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LIFE CYCLE OF *MISUMENOPS PALLIDA* (ARANEAE, THOMISIDAE)

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Postembryonic development of Misumenops pallida *(Keyserling) (Araneae, Thomisidae), one of the most abundant predator species in soybean fields in Buenos Aires Province (Argentina) was studied. The life cycle was observed in the laboratory from egg sacs collected in the field, and from egg sacs spined in the laboratory by gravid females collected in the field. Results indicated that instar length and feeding rate increased throughout the life cycle being higher in females than in males. Greater mortality was observed to third and fourth instars decreasing thereafter. These results may contribute to determine the efficiency of this species as a natural enemy of insect pests of soybean.*

Key words: arthropods – spiders – postembryonic development – behavior – soybean

Soybean is one of the most important crop in Argentina. It is cultivated from November-December to April-May, and occupies an extensive area including center and west of Buenos Aires Province, and south of Santa Fe and Cordoba Provinces (Remussi & Pascale, 1977).

Mayor pest species include the bud borer *Epinotia aporema* Wallsingham (Lepidoptera: Tortricidae), the defoliators *Rachiplusia nu* (Gueneé) and *Anticarsia gemmatalis* Hübner (Lepidoptera: Noctuidae), and the pod-eating *Piezodorus guildinii* Westwood and *Nezara viridula* (L.) (Heteroptera: Pentatomidae) (Samuel, 1975).

Misumenops pallida (Keyserling) is one of the most abundant spider species in soybean fields in Buenos Aires Province, being a natural enemy of the above mentioned pests (Minervino, unpublished data).

Postembrionic development, mortality, feeding rates, instar duration, survivorship and life expectancy of *M. pallida* was studied.

METHODS

Observations were made from egg sacs collected in the field, and egg sacs obtained in the laboratory by gravid females collected in the field. Egg sacs were collected from 40 soybean plants examined in the laboratory. Individuals were collected using a sweep-net (50 cm of diameter), and picking by hand. Weekly samples were taken between January and March 1990 on a plot of 1 ha in size in La Plata district (35°S, 58°O) (Buenos Aires Province).

From seven egg sacs obtained, four were opened for egg separation. Eggs were counted and postembryonic development observed. The remaining egg sacs were kept with their mothers to know the time between egg eclosion and the exit from egg sacs, and to check for possible maternal care.

The spiderlings borned in the laboratory were reared individually, at constant conditions (23°C; LD 14-10). Each individual was placed in a plastic jar (3.5 cm x 7.0 cm). A piece of paper (for building the shelter) and a piece of moisture cotton (for mantaining humidity) were placed inside jars which were plugged with voyle, fixed with a elastic band. Individuals were fed each two days with adult flies of *Drosophila melanogaster* Meiger born in captivity. Daily observations were made from egg to third instar and every two days from the fourth instar on.

After each molt exuviae were kept in a dry recipient, in order to take instar measures using stereo microscope with an ocular micrometer. Description of instars was done based on Galiano (1972, 1991) nomenclature.

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Survivorship (lx) was calculated as:

$$lx = \frac{Nx}{No}$$

where: Nx = number of individuals which were alive in each stage; and No = total number of eggs which have hatched.

Life expectancy (ex) was calculated using:

$$ex = \frac{Tx}{lx}$$

where: Tx = total number of remainder days in the life of an individual that had reached a x age:

$$Tx = \sum_{m}^{x} lx$$

being m the maximun age which was reached.

RESULTS AND DISCUSSION

Egg sacs are white, oval shape (7 x 3 mm), and have a silky appearance. They are covered with a thiny layer of soft threads. In the field, egg sacs were found during the last phenological stages of soybean (R6 and R7 acording to Fehr and Caviness, 1977), between the end of February to March, previous to harvest of this crop. The mean duration of life cycle of this species is 277 days (Table III), indicating that *M. pallida* spends part of its life cycle when soybean is not available in the field. Generally egg sacs were found in the back side of leaves or inside "shelthers" built by folding leaves and by sealing their edges with silk. These "shelters" covered with silk threads in the inner side, were used by females as refuges.

In the laboratory, females showed resistance to be separated from isolated egg sacs. When they were together, females stayed close to them continuously, even after egg eclosion. Females did not show aggressive behavior with the hatch, and usually did not feed.

Two out of four egg sacs observed were built by the same female in fourty days interval. The number of eggs per sac decreased with time, being 86 in the first and 37 in the second. Eggs are white, spheric with 1 mm diameter, gelatinous, and are difficult to separate to be counted.

Total number of eggs per sac was variable, with a range of 25-94 and mean of 60. The total number of eggs of all sacs was 242, being 60% of these (145) fertile (Table I).

TABLE I

Number of hatched and fertile eggs from each egg sacs of *Misumenops pallida*

Number of eggs	Egg sac number						
	1	2	3	4	Total	$\bar{X}$	S.D.
Hatched	94	25	86	37	242	60,5	34,5
Fertile	56	15	52	22	145	36,2	20,7

First three instars developed inside the egg sac with the first instar being intrachorionic. Fourth instars developed outside the egg sac. During the third instar, the setae of the following instar could be observed, and individuals acquired more mobility. After 2-3 days, the third molt occurred, setae appeared, and eyes became pigmented. Individuals started making web and were able to catch prey. During this stage they abandon the egg sac and start dispersing. These observations are similar to those reported to other species of spiders of the genus *Misumenops* (Shick, 1972).

An increase in average duration of instars as spiders progressed in their development was observed except in the eighth instar (previous to adult) (Table II). Four males and only one female were obtained from all the eggs observed, which prevented calculation of mean and standard desviation values for adult females. Females collected in the field as preadults and reared in the laboratory to reach adulthood, had an average duration of immature cycle of 161.3 ± 45.4 days, and range 128-213 days (Table II).

The mean life span (from eclosion to death) was 277 days and the mean duration of adult life 97 days (Table III).

Females reached maturity after seven molts and 50% of males reached maturity after six molts. The remaining 50% reached maturity after seven molts. This difference may be explained because females were always larger than males (Table IV), as a consequence they usually need one more molt to reach maturity.

TABLE II

Average duration (days) ($\bar{X} \pm$ s.d.) and range, of each instar in the life cycle of *Misumenops pallida*. N = number of individuals, ♀ adult (L) = female from egg sacs reared in the laboratory, ♀ adult (F) = females collected in the field as preadults

Stage of development	N	($\bar{X} \pm$ s.d.)	Range
Instar 3	145	2,5 ± 0,51	2-3
Instar 4	135	15,0 ± 6,45	1-34
Instar 5	14	12,2 ± 5,87	6-24
Instar 6	7	22,0 ± 11,88	4-34
Instar 7	6	65,0 ± 17,44	13-176
Instar 8	5	33,66 ± 28,00	17-66
♂ adult	4	69,2 ± 30,76	33-119
♀ adult (L)	1	143,0	
♀ adult (F)	10	161,3 ± 45,4	128-213

TABLE III

Duration (days) ($\bar{X}$, range and standard desviation (S.D.)) of life cycle of *Misumenops pallida*

Life cycle phases	$\bar{X}$	Range	S.D.
Eclosion-last molt	151	71-253	51,7
Dispersion-last molt	148	69-250	49,8
Eclosion-death	277	367-226	43,8
Last molt-death	97	31-214	43,2

Food consumed increased throughout life cycle reaching the maximum for females (Table V). This could be explained because of females bigger size and because they need to store major amounts of nutrients for reproduction.

Mortality affected mainly third and fourth instars, at the time of dispersion of the spiderlings. From this stage on they must start making the web and to hunt their preys. These events constitute a critic situation which increases mortality. In the next instar (fifth) mortality starts to decrease reaching zero in the final instar, when survivorship stabilizes (Fig.). This curve resembles the type IV survivorship curve from Slobodkin (1962).

TABLE V

Feeding rates (number of flies/spider/day) of *Misumenops pallida* ($\bar{X} \pm$ S.D. and range). Mean values followed by the same letter are not significantly different ($P > 0,05$) by Student test (Sokal y Rohlf, 1979)

Stage of development	Flies/spider/day $\bar{X} \pm$ S.D.	Range
Instar 4	0,36 ± 0,01a	0,51 – 0,22
Instar 5	0,43 ± 0,08a	0,70 – 0,35
Instar 6	0,68 ± 0,17a	0,82 – 0,40
Instar 7	0,74 ± 0,20a	1,03 – 0,44
Instar 8	1,75 ± 1,12b	2,22 – 1,09
♂ Ad	1,03 ± 0,29c	0,78 – 1,15
♀ Ad	3,50 ± 1,87d	0,50 – 6,21

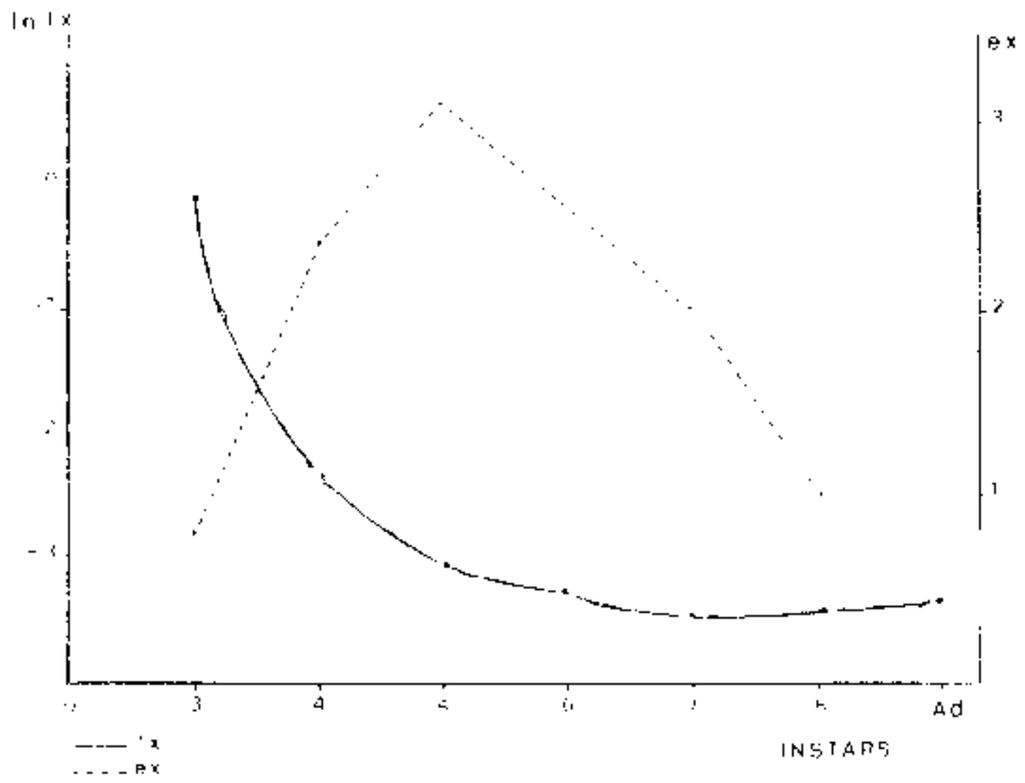
Life expectancy (Fig.) presents one peaks at fourth and at fifth instars, these being critic ages of this species because of greater mortality risk. From the sixth instar on this curve decreases progressively as advance in age occurrs (Deevey, 1947; Rabinovich, 1980).

Adult phase occupies 1/3 of the entire life cycle duration and presents the higher values to instar length, size and feeding rate, and the lower values of mortality. Therefore the adult stage is very important in the development of *M. pallida*.

TABLE IV

Measures of: total length, cephalotorax (length and width) and abdomen (length and width) for each instar (in mm) ($\bar{X} \pm$ S.D. and range)

Stage of development	Total length		Cephalotorax				Abdomen			
			Length		Width		Length		Width	
	$\bar{X} \pm$ S.D.	Range	$\bar{X} \pm$ S.D.	Range	$\bar{X} \pm$ S.D.	Range	$\bar{X} \pm$ S.D.	Range	$\bar{X} \pm$ S.D.	Range
Instar 3	3,2 ± 0,35	2,9-3,6	1,8 ± 0,15	1,5-2,0	1,6 ± 0,12	1,3-1,8	1,8 ± 0,17	1,6-2,1	1,6 ± 0,09	1,4-1,7
Instar 4	5,0 ± 1,22	4,1-6,3	2,0 ± 0,19	1,8-2,5	1,6 ± 0,11	1,5-2,0	3,0 ± 0,21	2,5-3,0	1,6 ± 0,08	1,5-1,8
Instar 5	5,4 ± 1,45	4,1-6,8	2,6 ± 0,26	2,0-3,0	2,4 ± 0,37	2,0-3,0	3,0 ± 0,33	2,5-3,5	2,0 ± 0,42	1,5-2,5
Instar 6	6,0 ± 2,78	4,0-7,5	3,0 ± 0,37	2,3-4,0	3,0 ± 0,36	2,6-3,5	3,0 ± 0,29	2,8-4,2	2,0 ± 0,35	1,8-3,2
Instar 7	8,0 ± 2,93	5,0-10	4,0 ± 0,50	3,0-5,0	3,6 ± 0,41	3,0-4,0	4,0 ± 0,39	3,5-4,5	3,0 ± 0,40	2,5-2,5
Instar 8	8,4 ± 2,90	5,5-10,5	4,0 ± 0,52	3,7-5,2	3,8 ± 0,40	3,4-4,3	4,4 ± 0,44	3,5-5,2	4,0 ± 0,50	3,0-4,0
♂ Ad	9,0 ± 3,05	6,1-13,3	4,0 ± 0,49	4,0-5,5	4,2 ± 0,42	3,5-4,5	5,0 ± 0,53	4,3-6,0	4,0 ± 0,52	3,4-4,6
♀ Ad	14,0 ± 3,57	9,0-16,0	5,0 ± 0,52	4,5-6,0	5,0 ± 0,49	4,7-5,0	9,0 ± 0,70	8,5-9,5	9,0 ± 0,71	10-15,0



Survivorship (lx) and life expectancy (ex) of *Misumenops pallida*.

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