



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2018; 6(2): 411-415

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Received: 21-01-2018

Accepted: 23-02-2018

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Biological attributes and seasonal incidence of yellow mite, *Polyphagotarsonemus latus* Banks (Acari: Tarsonemidae) on polyhouse capsicum

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Abstract

Studies on the biology of yellow mite, *Polyphagotarsonemus latus* was carried out during May-June, 2015-16 revealed that the mite passed through four phases viz., egg, larva, quiescent and adult. The egg stage lasted on an average 2.38 days. Male emerged as an adult a little bit earlier than the female. The pre-oviposition, oviposition and post-oviposition periods for unmated female were 1.71, 7.90 and 1.68 days and for mated female 1.51, 7.50 and 1.74 days, respectively. The rate of egg laying per day and fecundity for unmated female was higher than mated female. The yellow mite remains throughout the crop season under polyhouse and the peak activities were noticed during 6th week second week of February.

Keywords: Biology, yellow mite, *Polyphagotarsonemus latus*, seasonal incidence, capsicum

1. Introduction

Family Tarsonemidae includes more than 500 world widely distributed mite species. The greater part of which are pests of agricultural crops particularly those grow in greenhouses or polyhouses. Others are fungivores, algivores, predators of other mites, parasites of insects and possibly symbionts of insects [1, 2]. The broad mites, *Polyphagotarsonemus latus* (Banks) is a serious cosmopolitan pest in tropical and subtropical regions and in greenhouses worldwide [3]. It is extremely polyphagous and is found on more than 60 plant families [3]. The softer portions of the plants such as cotton [4], eggplant [5], jute [6] and grape [7] was attacked by this pest. Since broad mites are very small (body length between 100 and 200 microns) they are unnoticeable until serious damage occurs rapidly to apical leaves. Growers who are not familiar with the plant symptoms associated with the presence of broad mites can first confuse symptoms with a virus, phytotoxicity from a sprayed product or a nutrient related disorder [3]. The mites are usually found on the upper part of the plant, feeding on the apical shoots and the abaxial side of young leaves. They are believed to be cell feeders, having styliform simple chelicerae that are only slightly reversible [8], with an approximate extended length of 43 microns [9]. Their feeding causes a variety of symptoms in different hosts and plant organs. In general, plant growth is inhibited [10, 11]. Usually, the young apical leaves are heavily damaged, seem distorted, more rigid and their edges curl downwards. The present paper gives an account of the life history of the broad mite, *P. latus* on capsicum under laboratory condition along with its seasonal activities in polyhouse under South Gujarat conditions.

2. Material and Methods

2.1 Biology of *P. latus* on capsicum: The life history of broad mite, *P. latus* was studied under laboratory conditions at 28 to 32°C temperature and 74 to 87 per cent relative humidity during the period of May-June, 2014-15. Stock cultures of *P. latus* were raised and maintained in petri dishes under laboratory conditions on detached leaves of capsicum (cv Bachata). The broad mite preferred underside of top young leaves, these leaves were placed upside down on cotton pad saturated with water in petri dish (15 cm diameter) to keep the leaf turgid and fresh. Lanolin was applied on the edges of the leaf to prevent the migration of mites. Twenty gravid females lifted carefully using 'O' number camel hairbrush from infested capsicum leaf were transferred to individual leaf in petri dish and as such five sets were prepared. Adult mites were removed from the leaf after 2 to 3 days when sufficient numbers of eggs were laid. Beginning with these eggs, mass rearing was done and utilized for different biological studies.

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The transfer of mites from deteriorating leaf to fresh leaf was accomplished by putting them on fresh leaf for 3 to 4 hrs to ensure all mites and freshly emerged ones crawled/migrated to fresh leaves.

For studying the detail life cycle of yellow mite, a method as described by Rodriguez ^[12] and Gilstrap ^[13] of confining individual mite on chilli leaf was adopted throughout the life span with some modification. Ten gravid females taken from mass culture were released on a fresh leaf kept upside down in a petri dish for day and as such ten sets were prepared. Next day, the number of eggs laid on the leaves were counted and marked for subsequent development. The adult females were removed. Beginning with these eggs, the detail biology of yellow mite was taken up. A stereo binocular microscope was used for critical observations on behavior, colour, morphology etc. of the yellow mite in different stages. A standardized ocular micrometer fitted to stereobinocular microscope was used for measuring size of various stages of *P. latus*. Observations on durations of various stages (sex-wise) were recorded under microscope twice a day (9.00 A.M. and 5.30 P.M.) until the death of individual mite. Pre-oviposition period, post oviposition period, fecundity of female and longevity of male and females were also recorded.

2.2 Seasonal Incidence of broad mite, *P. latus* on capsicum under polyhouse: The seasonal incidence of broad mite was also investigated under the polyhouse conditions. For this the seedlings of capsicum cv Bachata were transplanted into beds of 3 x 12 m. Five plants from three beds were randomly selected and tagged and from these plants three leaves from the top canopy were plucked and placed into marked polythene bags. These leaves were brought to the Acarology laboratory and observed under microscope to record the mobile stages from underside of 2 cm² leaf surface. The observations were recorded throughout the crop season. The experiment was carried out during the period of 2013-14 to 2015-16 at the poly house of AINP on Agricultural Acarology, Department of Entomology, N.M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat.

3. Results and Discussion

3.1 Biology of *P. latus* on capsicum: The data on measurement of different stages are presented in Table 1 and biological observation in Table 2.

3.1.1 Egg: The eggs were laid singly mostly on the lower side of the leaf. They were creamy white in colour and somewhat elongated. They had a convex dorsal surface and a flattened ventral surface that is attached to the leaf surface. The dorsal surface of eggs was covered with prominent shiny white coloured protuberances that were arranged in 6-7 distinct longitudinal rows in rhombic fashion. The eggs were small measuring on an average 0.113 ± 0.007 mm in length and 0.069 ± 0.010 mm in width (Table 1). The incubation period of eggs (irrespective of sexes) ranged from 2 to 3 (av. 2.38 ± 0.28) days (Table 1). The shape, size, colour and pattern of egg laying recorded under the study were almost similar to the findings of Senapati and Ghose ^[14], Dhooria ^[15], Karuppuchamy and Mohanasundaram ^[16] and Karmakar ^[17]. In present investigation, cent-per-cent hatching was recorded however Yang and Chen ^[18] reported an average of 95.60 per cent hatching, it may be due to different host and rearing

technique.

3.1.2 Larval stage: The newly hatched six legged larvae were yellowish white colour possessing small tail like processes. At eclosion, egg chorion split just aside the mid-dorsal line towards anterior region on upper side (dorsal) of the eggs. The larvae with the help of its legs make a circular hole emerge out leaving papery white eggshell intact to the leaf surface. The male and female larvae could be distinguished by their size and shape before entering into quiescent stage. The male larvae were comparatively smaller, tapering posteriorly, while the female larvae were larger and oval in shape. The body measured 0.133 ± 0.014 mm in length and 0.078 ± 0.008 mm in width for female larva, while it measured 0.126 ± 0.012 mm in length and 0.069 ± 0.008 mm in width for male larva (Table 1). This stage lasted 0.4 to 1.5 days with an average of 0.98 ± 0.18 day for male and 0.5 to 1.5 days with an average of 0.95 ± 0.21 day for female (Table 2). Dhooria ^[15] and Karmakar ^[17] only one larval stage in entire life cycle of *P. latus*, which is in agreement with present findings.

3.1.3 Quiescent stage: The mature larva enters into a quiescent stage by anchoring to leaf surface and remained motionless until adult emergence. This stage may be differentiated into male and female by its size. The male in this stage was bit smaller (0.159 ± 0.017 mm in length and 0.083 ± 0.009 mm in width) than the female quiescent (0.174 ± 0.014 mm in length and 0.089 ± 0.007 mm in width). Male quiescent lasted for 0.55 ± 0.16 day while female quiescent lasted for 0.75 ± 0.22 days. This finding is agreement with Karuppuchamy and Mohanasundaram (1987) and Senapati and Ghose (1992).

3.1.4 Developmental period (from egg to adult emergence): This period lasted for 3 to 5 days in male (av. 3.79 ± 0.38 days), while it ranged from 3 to 5.5 days in female (av. 4.01 ± 0.48 days). However, the male emerged as an adult a bit earlier than female. This finding is in agreement with Karuppuchamy and Mohanasundaram ^[16] and Senapati and Ghose ^[14].

3.1.5 Adult Stage: The quiescent stage developed into adult male or female having four pairs of legs. The adults were shiny and translucent with yellowish tinge. Males were translucent with dorsal white patch, which gradually turned to faint white line along dorsomedian line with brownish appearance. They are active and fast moving than female. The females were broad and elliptical in shape. While males narrowed posteriorly and had papilla projection on the tip of the abdomen to hold quiescent female. The average length and width of male was 0.132 ± 0.009 mm and 0.070 ± 0.006 mm respectively, while the average length and width in female ranged from 0.147 ± 0.014 mm and 0.082 ± 0.006 mm. The mated males live shorter (4.0 to 5.0 days, av. 4.57 ± 0.43 days) than unmated male (4.0 to 7.0, av. 5.19 ± 0.67 days). This period for mated female and unmated female ranges from 9.5 to 12.2 days (av. 10.70 ± 1.01 days) and 9.6 to 13.9 days (av. 11.09 ± 1.17 days) respectively. Scheunhoven *et al.* ^[19] reported that adult male and female lived for 11-14 days and 7-8 days on bean leaves is in agreement with present findings.

Table 1: Morphometric differences of various stages of *P. latus* reared on capsicum

Stage	Length (mm)				Width (mm)			
	No. Observed	Max.	Min.	Av.± S.D.	Max.	Min.	Av.± S.D.	
Egg	30	0.125	0.083	0.113± 0.007	0.097	0.056	0.069± 0.010	
Larva	M	20	0.153	0.111	0.126± 0.012	0.083	0.056	0.069 ± 0.008
	F	20	0.166	0.111	0.133± 0.014	0.090	0.056	0.078 ± 0.008
Quiescent	M	20	0.181	0.125	0.159± 0.017	0.097	0.069	0.083 ± 0.009
	F	20	0.194	0.138	0.174± 0.014	0.097	0.083	0.089 ± 0.007
Adult	M	20	0.153	0.112	0.132± 0.009	0.083	0.056	0.070 ± 0.006
	F	20	0.166	0.125	0.147± 0.014	0.097	0.070	0.082 ± 0.006

3.1.6 Sexual behaviour: Adult males were generally seen congregating near quiescent females. They usually carried the quiescent female on its abdominal projection at the tip, which were near to emergence as an adult. This phenomena of carriage of female by male lasted for about half and hour. Mating took place soon after the emergence of female from quiescent stage. The copulation period lasted for 2.88 to 3.13 minute (av. 2.98 ± 0.09 minute). Mating between male and female took place in opposite direction (tail to tail position) at a slight angle keeping abdominal tip of both sexes joined together.

3.1.7 Pre-oviposition, Oviposition and Post-oviposition Period: The female after emergence laid eggs after a lapse of time, this period was Pre-oviposition period, which was 0.9 to 2.6 days (av. 1.71 ± 0.41 days) in unmated female and 1 to 2.2

days (av. 1.51 ± 0.42 days) in mated female. The egg-laying period *i.e* oviposition period of unmated female slightly longer (7.90 ± 1.25 days) than mated female (7.50 ± 1.13 days). Almagual *et al.* [20] reported in Cuba that each female took 9.15 days on capsicum cultivars California wonder and 7.14 days an Espanol. The post oviposition period for unmated female ranged from 1.0 to 2.5 days (av. 1.65 ± 0.34 days) and 1.0 to 2.5 days for mated female.

3.1.8 Fecundity: There was no apparent variation in the fecundity as affected by mating. The rate of eggs laying per female per day for virgin female was 3.3 to 5.40 eggs (av. 4.50 ± 0.51 eggs) and 3.37 to 5.01 eggs (av. 4.39 ± 0.63 eggs). The present findings are also supported by Silva [21] from Brazil

Table 2: Duration of various stages of yellow mite, *P. latus* reared on capsicum

Stage	No. of Observed	Duration in (Days)			
		Min.	Max.	Av. ± S.D.	
Incubation Period	50	2.0	3.0	2.38 ± 0.28	
Larval period	Male	40	0.4	1.6	0.98 ± 0.18
	Female	58	0.5	1.5	0.95 ± 0.21
Quiescent Period	Male	40	0.5	1.0	0.55 ± 0.16
	Female	58	0.5	1.0	0.75 ± 0.22
Development Period	Male	40	3.0	5.0	3.79 ± 0.38
	Female	58	3.0	5.5	4.01 ± 0.48
Adult Period	Unmated Male	32	4.0	7.0	5.19 ± 0.67
	Mated Male	28	4.0	5.0	4.57 ± 0.43
	Unmated Female	48	9.6	13.9	11.09 ± 1.17
	Mated Female	10	9.5	12.2	10.70 ± 1.01
Pre-oviposition Period	Unmated Female	48	0.9	2.6	1.71 ± 0.41
	Mated Female	10	1.0	2.2	1.51 ± 0.42
Oviposition Period	Unmated Female	48	5.4	10.1	7.90 ± 1.25
	Mated Female	10	5.9	9.6	7.50 ± 1.13
Post oviposition Period	Unmated Female	48	1.2	2.4	1.62 ± 0.34
	Mated Female	10	1.0	2.4	1.74 ± 0.41
Rate of egg laying female/day	Unmated Female	48	3.3	5.4	4.50 ± 0.51
	Mated Female	10	3.3	5.01	4.39 ± 0.63
Fecundity	Unmated Female	48	24.0	44.0	35.12 ± 4.45
	Mated Female	10	28.0	39.0	32.20 ± 3.53

3.2 Seasonal incidence of *P. latus* on capsicum under polyhouse: The seasonal incidence of yellow mite, *P. latus* was recorded in greenhouse for three years. During 2013-14, the yellow mite activities first noticed in 42nd standard meteorological week (SMW) (3rd week of October) (0.40 mite per leaf), than the population fluctuated during the crop season and it was reached to the peak during 6th SMW (2nd week of February) with the population of 6.08 mites per leaf, the mite population gradually decreased and at the time of crop maturity it was 3.88 per leaf. The overall seasonal mean was 1.75 mites per leaf (Table 3). During 2014-15, the yellow mite presence was noticed in 41st SMW (2nd week of October) with 0.20 mite per leaf. The yellow mite population than

fluctuated during different weeks of the season and the peak population was recorded during 5th SMW (last week of January) where the yellow mite population was 5.60 per leaf. The yellow mite population decreased gradually and at the time of crop maturity it was 4.00 mites per leaf (Table 3). The overall seasonal mean of the yellow mite during 2014-15 was 2.21 mites per leaf. in the year 2015-16 the yellow mite presence was recorded during 41st SMW (first week of October) (0.66 mites per leaf). The yellow mite population then gradually increased and reached to the peak during 6th SMW (Second week of February) with the population of 5.20 mites per leaf (Table 3). At the time of crop maturity the mite population was 4.62 per leaf. The overall seasonal mean of

yellow mite during 2015-16 was 2.32 mites per leaf.

Table 3: Seasonal activities of *P. latus* infesting capsicum under polyhouse condition

St. Met. Week	Mean no. of mobile stage per 2 cm ² leaf			
	2013-14	2014-15	2015-16	Poole data
41	0.00	0.20	0.66	0.29
42	0.40	0.60	0.80	0.60
43	0.60	0.66	0.81	0.69
44	1.20	1.40	1.40	1.33
45	0.60	0.44	1.00	0.68
46	1.00	1.20	1.40	1.20
47	0.60	1.00	1.40	1.00
48	0.88	1.20	1.45	1.18
49	1.04	1.41	2.61	1.69
50	1.20	1.20	2.22	1.54
51	0.60	0.40	1.47	0.82
52	0.20	1.60	1.20	1.00
01	1.20	1.60	1.60	1.47
02	1.41	1.82	1.40	1.54
03	1.44	3.02	2.66	2.37
04	2.88	4.21	3.40	3.50
05	3.21	5.60	3.80	4.28
06	6.08	5.28	5.20	5.52
07	4.25	4.85	5.00	4.70
08	4.21	4.81	4.80	4.60
09	3.88	4.00	4.62	4.16
Seasonal Mean	1.75	2.21	2.32	2.09

The pooled data of three years are presented in Table 3 showed that on capsicum, the yellow mite appeared during 41st SMW (0.29 mite per leaf) and then the population gradually fluctuated and reached to its peak during 6th SMW (5.52 mites per leaf) and persist till the maturity of the crop. The overall pooled seasonal mean of yellow mite population in greenhouse condition was 2.09 mites per leaf. Asma and Hanumantharaya^[22] reported the peak activities of *P. latus* on open cultivated chilli during April-May. The difference in the time of peak activities may be due to different crop, its growing condition and difference in the agro-climatic conditions.

4. Conclusion

The biology of yellow mite, *P. latus* showed that the development period of male was 3.79±0.38 days and 4.01±0.48 days for the female. The adult period of mated and unmated males were 4.57±0.43 days and 5.19±0.67 days, respectively, while the adult period for mated and unmated females were 10.70±1.01 days and 11.09±1.17 days, respectively. The unmated female laid 35.12±4.45 eggs while mated females laid 32.20±3.53 eggs in its life span. Under the polyhouse conditions, the yellow mite remained active throughout the crop season with peak activities during 6th SMW (2nd week of February). The overall seasonal mean of yellow mite population on capsicum was 2.09 mites per leaf.

5. Acknowledgements

Authors are highly grateful to the Principal and Dean, N.M. College of Agriculture and Director of Research and Dean Post Graduate Studies, Navsari Agricultural University, Navsari for providing all facilities.

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