct., 2008. Kasap (2004) reported the total life period for female varied from 29.9 ± 1.50 days and 25.9 ± 1.44 days for male of *T. urticae* on apple, respectively.

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