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Biology of predatory mite, *Amblyseius longispinosus* (Evens) (Acari: Phytoseiidae) on broad mite, *Polyphagotarsonemus latus* (Banks)

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ABSTRACT

Biological parameters of *A.longispinosus* was recorded by feeding on broad mite, *P. latus*at Acarology Laboratory, Department of Entomology, Navsari Agricultural University, Navsari, Gujarat during April to June of the year 2014 and 2015. The results indicated that the mean of immature period for egg, larvae, protonymph and deutonymph were 2.33±0.49, 3.73±0.70, 4.53±0.52 and 4.67±0.72 days, respectively when feed on *P. latus*. The total developmental period completes in 15.26±0.68 days, while the pre-oviposition, oviposition and post- oviposition period took 5.53±0.51, 15.73±0.45 and 4.13±0.51 days. The period of adult longevity for male and female were 9.00±0.95 and 25.39±0.45 days, respectively. A single female laid on an average 30.00±2.77 eggs in her life span when reared on *T. urticae* under the laboratory conditions.

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INTRODUCTION

The broad mite, *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae), is a serious pest in tropical and subtropical regions and has been collected from about 60 different plant families (Gerson, 1992). This mite attacks young growing plant parts and is very small and difficult to be detected. It usually feeds on the lower leaf surface making the leaf edges become rigid and roll under, causes distortion and/or discoloration of the flowers and blistering of the fruits and finally the reduction of the plant yield. *P. latus* is an important pest of vegetables and peppers show a low tolerance level against this pest mite (De Coss-Romero and Peña, 1998 and Tal *et al.*, 2007). Increase in mite pest problems has led to indiscriminate use of pesticides resulting in the resurgence of mite. Hence, even with very frequent spraying of pesticides, it has not been possible to bring down the population of spider mites to manageable level in most of the greenhouses. To overcome these limitations, it is essential that ecofriendly approaches are explored which would be safer to the environment in the

Indian context. The utilization of natural enemies including mite predator has remained an unexplored area in the country. Among, the mite predators, phytoseiids are most promising. More than 1200 species are known from the world and 139 species have been reported from India (Gupta, 1986). Genus *Amblyseius* is one of predator mites that often found in agricultural crops. This genus has species that play important role in controlling plant mites. Laboratory studies have shown that some of these phytoseiids are capable of eliminating the prey within a short period when released in appropriate ratios (Mallik, 1974). *A. longispinosus* has been observed praying on spider mites and other mites which includes *P. latus* in chilli, capsicum, French bean, cowpea and other greenhouse flowers. These facts suggest that this predator can play an important role as a biological control agent of plant inhibitingmites. The study of developmental biology should lead to a better understanding of its potentiality as a predator. Therefore, the present study was carried out under laboratory conditions to understand the biological attributes of *A. longispinosus* on the *P. latus*.

MATERIAL AND METHODS

The experiment on biology of *A. longispinosus* was conducted at Acarology Laboratory, Department of Entomology, Navsari Agricultural University, Navsari, Gujarat during April to June of the year 2014 and 2015 at room temperature (28 to 32 °C) and relative humidity (78 to 83%). The duration of developmental stages was studied on an arena that was excised leaf disc in the laboratory. French bean leaf disc was made by preparing one piece of leaf. The leaf discs were placed on cotton wed facing upper surface upwards. Then cotton wed was put on a piece of foam (5.5 cm x 0.75 cm) in Petridish. The cotton wed and foam was kept wet by socking with water twice daily so that the discs remained fresh.

Rearing of broad mite,*P. latus* (Prey) :

The stock culture of broad mite, *P. latus* was maintained in the laboratory on capsicum leaves. For this capsicum (cv. BACHATA) were raised in the polyhouse at an interval of one month for continuous supply of food material. The whole leaf or piece of leaflet was placed upside down on wet cotton swab in Petridish. Water was added periodically to kept the cotton pad moist and maintain the leaves fresh and turgid. Initially the mites were collected from field at Collage farm. Adult mites were released at the rate of five males and five females per leaf. The food material was changed after two-three days when sufficient number of eggs was laid. Beginning with these eggs further rearing was done to have pure mass culture and constant supply of the prey mite. For the sake of convenience and easy handling, the old and deteriorating capsicum leaves were cut into small pieces and carefully removed alongwith mites and kept on fresh leaves for about 3 to 4 days so as to ensure that all the mites have migrated to new fresh leaves as the former progressively dried.

Rearing of predatory mite, *A. longispinosus* in laboratory :

Predatory mites were reared separately on mixed stages of spider mite *T. urticae*. Predatory mites were transferred with the help of fine camel hair brush to the spider mite culture. The predatory mite feeds on the spider mite developed reddish tinge on the body. About 20 sets were cultured in laboratory for studying the predator for its biology attributes.

Life history and biological feature of *A. longispinosus* were studied in the laboratory on mixed stages (eggs, larvae, nymphs and adults) of the broad mite, *P.latus*. The observation on different developmental stages and their measurements were recorded. The fecundity was worked out by recording total number of eggs laid by a single female during her life span. The eggs obtained were allowed to develop separately until adult emergence for finding out its sex ratio. Duration and behaviour of different stages were recorded. The data obtained on duration of life stages were statistically analysed to work out standard deviation.

RESULTS AND DISCUSSION

The developmental stage of *A.longispinosus* includes egg, larva, protonymph and deutonymph. The detailed description of each stage was discussed herewith.

The eggs were laid singly on the leaf surface in the vicinity of *P. latus* colony or near the developing stages of its prey. A sticky substance was found present on the surface of the egg which helps the eggs to adhere to the substratum. The freshly laid eggs were translucent, white crystalline and later turned yellowish before hatching. The eggs were ovoid. It measured 191.37±13.69 µm in

lengthand 109.00±1.96µm in width. The incubation period of *A. longispinosus* ranged between 2.00 to 3.00 days with a mean of 2.33±0.49 days. These eggs were given singly near the eggs or developing stages of *P. latus*, on the under surface of the leaves. These results are in general agreement with those obtained by Kain and Nyrop (1995) and Sabelis and van Rijn (1997) who also found that the phytoseiid mites generally lay its eggs on underside of leaves near the prey colony.

The larva emerged out from the narrower region of the egg with the help of its hind part first. The newly hatched hexapod larva was very active and more or less rectangular in shape. During the first few hours the larva was almost transparent. The opisthasomal region of the larva was found expanded. The larvae were found to feed generally on egg and larval stages of *P. latus*. In absence of the developing stages of the prey mite, it was survived on adult stages of its prey (*P. latus*) too. A perceptible change in colour of predatory mite noticed when fed on, it developed reddish tings on the body. The larva used 1st and 2nd pair of legs for capturing the prey. The larvae measured on an average 217.60±9.95µm in length and 139.10±5.80µm in width. The larval duration ranged between 3.00 to 5.00 day with a mean of 3.73±0.70 days at room temperature and relative humidity (Table 2).

After the molting, the protonymph was found oval shaped. It had four pair of legs. The movement of protonymph was more rapid than larva and moved all around in search of prey. Protonymph also caught the

Table 1 : Measurements of various life stages of *A. longispinosus* when reared on broad mite, *P. latus*(µm) (Pooled of two years)

Stages		Number of observations		Minimum	Maximum	Average± SD
Egg		10	Length	164.50	205.00	191.37±13.69
			Width	107.00	112.50	217.60±9.95
Larva		15	Length	206.00	243.00	217.60±9.95
			Width	126.50	148.50	139.10±5.80
Protonymph		15	Length	243.50	264.50	255.10±7.65
			Width	137.50	148.50	141.83±3.43
Deutonymph		10	Length	320.00	337.00	328.27±5.63
			Width	177.00	200.50	186.40±7.16
Adult	Male	10	Length	303.50	318.50	311.73±4.76
			Width	137.00	154.00	143.13±5.96
	Female	10	Length	407.50	429.50	418.67±6.18
			Width	243.00	275.50	287.87±8.33

Table 2 : Duration of various life stages of *A. longispinosus* when reared on broad mite, *P. latus* (Pooled of two years)

Stages		Minimum	Maximum	Average± SD
Incubation period (Days)		2.00	3.00	2.33±0.49
Larval period (Days)		3.00	5.00	3.73±0.70
Protonymph period (Days)		4.00	5.00	4.53±0.52
Deutonymph period (Days)		4.00	6.00	4.67±0.72
Total developmental period (Days)		13.00	19.00	15.26±0.68
Pre-oviposition period (Days)		5.00	6.00	5.53±0.51
Oviposition period (Days)		15.00	16.00	15.73±0.45
Post-oviposition period (Days)		3.00	5.00	4.13±0.51
Adult longevity (Days)	Male	8.00	10.00	9.00±0.95
	Female	23.00	27.00	25.39±0.45
Total life span (Days)	Male	18.14	25.14	21.57±1.34
	Female	36.00	46.00	40.65±1.16
Fecundity (Number of eggs laid per female)		27.00	36.00	30.00±2.77

prey with legs like the developmental stages also. It also caught the prey with legs like the larvae. The colour of the body changed according to the food as it was yellowish red when they fed on protonymph or deutonymph or adult of its prey (*P. latus*). The protonymphal stage measured 255.10±7.65µm in length and 141.83±3.43µm in width. The protonymph period ranged between 4.00 to 5.00 days with a mean of 4.53±0.52 days. The protonymph after molting entered into deutonymphal stages. The body of the predatory mite was oval with light yellow-reddish ting on it. The male and female stages were also distinguishable at this stage from its shape of abdomen and size of body. The abdomen of the female is more rounded while in case of male it was more slender. The deutonymph measured 328.27±5.63µm in length and 186.40±7.16µm in width (Table 1). The deutonymphal period was ranged between 4.00 to 6.00 with a mean of 4.67±0.72 days. The period of total immature stages varied between 13.00 to 19.00 days with a mean of 15.26±0.68 days. The results are in general agreement with those obtained by van Houten *et al.* (1995) and Zhang Hui-Yuan *et al*. (2010) who stated that *A. fallacies* could complete its developmental period and lay eggs with one generation time of 9.54 days. Riudavets (1995) and Sabelis and Van Rijn (1997) found that 6.2 days are required to complete the life cycle for *Amblyseius* sp., also they found the *A. cucumeris* completes its life cycle in 11.10, 8.70 and 6.30 days at different temperatures. The adults were shiny at the time of emergence. The males can be distinguished from the female by their more elongated body. The life span of the male was shorter than females. The adults remain inactive for few hours after molting. The adult mites were quite active and fast moving as compared to their prey. The adults were yellowish-red in colour. The shadow of redness was more pronounced in this adult stage as compared to developing stages after consuming the mixed stages of *P. latus* as food. The adult female measured 418.67±6.18µm in length and 287.87±8.33µm in width while the adult male measured 311.73±4.76µm in length and 143.13±5.92 µm in width. The total life span of adult female is divided into three demarkable parts *i.e.* pre-oviposition, oviposition and post-oviposition periods. The pre-oviposition period ranges between 5.00 to 6.00 days with a mean of 5.53±0.51 days, while the oviposition period ranged between 15.00 to 16.00 days with an average of 15.73±0.45 days when fed on broad mite, *P. latus* under the laboratory condition at room temperature and relative humidity. The post-ovipositional period ranged between 3.00 to 5.00 days with a mean of 4.13±0.51 days. The adult male longevity ranged between 8.00 to 10.00 days with a mean of 9.00±0.95 days under the same conditions. The present findings under the laboratory conditions revealed that the adult female of *A. longispinosus* when reared on *P. latus*laid the eggs ranged between 27.00 to 36.00 eggs per female with an average of 30.00±2.77 eggs. Different results were obtained by Zhang Hui-Yuan *et al*. (2010) who stated that the average amount of eggs laid by female *A. cucumeris* was 36.70. El-Laithy (1998) found that *Agistemusexsertus* had the highest fecundity rate of 66.6 eggs per female, followed by *A. swirskii* 44.4 eggs per female and *P. finitimus* 23.5 eggs per female. In females, the duration of life span ranged between 16.00 to 25.00 days with an average of 25.08±2.856 days, while the corresponding values for males lasted from 7.00 to 13.00 days with an average 9.76±1.716 days. These results are in agreement with those obtained by Kain and Nyrop (1995). Helle and Sabelis (1985) and Karim and Wareth (2012). El-Laithy (1998) found that the predatory mites successfully fed on *Eriophuesolivi*. The developmental time of the predaceous mites averaged 10.5, 5.7 and 7.9 days for *Agistemusexsertus*, *A. swirskii* and *P. finitimus*, who stated that life of female was 38.52 days. Reis *et al.* (2007) studied the life history of predatory mite *A. hericlolus* using *Brevipalpusphoenic* as prey. The adult female had longevity of 38 days. The intrinsic rate of population increase was 0.15 and the mean generation time was 25.3 days. Further, the present findings are also corroborated with the work of Mandape and Shukla (2016) who studied the biological attributes of *A. longispinosus* by feeding the spider mite, *T. urticae* that the mean of immature period for egg, larvae, protonymph and deutonymph were 2.010±0.341, 0.851±0.129, 1.152±0.354 and 2.666±0.515 days, respectively. The total developmental period completes in 6.240±0.890 days, while the preoviposition, oviposition and post-oviposition period took 1.601±0.287, 18.600±2.610 and 3.500±1.007 days. The period of adult longevity for male and female were 9.760±1.116 and 21.080±2.856 days, respectively. A single female laid on an average 38.040±4.631 eggs in her life span when reared on *T.*

urticae under the laboratory conditions.

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