

BIOLOGY OF RED SPIDER MITE (*Tetranychusurticae*) KOCH ONBRINJAL

ABSTRACT

Red spider mite, *Tetranychusurticae* Koch passed through five stages viz., egg, larva, protonymph, deutonymph and adult with three short resting stage known as quiescent stages which termed as nymphochrysalis, deutochrysalis and teleiochrysalis. The incubation period of egg was 3.28 ± 1.10 days with 0.13 ± 0.01 mm diameter in size. The average length and breadth of larva, nymphochrysalis, protonymph, deutochrysalis, deutonymphs, teleiochrysalis, adult male and adult female stage were 0.14 ± 0.01 and 0.10 ± 0.01 , 0.19 ± 0.01 and 0.12 ± 0.01 , 0.20 ± 0.01 and 0.12 ± 0.01 , 0.24 ± 0.02 and 0.13 ± 0.01 , 0.29 ± 0.02 and 15 ± 0.02 , 0.35 ± 0.03 and 0.18 ± 0.01 , 0.43 ± 0.04 and 0.19 ± 0.01 and 0.47 ± 0.02 and 0.22 ± 0.01 mm, respectively. The mean duration of male and female larva, nymphochrysalis, protonymph, deutochrysalis, deutonymphs, teleiochrysalis and adult was 2.07 ± 0.73 and 2.36 ± 0.22 , 0.58 ± 0.32 and 0.68 ± 0.22 , 2.23 ± 0.35 and 2.92 ± 0.81 , 0.70 ± 0.35 and 0.76 ± 0.39 , 2.12 ± 0.44 and 2.56 ± 0.51 , 0.77 ± 0.19 and 0.87 ± 0.37 and 7.12 ± 0.93 and 11.08 ± 0.86 days, respectively. Female of *T. urticae* occupied 2.48 ± 0.96 , 5.32 ± 0.99 and 2.35 ± 0.84 days as pre-oviposition, oviposition and post-oviposition period, respectively. Total life period of male and female was 19.14 ± 2.06 and 23.85 ± 1.65 days, respectively. The average fecundity and hatching percentage were 47.60 ± 6.13 days and 91.11 ± 4.14 per cent, respectively with 1 : 2.50 sex ratio.

Keywords: *Tetranychusurticae*, egg, larva, nymphochrysalis, protonymph, deutochrysalis, deutonymphs, teleiochrysalis, adult, morphometrics, size, duration

INTRODUCTION

Mite is microscopic creature belong to the class Arachnida and sub-class Acari. It classified as predatory, parasitic, phytophagous and stored product mite on the basis of their feeding habit. The red spider mite, commonly referred to as *Tetranychusurticae*, is a notorious agricultural pest known for its significant impact on a wide range of crops and ornamental plants. Characterized by its tiny size and its distinctive red or orange coloration, this mite feeds on plant sap, causing stippling and discoloration of leaves. Its preference for warm, dry environments and rapid

reproduction make it a formidable pest, leading to reduced crop yields and plant health. Members of the family Tetranychidae are the major crop pests worldwide. Study on biology of red spider mite, *T. urticae* carried out under laboratory condition at Department of Agricultural Entomology, Chimanbhai Patel College of Agriculture, SardarkrushinagarDantiwada Agricultural University, Sardarkrushinagar during September to November, 2021. For that different life stages of red spider mite, *T. urticae viz.*, egg, larva, nymphochrysalis, protonymph, deutochrysalis, duetonymph, teleiochrysalis and adult observed critically and their measurement and duration.

MATERIAL AND METHODS

To study the different biological attributes of *T. urticae* the research work was carried out in the laboratory of the Agricultural Entomology, Chimanbhai Patel College of Agriculture, SardarkrushinagarDantiwada Agricultural University, Sardarkrushinagarduring the year 2021-2022. Fifteen pairs of mite were collected with the help of fine camel hair brush from infested plants and released on brinjal leaves kept in Petri dish separately. To maintain turgidity of leaf wet cotton was used in Petri dish. The adults were removed from Petri dish after three days as sufficient numbers of eggs were laid. The eggs were allowed to hatch. Thus, a pure culture of *T. urticae* was raised for mass culturing. The mite individuals were transferred from old to fresh leaf evenly 2 days. The stock culture was maintained throughout the study tenure(Plate I).

Leaf bit technique

The leaf bit technique was used for rearing the mite, *T. urticae* on brinjal. Each leaf bit (2 cm × 2 cm) was placed on a filter paper having wet cotton swab at bottom in a glass Petri dish. Water was sprinkled periodically to maintain turgidity of leaf bits. The leaf bits were replaced on every alternate day to meet nutritional requirement(Plate I). The mites obtained from mass culture were used for the further study under stereoscopic binocular microscope. Measurement on length and breadth of different life stages *viz.*, egg, larva, nymphochrysalis, protonymph, deutochrysalis, deutonymph, teleiochrysalis and adult were recorded with the help of a stereozoom microscope (Euromax software).

RESULT AND DISCUSSION

Study on biology of red spider mite, *T. urticae* carried out under laboratory condition at Department of Agricultural Entomology, Chimanbhai Patel College of Agriculture, SardarkrushinagarDantiwada Agricultural University, Sardarkrushinagar during September to November, 2021. For that different life stages of red spider mite, *T. urticae viz.*, egg, larva, nymphochrysalis, protonymph, deutochrysalis, duetonymph, teleiochrysalis and adult observed critically and their measurement and duration were presented in Table 1 and 2, respectively and graphically depicted in Figure 1.

Egg

The eggs were smooth, soft, spherical, translucent white in colour and laid singly, mostly on the lower surface of leaves. Just before hatching the egg turned brownish in colour(Plate II). Two red spot on egg surface corresponding to simple eyes of the developing embryo were clearly visible under high magnified microscope. The diameter of egg ranged between 0.11 and 0.14 mm with an average of 0.13 ± 0.01 mm. The incubation period of *T. urticae* varied from 2.00 to 5.00 (Av. 3.28 ± 1.10 days).

Satishet *al.* (2018) and Siddhpara and Virani (2018) who recorded that the freshly laid eggs were smooth, spherical in shape and translucent white in colour laid singly on under surface of leaf. Egg diameter of *T. urticae* ranged between 0.101 and 0.162 (Av. 0.130 ± 0.002 mm). The incubation period of *T. urticae* was 3.92 ± 0.41 days. The variation in the incubation period of *T. urticae* might be due to different food on which *T. urticae* reared and environmental condition of the locations.

Larva

The newly hatched larva possessed three pair of legs, spherical in shape and whitish straw in colour. Later it became elongated, pale yellow in colour and developed greenish shade on the body. Two bright prominent eye spots appeared on each side near the margin of dorsal propodosomal region (Plate II). The length and width of larva of *T. urticae* was ranged from 0.13 to 0.15 (Av. 0.14 ± 0.01 mm) and 0.09 to 0.12 (Av. 0.10 ± 0.01 mm), respectively. The larval duration ranged from 1.00 to 3.00 (Av. 2.07 ± 0.73 days) in case of male and 2.00 to 4.00 (Av. 2.36 ± 0.22 days) in case of female of *T. urticae* when reared on brinjal.

Siddhpara and Virani (2018) observed that newly emerged larva of *T. urticae* was spherical in shape, creamy in colour with two prominent red spots on the dorsal

propodosomal region. Patil *et al.* (2014) recorded that the length and breadth of *T. urticae* larva was 0.14 ± 0.01 and 0.10 ± 0.01 mm, respectively. Thus, the findings of above workers are in closely supported the results obtained during present findings.

Nymphochrysalis (First quiescent stage)

The mature larva entered in quiescent stage by anchoring itself with the leaf surface. The front two pairs of legs projected forward and the hind pair projected backward held closed to the body (Plate III). During this stage, the mite suspended its all activity of feeding. In the act of moulting, integument split transversely from mid line of body and posterior portion came out first and pulled out anterior body portion afterward where white exuviae remained attached to the leaf surface. The length and breadth of nymphochrysalis stage ranged from 0.17 to 0.21 (Av. 0.19 ± 0.01 mm) and 0.10 to 0.13 (Av. 0.12 ± 0.01 mm), respectively. The duration of male and female nymphochrysalis stage varied from 0.20 to 1.00 (Av. 0.58 ± 0.32 days) and 0.20 to 1.00 (Av. 0.68 ± 0.22 days), respectively when reared on the brinjal.

In past, Satishet *al.* (2018) and Siddhapara and Virani (2018) also reported that larva stopped feeding and moved to a suitable place on the leaf and entered into first quiescent stage. Nymphochrysalis stage measured as 0.18 ± 0.01 mm in length and 0.12 ± 0.01 mm in breadth. The duration of nymphochrysalis stage from 0.55 to 0.71 and 0.59 to 0.83 days for male and female, respectively. Thus, the findings documented by above workers are closely related with the observations of present study.

Protonymph (First nymphal stage)

The protonymph was oblong to oval in shape and possessed four pair of legs, amber in colour when freshly formed and changed to greenish post feeding. Two red spots were present on either side of cephalothorax. The dark specks were present on the dorsum. It was slightly bigger in size than the larval stage (Plate II). The length and width of protonymph stage ranged from 0.18 to 0.23 (Av. 0.20 ± 0.01 mm) and 0.11 to 0.14 (Av. 0.12 ± 0.01 mm), respectively. The duration of protonymphal stage ranged between 1.00 and 3.00 (Av. 2.23 ± 0.35 days) in case of male and 2.00 to 4.00 (Av. 2.92 ± 0.81 days) in case of female.

In past, Patil *et al.*, (2014) and Reddy and Rajasekar (2017) observed that the newly emerged protonymph was oval shaped and greenish in colour, length and width

of protonymph stage of mite as 0.19 ± 0.01 mm and 0.12 ± 0.01 mm, respectively. Protonymph duration of *T. urticae* was 2.54 ± 0.50 days in male and 2.97 ± 0.51 days in female, which clearly supported the findings of present research work.

Deutochrysalis (Second quiescent stage)

Matured protonymph stage again entered into the quiescent stage second time. The fore and middle pair of leg projected forward and the hind pair of leg projected backwards and held close to the body. This stage became inactive and suspended all the activities and remained anchored to the leaf surface. It contracted the body and reduced in size (Plate III). The perusal of data on length and width of deutochrysalis stage indicated that the length and width of deutochrysalis stage was ranged between 0.19 and 0.25 mm (Av. 0.24 ± 0.02 mm) and 0.12 to 0.15 mm (Av. 0.13 ± 0.01 mm), respectively. The duration of deutochrysalis male and female varied from 0.20 to 1.00 (Av. 0.70 ± 0.35 days) and 0.20 to 1.20 (Av. 0.76 ± 0.39 days), respectively.

The present results are in conformity with the findings of Siddhapara and Virani (2018) who observed the similar behaviour of deutochrysalis stage as second quiescent stage of *T. urticae*, length and width of deutochrysalis stage as 0.22 ± 0.02 and 0.13 ± 0.01 mm, respectively and duration of deutochrysalis stage of male and female *T. urticae* consumed 0.74 ± 0.42 and 0.96 ± 0.42 days, respectively.

Deutonymph (Second nymphal stage)

The deutonymph stage found larger and broader in shape and size than the protonymph. Initially, the moulted deutonymph looked amber coloured and later turned to reddish in colour. Two red spots on either side of cephalothorax were clearly visible (Plate II). The size of deutonymphal stage was 0.25 to 0.31 (Av. 0.29 ± 0.02 mm) in length and 0.13 to 0.18 (Av. 0.15 ± 0.02 mm) in width. The duration of deutonymph was varied from 1.00 to 3.00 (Av. 2.12 ± 0.44 days) in male and 2.00 to 4.00 (Av. 2.56 ± 0.51 days) in case of female.

The present findings are in conformity with the results recorded by Reddy and Rajasekar (2017), Satish *et al.* (2018) and Siddhapara and Virani (2018) who observed that newly emerged deutonymphal stage was red in colour and larger in body size compared to protonymph.

Teleiochrysalis (Third quiescent stage)

The deutonymph stage entered in quiescent stage before moulting to adult stage. The fore and two middle pair of legs projected forward and the hind pair projected backward and held tight with the body. This stage remained inactive, suspended all

the activities and anchored to leaf surface (Plate III). The moulting of teleiochrysalis resulted in the emergence of adult stage. Thus, it was recorded as the third quiescent stage in the life cycle of mite, *T. urticae*. The length and width of teleiochrysalis stage varied from 0.29 to 0.38 (Av. 0.35 ± 0.03 mm) and 0.15 to 0.19 (Av. 0.18 ± 0.01 mm), respectively. The duration of teleiochrysalis stage ranged from 0.40 to 1.00 (Av. 0.77 ± 0.19 days) in male and female it lasted for 0.50 to 1.40 days (Av. 0.87 ± 0.37 days).

In past, Reddy and Rajasekar (2017) and Satishet *al.* (2018) also observed the similar features of teleiochrysalis stage which conformed the results of present findings.

Total developmental period

The period of development of red spider mite from egg to emergence of adult was considered as total developmental period. It was ranged from 5.00 to 10.00 (Av. 8.76 ± 1.16 days) in male and 7.00 to 12.00 (Av. 10.45 ± 1.58 days) in female adult.

In past, Siddhapara and Virani (2018) recorded the total development period of *T. urticae* as 7.81 \pm 1.40 days for male and 10.66 \pm 1.28 days for female when reared on okra. Thus, the little variation found in the total developmental period might be due to hosts on which *T. urticae* reared.

Pre-oviposition, oviposition and post-oviposition period

The duration between the emergence of female and commencing egg laying considered as pre-oviposition period. This period was 1.00 to 3.00 days with an average of 2.48 ± 0.96 days. The period of commencing of egg laying till the ceasing of egg laying considered as oviposition period. It was lasted from 3.00 to 6.00 days with an average of 5.32 ± 0.99 days. The period between ceasing of egg laying and death of the adult female considered as post-oviposition period. The post-oviposition period ranged from 1.00 to 3.00 days with an average of 2.35 ± 0.84 days in *T. urticae*.

In past, Patil *et al.* (2014) who reported that the pre-oviposition, oviposition and post-oviposition duration in *T. urticae* were 2.69 ± 0.68 , 7.79 ± 1.68 and 2.20 ± 1.03 days, respectively. Thus, the results extracted during present study on pre, post and oviposition period of *T. urticae* was clearly in association with the finding of above workers.

Adult

The newly emerged female was oval in shape, bright red in colour with broad body and blunt posterior end having four pairs of legs on propodosomal region. Later it turned to dark after continuous feeding. The matured male found lighter in colour with narrow body and distinctly pointed abdomen compared to female (Plate II). The length and width of male ranged from 0.39 to 0.47 (Av. 0.43 ± 0.04 mm) and 0.17 to 0.20 (Av. 0.19 ± 0.01 mm, respectively). While, it was 0.44 to 0.50 (Av. 0.47 ± 0.02 mm) and 0.19 to 0.24 (Av. 0.22 ± 0.01 mm), respectively in female when reared on brinjal host. The duration of male and female of *T. urticae* varied from 5.00 to 8.00 (Av. 7.12 ± 0.93 days) and 10.00 to 12.00 (Av. 11.08 ± 0.83 days), respectively. The observations recorded during present investigation clearly confirmed the findings with Reddy and Rajasekar (2017) and Satishet *al.* (2018).

Total life span

The total life span occupied by *T. urticae* was varied from 16.00 to 23.00 (Av. 19.14 ± 2.06 days) in male and 18.00 to 29.00 (Av. 23.85 ± 1.65 days) in female.

Patil *et al.* (2014) reported that the total life period of male and female of *T. urticae* was 22.28 ± 1.54 and 26.85 ± 1.15 days, respectively when reared on carnation. Thus, the results recorded by above workers are more or less similar with the present findings.

Fecundity

The rate of egg laying per female was varied from 38 to 54 eggs/female with an average of 47.60 ± 6.13 eggs/female.

In past, Meena *et al.* (2013) reported that a female of *T. urticae* laid 36 to 52 (Av. 44.53 ± 2.71 eggs/female). Thus, the results recorded by above workers are more or less in accordance with the findings of present study.

Hatching (%)

Hatching per cent of *T. urticae* was varied from 84.91 to 96.72 per cent with an average of 91.11 ± 4.14 per cent.

In past, Siddhpara and Virani (2018) observed the hatching per cent of *T. urticae* from 83.33 to 97.67 (Av. 91.06 ± 3.84 per cent) when reared on okra. Thus, the results obtained during present study are in close association with that observed by above worker.

Sex ratio

The male to female sex ratio of *T. urticae* was 1:2.50 during the period of investigations when reared on brinjal.

In past, Siddhapara and Virani (2018) calculated the sex ratio of *T. urticae* as 1:2.55. Thus, the results documented by above workers on male to female sex ratio of *T. urticae* are highly uniform with the findings of present study.

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Table 1: Measurement of life stages of *T. urticae* reared on brinjal

Stage		Diameter (mm)					
		Minimum		Maximum		Av. ± S.D.	
Egg		0.11		0.14		0.13 ± 0.01	
Larva		Length (mm)			Width (mm)		
		Minimum	Maximum	Av. ± S.D.	Minimum	Maximum	Av. ± S.D.
		0.13	0.15	0.14 ± 0.01	0.09	0.12	0.10 ± 0.01
Nymph	Nymphochrysalis	0.17	0.21	0.19 ± 0.01	0.10	0.13	0.12 ± 0.01
	Protonymph	0.18	0.23	0.20 ± 0.01	0.11	0.14	0.12 ± 0.01
	Deutochrysalis	0.19	0.25	0.24 ± 0.02	0.12	0.15	0.13 ± 0.01
	Deutonymph	0.25	0.31	0.29 ± 0.02	0.13	0.18	0.15 ± 0.02
	Teleiochrysalis	0.29	0.38	0.35 ± 0.03	0.15	0.19	0.18 ± 0.01
Adult	Male	0.39	0.47	0.43 ± 0.04	0.17	0.20	0.19 ± 0.01
	Female	0.44	0.50	0.47 ± 0.02	0.19	0.24	0.22 ± 0.01

Table 2: Duration (day) of life stages of *T. urticae* reared on brinjal

Stages		Minimum	Maximum	Av. \pm S.D.	
Egg		2.00	5.00	3.28 \pm 1.10	
Larva	Male	1.00	3.00	2.07 \pm 0.73	
	Female	2.00	4.00	2.36 \pm 0.22	
Nymph	Nymphochrysalis	Male	0.20	1.00	0.58 \pm 0.32
		Female	0.20	1.00	0.68 \pm 0.22
	Protonymph	Male	1.00	3.00	2.23 \pm 0.35
		Female	2.00	4.00	2.92 \pm 0.81
	Deutochrysalis	Male	0.20	1.00	0.70 \pm 0.35
		Female	0.20	1.20	0.76 \pm 0.39
	Deutonymph	Male	1.00	3.00	2.12 \pm 0.44
		Female	2.00	4.00	2.56 \pm 0.51
	Teleiochrysalis	Male	0.40	1.00	0.77 \pm 0.19
		Female	0.50	1.40	0.87 \pm 0.37
	Total development	Male	5.00	10.00	8.76 \pm 1.16
		Female	7.00	12.00	10.45 \pm 1.58
Adult	Pre-oviposition		1.00	3.00	2.48 \pm 0.96
	Oviposition		3.00	6.00	5.32 \pm 0.99
	Post oviposition		1.00	3.00	2.35 \pm 0.84
	Adult longevity	Male	5.00	8.00	7.12 \pm 0.93
		Female	10.00	12.00	11.08 \pm 0.86
	Total life span	Male	16.00	23.00	19.14 \pm 2.06
		Female	18.00	29.00	23.85 \pm 1.65
	Fecundity (Eggs/female)		38.00	54.00	47.60 \pm 6.13
	Hatchability (%)		84.91	96.72	91.11 \pm 4.14
Sex ratio (Male : Female)		1:2.50			

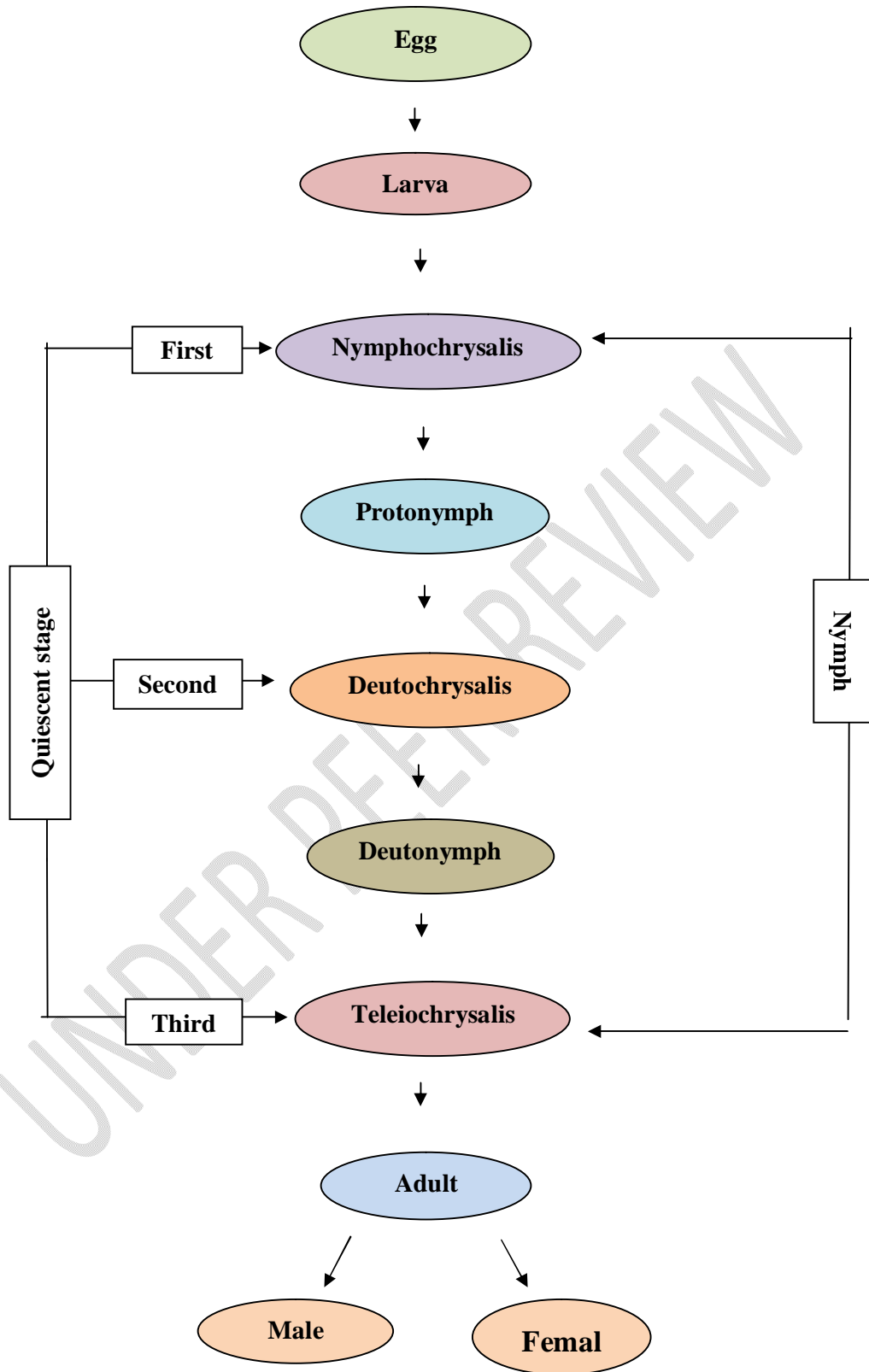


Figure 1: Schematic diagram of life stages of *T. urticae*



A. Mother culture

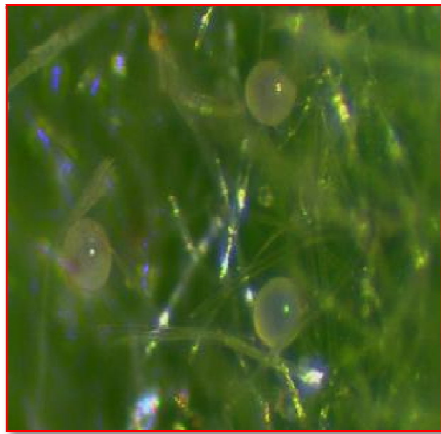


B. Mass culture



C. Leaf bit rearing technique

Plate I: Rearing technique of *T. urticae* on brinjal



Eggs



Larva



Protonymph

Nymph



Deutonymph



Female

Adult



Male

Plate II: Active life stages of *T. urticae*



Nymphochrysalis(Between larva and protonymphal stage)



Deutochrysalis(Between protonymph and duetonymphal stage)



Teleiochrysalis(Between duetonymph and adult stage)

Plate III: Resting life stages of *T. urticae*

UNDER PEER REVIEW