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On the Biological Aspects of *Tetranychus macfarlanei* (Acari : Tetranychidae) Infesting Okra (*Abelmoschus esculentus*) in South Gujarat

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ABSTRACT

The life cycle of *Tetranychus macfarlanei* Baker and Pritchard was studied in laboratory, Department of Entomology, Gujarat Agricultural University, Navsari during March-April, 1989 (Av. 27.67°C & 60.45% RH) and July-August (Av. 29.67°C and 87.30% RH). The span of the various stages varied during different seasons. The low temperature and relative humidity during March-April prolonged the developmental period, whereas relatively high temperature and relative humidity had shorten the duration. Increased fecundity and rate of egg laying were observed after the mating despite the fact that unmated female oviposited for a longer time. While studing the life table of the mite at 29.67°C & 87.30% RH, the net reproductive rate (Ro), the mean generation time (T), the innate capacity for increase in number (rm) and the finite rate of increase (λ) were worked out : 30.3744 times, 12.037 days, 0.2836 and 1.328 per day, respectively.

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INTRODUCTION

Tetranychus macfarlanei Baker and Pritchard has recently been recorded on cotton, vegetable crops and several weed plants in South and Central Gujarat (Jose and Shah, 1989), it was observed abundant on *okra* during summer 1989. It generally prefers the lower side of the leaf. Feeding leads to the appearance of chlorotic spots which mearge to form bigger patches. Biology of some species of *Tetranychus* have been reported in the past (Boudreaux, 1963; Laing, 1969 and Puttaswamy and Channabasavanne, 1979). Very little information is available on bionomics of *T. macfarlanei*, therefore, studies were undertaken on biology and life table of this pest.

MATERIALS AND METHODS

Initially, *T. macfarlanei* was collected from *okra* plant of Research Farm, Gujarat Agricultural University, Navsari and reared continuously in laboratory on *okra* leaves to have pure mass culture and constant supply of materials for different studies. The life cycle was studied in laboratory at room temperature and humidity conditions (an average of 27.53°C and 60.45% RH during March-April and an average of 29.67°C and 87.30% RH during July-August). First of all, thirty adult females taken from stock culture were released on *okra* leaves in the morning in order to collect eggs for the study. Next day morning, the number of eggs laid by these mites were counted and marked

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for subsequent development and adults were removed from the leaf. Beginning with these eggs, the detail studies on biology of this mite were carried out on excised bit of *okra* leaf (size - 1.5 x 1.5 cm) kept on water soaked filter paper (7 x 5 cm) overlying a little mass of wet cotton (size 8 x 6 x 0.4 cm) in Petri dish (15 cm. diameter and 1 cm. height). The method of retaining individual mite on *okra* leaf bit was adopted throughout the life span. Water was added periodically so as to keep cotton saturated and maintain leaf bits in turgid condition. The leaf bits were replaced every alternate day to avoid leaf deterioration and consequent poor nutrition. After egg hatching, the newly emerged hexopod larvae were lifted carefully with the help of zero number fine camel hair brush and kept on leaf bits at the rate of one larva per leaf bit. Observation were made twice a day for developmental stages, and once, when adults were persent. In rare occasions, some mites drowned in water and died before completing their life cycle, such sets were discarded under the study from that stage. The fecundity was worked out by nothing total number of eggs laid by an individual adult female mite during her life span. During oviposition, eggs laid were crushed to avoid recounting. Duration and behaviour of various stages, sex ratio and parthenogenesis were also studied. A standardized occular micrometre fitted to a stereoscopic microscope was used for measuring various stages.

To determine the effect of mating and influence of female age on egg laying, the same method of retaining individual mite kept on leaf bits overlying a wad of cotton in petri dish was employed. Leaf bits were replaced every alternate day. For the purpose, a teleochrysalis female (quescent female dentonymph) was placed singly on leaf bit and no males were provided. In another case, two males were provided to fartilize the female since their emergance as an adult. Twelve sets each for female

TABLE 1

Morphometric differences of various stages of *Tetranychus macfarlanei**

Stage	*Length (mm)*			*Width (mm)*		
	Max.	*Min.*	*Av. ± S. D.*	*Max.*	*Min.*	*Av. ± S. D.*
1.	*2.*	*3.*	*4.*	*5.*	*6.*	*7.*
Egg**	0.13	0.12	0.127 ± 0.005			
Larva	0.18	0.16	0.175 ± 0.0071	0.13	0.12	0.129 ± 0.0032
Protonymph	0.26	0.23	0.25 ± 0.0105	0.16	0.15	0.156 ± 0.0052
Deutonymph	0.38	0.33	0.364 ± 0.0217	0.21	0.19	0.203 ± 0.0082
Adult						
Male	0.38	0.35	0.362 ± 0.0132	0.21	0.20	0.206 ± 0.0052
Female	0.42	0.40	0.411 ± 0.0086	0.25	0.23	0.243 ± 0.0095

* Average of 25 observations.

** Measurement in diameter.

without male (unmated) and female with male (mated) were prepared. The number of eggs laid by each virgin female (unmated) and mated female was recorded daily. In the later group of mites, the progeny contained female indicating that mating was followed by fertilization as unmated female invariably gave rise to male progeny. Male emerges a bit earlier as an adult than female.

A life table was worked out in laboratory during July-August (av. 29.67°C and 87.30% R.H.). Initially, sixty adult females were released on *okra* leaves. Next morning, mites were removed and eggs counted. Subsequent observations on their hatching and on the emergence of larva, nymph and adult and their survival at each age interval were made. To determine the age specific fecundity (mx), females (50) emerged on the same day were transferred to new *okra* leaves and reared singly. Eggs laid on subsequent days were recorded. Studies continued till all female died. The data were analysed according to the formule given by Atwal and Bains (1974).

RESULTS AND DISCUSSION

Developmental stage

Both sexes of *T. macfarlanei* consisted of egg, larva, protonymph, deutonymph and adult. At the end of the larval and each nymphal instar, there was a short quiscent phase in which mites anchored and moulted to the succeeding stage. Usually this behaviour is normal and common to all tetranychids. Eggs were laid singly generally on the lower side of the leaf alongwith midrib. They were spherical, translucent white when freshly laid, later changing to light yellow and finally to brackish brown. Hatching varied from 91.43 to 97.26 per cent. Larvae were less active than protonymphs which in turn were less active than deutonymph.

Developmental period

The span of various stages varied during different seasons. The key factor affecting the life span seemed to be the variation in temperature and humidity. In March-April, incubation period for male & female was 4.31 ± 0.46 days, while it was 3.06 ± 0.23 days during July-August when relativeiy higher temperature and humidity prevailed. Similarly, the duration of various developmental stages was prolonged during March-April as compared to July-August. Combind larval-nymphal period was 5.69 ± 1.55 days for male and 6.13 ± 0.41 days for female during March- April, while it was 4.30 ± 0.39 days and 5.07 ± 0.23 days, for respective sexes, during July-August. Hence, the males emerged earlier than the females and were found near the teleochrysalis female. This behaviour increases the probobility of mating and might enhance the reproductive potential under natural conditions. Similar impact of low temperature in extending the developmental period and the duration of various stages has also been reported among tetranychids (Shih and Sheih, 1978; Puttaswamy and Channabasavanna, 1979 and Jose and Shah, 1989).

Adult stage

The male was slightly pinkish and smaller than the female. The body was narrow with a pointed abdomen. It lived longer during July-August (11.2 ± 3.71 days) than during March-April (4.31 ± 0.88 days). The female was bright red having dark patches on the dorsum, and survived for 15.27 ± 4.00 and 11.36 ± 3.62 days during respective seasons.

TABLE 2

Duration of various developmental stages, adult period and ovipositional period of okra mite, *Tetranychus macfarlanei.*

Stage		*March-April*		*July-August*	
		No. observed	*Av.* ± S.D.	*No. observed*	*Av.* ± S.D.
1.		*2.*	3.	*4.*	5.
Incubation period	Male				
	Female	145	4.31 ± 0.46	75	3.06 ± 0.23
Larval period	Male	17	2.27 ± 0.24	20	0.98 ± 0.42
	Female	42	2.36 ± 0.35	34	1.13 ± 0.34
Nymphochrysalis	Male	17	0.54 ± 0.25	20	0.65 ± 0.21
	Female	42	0.66 ± 0.25	32	0.70 ± 0.81
Protonymphal period	Male	17	1.16 ± 0.32	20	0.86 ± 0.24
	Female	36	1.18 ± 0.31	26	0.96 ± 0.14
Deutochrysalis period	Male	17	0.43 ± 0.25	20	0.35 ± 0.21
	Female	36	0.65 ± 0.23	26	0.39 ± 0.26
Deutonymphal period	Male	17	0.06 ± 0.27	20	0.75 ± 0.20
	Female	36	0.69 ± 0.52	22	1.27 ± 0.38
Teleochrysalis period	Male	17	0.56 ± 0.27	20	0.66 ± 0.39
	Female	36	0.67 ± 0.28	22	0.50 ± 0.33
Combined larval-nymphal period	Male	17	5.69 ± 1.55	20	4.30 ± 0.39
	Female	36	6.13 ± 0.41	22	5.07 ± 0.23
Adult period	Male	17	4.31 ± 0.88	20	11.20 ± 3.71
	Female	22	11.30 ± 3.62	22	15.27 ± 4.00
Pre -oviposition period	Unmated	28	1.24 ± 0.39	22	0.71 ± 0.15
	Mated	–	–	12	1.83 ± 0.75
Oviposition period	Unmated	23	6.04 ± 3.13	22	13.09 ± 4.61
	Mated	–	–	12	12.67 ± 2.52
Post-oviposition period	Unmated	22	3.91 ± 0.92	22	2.73 ± 1.19
	Mated	–	–	12	2.33 ± 0.68
Rate of egg laying/ female/ day	Unmated	22	4.62 ± 1.18	22	5.28 ± 0.27
	Mated	–	–	12	5.96 ± 4.05
Fecundity	Unmated	23	25.78 ± 10.63	22	44.64 ± 18.77
	Mated	–	–	12	69.00 ± 27.88
Egg to egg generation period		26	10.69 ± 0.68	22	8.77 ± 0.08
Mean temperature (0)		–	27.53	–	29.67
Mean relative humidity (%)		–	60.45	–	80.30

Mating

Mating was observed soon after the emergence. The male slipped underneath the female and arched its opisthosomal region upward to bring aedegous in contact with female genital opening. The mating lasted 1-2 minutes. Similar mating behaviour was observed in *T. ludeni* (Puttaswamy and Channabasavanna, 1979).

Oviposition period and fecundity

Oviposition period, fecundity and the rate of egg-laying for mated female was recorded only during July-August. Fecundity and the rate of egg laying following mating increased despite the fact that the unmated female oviposited for longer period. Comparatively lower fecundity (25.78 ± 10.63 eggs) and fecundity rate (4.62 ± 1.18 eggs/days) and longer preoviposition period (1.24 ± 0.39 days) were recorded for unmated female during March-April (at low temperature and humidity). The generation period (egg to egg) was 10.69 ± 0.68 days during March-April, while it was 8.77 ± 0.08 days during July-August. Jose and Shah (1989) recorded increased fecundity following the decrease of temperature which is in contrast to the present findings. Some of the comparable reports on oviposition and fecundity are reported in case of *T. cinnabarinus* (Shih and Sheih, 1978) and *T. ludeni* (Puttaswamy and Channabasavanna, 1979).

Sex ratio

Male to female sex ratio was 1:6.5 parthenogenetically reproduced population gave 100 per cent males. Effect of mating and

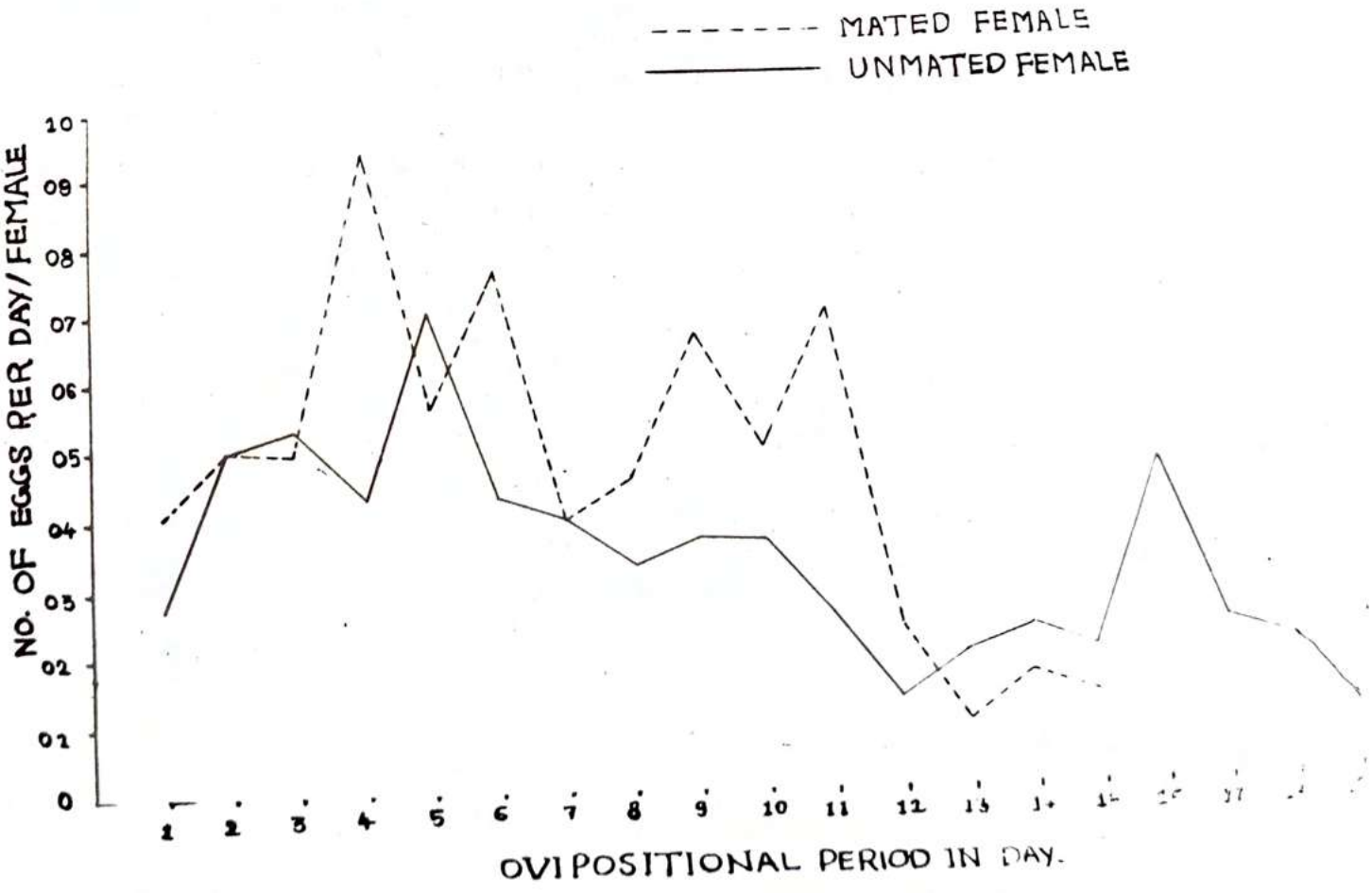


Fig. 1: Influence of mating on oviposition in ***Tetranychus macfarlanei***

influence of female age on egg laying : An almost similar pattern of egg laying recorded in case of *T. macfarlanei* was reported for other tetranichids (Boudreaux,1963); with advancing age, the rate of egg laying increased for few days in case of both mated and unmated females. Thereafter, it declined, though not smoothly (Fig. 1). The fecundity rate after mating reached its peak on 4th day of adult life (9.33 eggs) and on 5th day (7.00 eggs) in case of unmated females. The total fecundity and rate of egg laying by mated females was higher than by unmated females. The later ones oviposited for a longer period. Similar observations are reported for many species of tetranychids (Banu and Channabasavanna, 1972 and Lakshamanlal and Mukharjee, 1978).

Life table

A life table of *T. macfarlanei* on okra was constructed from the data obtained in laboratory (Table 3). The net reproductive rate (Ro), mean generation time (T), innate capacity for increase (rm) and finite rate of increase (l) were worked out to be 30.3744 times, 12.037 days, 0.2836 progeny/female/day and 1.328 per head/day at 29.67^0c and 37.30% R.H. Laing (1969) recorded on almost similar value of Ro as 30.93 for *T. urticase* from 15 to 28^0c, but he found lower rm value (0.143) which might have been due to a higher mean generation time (24.0 days). rm was reported as 0.336 at 27 c and 95% R.H. for *T. urticae* (Shah *et al.*, 1976) and 0.318 at 27 ± 2^0c and 65.5% R. H. for *T. Cinnabasinus* (Shih and Shieh, 1978).

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