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Biology of Spider, *Cheiracanthium Melanostomum* (Thorell) Under Laboratory Conditions

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Abstract **– Investigation on the biology of spider, *Cheiracanthium melanostomun* (Thorell) was studied for the first time from sindh for Study on biology of spider, *Cheiracanthium melanostomum* on natural diets was carried out under lab conditions (27°C ± 2°C) from October to July 2011. For this purpose, one gravid female spider was kept in Petridis. After hatching twenty spider ling were kept in separate petridishes, the mean development period of 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, and 8th instars was 12.4±0.33, 20.95 ± 0.49, 17.10± 0.45, 36.50 ± 1.94, 17.05 ± 0.93, 23.55 ± 2.30, 20.40 ± 3.44 and 18.10 ± 3.40, respectively. Mean survival of male ranged between 211-222 days, whereas, female lived from 209-268 days. The result further showed that repopulation period of spider varied from 30-50 second, copulation period lasted up to 3-4 minutes; the incubation period lasted 14-15 days. The fecundity of each female ranged from 57-65 eggs. The fertility ranged between 46-53 eggs whereas, hatching ranged from 80-81.70%. The result further showed that maximum mortality took place in eggs up to 26.15% followed by 7.89-12.5% in 1st to 4th instars. Afterwards, mortality remained decreased 3.57-3.22% in 5th to 8th instars. The study further showed that male adults emerged in 6th instars whereas, female adults emerged in 8th instars and male female ratio was 6:21. The results obtained shall be useful for the researchers, progressive farmers, extension workers and all the stakeholders in the field of agriculture for suppression of the pest population through use of predatory spiders as biological control agents.**

Keyword **– Biology, Spider, Natural Diets, Repopulation Period and Biological Control.**

I. INTRODUCTION

The grower of Pakistan heavily depends on pesticides to get better yields. There has been a tremendous increase in pesticide application in Pakistan. Indiscriminate use of pesticides has created many problems of resistance, resurgence, emergence of new pests as well as environmental contamination. Resistance to insect pests is of critical importance. Besides pesticides have also disbalanced the natural ecosystem. Pesticides not only kill the harmful insect pests, but also kill the beneficial insects and have the residual effect on crop, fruits, vegetables and human health [1]. The use of biological control is a fundamental tactic for pest suppression within an effective Integrated Pest Management (IPM) program. Biological control refers to the use of natural enemies against pest population to reduce their density and damage to a level lower than would occur in their absence. Biological control as a management tool dates back over 1,000 years when ancient Chinese citrus growers used ants to control caterpillar larvae infesting their trees. [2]. It is one of the safest methods of control since it is not toxic, pathogenic or injurious to humans. Biological control has the advantage of being self-perpetuating once established and usually does not harm non target organisms found in the environment. In addition, it is not eigther polluting or as disruptive to the environment as chemical pesticides, nor does it leave residues on food, a concern to many people today. However, the use of biological control does require detailed knowledge of the biology and population dynamics of pest as well as the natural enemies associated with the pests and their impact. Control is usually not complete with this component of IPM since a residual population of the pest is often necessary for the natural enemies to remain in the environment, so some non economic population levels of pests must be acceptable or tolerated. Biological control also fits well in combination with other IPM strategies [3]. Recent trends in agriculture towards reduced pesticide use and ecological sustainability have lead to increased interest in spiders as potential biological control agents. Although the Chinese have augmented spider populations in field crops as a pest management strategy for centuries, much debate remains

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as to whether spiders will effectively control pest populations in U.S. agricultural ecosystems [4] and [5] .For a predator to effectively and economically control an insect pest, the predator must be capable of not only reducing pest densities to levels below an economic threshold, but also to stabilize those pest densities over time. If the pest population is not stable, the predator may drive the prey to local extinction, then die off itself, thus allowing for the potential of an unchecked secondary pest outbreak in the absence of this predator. Spiders may be capable of fulfilling both of pest reduction and pest stabilization requirements. Spiders are predatory arthropods that have two body segments, eight legs, no chewing mouth parts and no wings. They are classified in the order Araneae, one of several orders within the larger class of arachnida. The study of spiders is known as arachnology. All spiders produce silk, a thin, strong protein strand extruded by the spider from spinnerets most commonly found on the end of the abdomen. Many species use it to trap insects in webs, although there are also many species that hunt freely [6]. Silk can be used to aid in climbing, form smooth walls for burrows, and build egg sacs, wrap prey, and temporarily hold sperm, among other applications. Spiders feed on insects and some other arthropods. They can play important roles in pest control. More than 35000 species of spiders have been identified in the world and a total of 244 species of spiders are known in Iran [7]. Spiders prey on a vast range of potential pest species; they are predators during each stage of their development; they have long life-spans; they rapidly colonise fields; are resistant to starvation and dehydration and they do not migrate during low density prey periods. Thus, spiders may present a settling effect, which contributes towards maintaining the community balance. They should be considered an important component of the natural enemy complex [8]. Baseline information on life history and biology is fundamental for ecological work and is also important to further investigate the potential of spiders as biological control agents. However, life history studies have been done on very few species of spiders. One reason is the lack of reliable rearing methods to determine life histories and other biological data directly from laboratory cultures [9]. Keeping in view the importance of predatory spiders and pesticide pollution in agro-ecosystem, present research investigation on the biology of spider**,** *Cheiracanthium melanostomun* (Thorell) under laboratory conditions is planned. The results obtained shall be useful for the researchers, progressive farmers, extension workers and all the stakeholders in the field of agriculture for suppression of the pest population through use of predatory spiders as biological control agents.

II. Materials and Methods

The experiment on the biology of *Cheiracanthium melanostomun* (Thorell) was evaluated in the laboratory of Department of Entomology, Sindh Agriculture University, Tandojam during spring of 2010-2011.The biology of *Cheiracanthium melanostomum* was studied under laboratory conditions at 27 ± 2 °C, 65 ± 5% R.H. Initially, one gravid female Fig I was collected through plastic jar and hand sort method [10]; [11] and [12]. The gravid female was kept in a glass Petri dish (4 inch dia). After egg laying by the female, Fig II the fecundity and fertility (number of spider lings) hatched were recorded FigIII. The un-hatched eggs were considered as non fertile. Out of 48 hatched spider lings, 20 spider lings were kept in separate Petri dishes. The number of prey (aphid/jassid) given was 5 from 1st to 2nd instars. number of prey was increased up to 10 in 3rd and 4th instars later on 20 prey jassidand aphid were given 5th instars to adult stage. The developmental periods, number of molts and mortality in each stage of spiders were recorded. After reaching to their maturity, three pairs of spiders (male and female) were transferred into separate Petri dishes. Pre-copulation, copulation and post-copulation periods were recorded. As such, the life table study of spider was also carried out Mean and standard error of all stages was calculated.

III. Results and Discussion

The result of the experiment on the biology of spider under laboratory conditions in presented the data in Table I depicts the mean developmental periods of 20 spider lings from 1st instar to adult stage. The mean developmental period of 1st, 2nd, 3rd, 4th, 5th and 6th instar was 12.4 ± 0.33, 20.95 ± 0.49, 17.10 ± 0.45, 36.50 ± 1.94, 17.05 ± 0.93 and 23.55 ± 2.30 days, respectively. Out of 20 spider lings 3 adult males emerged in 6th instar, whereas, mean developmental period of 7th and 8th instar was 20.40 ± 3.44 and 18.10 ± 3.40 days. The data in Table II indicate that three adult males (134-135 days old) were released in Petri dishes containing adult females (191-200 days old). After release of 30-50 seconds in petridishes, males copulated with females which lasted for 3-4 minutes. The incubation period of eggs lasted from14-15 days with mean of 14.66 ± 1.56 days. No. of eggs laid by each female (fecundity) varied from 57 to 65. Some eggs did not hatch out due to unknown factors. The hatching percent of eggs ranged between 80.77% to 81.51%. Life table studies from egg to mature spiders in laboratory conditions Table III revealed that 17 eggs did not hatch out due to unknown reasons. In the 1st instar, 6 spiderlings died with mortality of (12.5%). As such, the mortality in 2nd, 3rd, 4th, 5th, and 6th instars was (9.52%), (7.89%), (11.42%), (3.22%) and (3.33%), respectively. Male adults emerged in 6th instar and female adults emerged in 8th intar. Whereas, the mortality in 7th and 8th instar was (3.44%) and (3.57%). Male-female sex ratio was (6:21). The data in Table IV show that maximum mean number of jassid/ aphid was consumed more by male than female spiderlings. 1st instar consumed maximum number of prey (0.94) than female spiderlings (0.72) Table IV -A. Similarly, maximum mean number of jassid/ aphid was consumed by males than females (2.55 and 1.44, 5.77 and 3.99, 8.08 and 6.02, 9.61 and 8.47, 10.51 and 8.44) as shown in Table IV - B, Table IV - C, Table IV - D, Table IV - E and Table IV - F. Maximum mean number of jassid/ aphid was consumed by females (8.63) and

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(9.06) in 7th and 8th instar as shown in Table IV - G and Table IV-H. The adult males consumed maximum number of prey/ food which resulted early adult emergence in 6th instar, whereas females consumed comparatively less number of jassid/ aphid (prey) and took longer time to become adult. Investigation on the biology of spider, *Cheiracanthium melanostomun* (Thorell) was studied first time from sindh. The study showed that male adults emerged in 6th instar whereas; female adults emerged in 8th instar. The results further revealed that maximum mortality took place in egg up to (26.15 %), followed by (7.89-12.55 %) in 1st to 4th instars. Afterwards, mortality remained decreased (3.57-3.22 %) in 5th-8th instars. Male: female ratio was 6:21. In the present investigation, the females showed strange behavior which consumed males quickly after mating. This could be due to the need of extra protein needed by the females for egg laying. However, the females lived longer from 209 to 268 days under laboratory conditions. In contrast, the males lived shorter from 211 to 222 days. The size of female was comparatively larger than male. The feeding efficiency of immature stages of both sexes showed that males consumed more number of preys (jassid/ aphid) in comparison to females. Due to more consumption of food in 1st to 6th instars, the males reached earlier to maturity and emerged as adults in 6th instar, whereas, females consumed comparatively low number of preys and emerged as adults in 8th instar. This investigation part is new which shows maximum consumption by the males and early adult emergence than females; The results of present investigations partially agree with those of [13] who described the biology of aberrant saltioid spider, *Euryattus thorell.*The adult males spin neither webs nor suspension nests. Females oviposit inside their suspension nests, but if denied access to leaves for suspension, they spin and oviposit in webs similar to those spun by juveniles for moulting. The flat, papery egg sacs of *Euryattus* are atypical for a salticid, being more like the egg sacs of many of the Gnaphosidae. Intraspecific display behavior has characteristics in common with typical salticids, but also includes unique features. Male courtship includes vibratory displays performed on the surface of the suspended leaf. Mating occurs inside the curled-up leaf, but in present study pairs of spiders were released in Petri dishes and natural diet was provided. [14] Who reported that the *Neoscona nauticus* (Argiopidae) preyed upon *Aphis gossypii*, *Nysius vinitor* and *Graptostethus servus* which infested cotton and sunflower crops. It preferred feeding on *A. gossypii*, than on *N. vinitor* and *G. servus* and consumed on an average 8.3, 5.7 and 5.3 adults of *A. gossypii, N. vinitor* and *G. servus*, respectively, after 24 hr of starvation. [15] Evaluated the feeding capacity of spiders on different pests of cotton in the laboratory. *P. birmanica* was found one of the dominant spiders in the cotton agro ecosystems. The rate of predation was found varying in different developmental stages and between the sexes. Sub adult and adult females were found to be having a high feeding capacity on four insect pests, *Aphis craccivora, Amrasca biguttula, Tricentrus bicolor, Heliothis armigera* of cotton. [16] Determined feeding potential of 14 species of spiders on *Aphis craccivora* infesting cotton. The feeding efficiency varied with the life stage and sex of the spiders. Adult females consumed more number of preys than adult males and sub adult stages. Among the 14 species tested, *Lycosa poonaensis* and *L. tista* consumed the highest number of prey. [13] Determined the predatory potential of spiders on insect pests of okra. The spiders collected from okra were *Argiope pulchella*, *Crybophora cicatrosa* (*Cyrtophora cicatrosa*), *Crybophora citricola* (*Cyrtophora citricola*), *Gasteracantha geminata*, *Gasteracantha kuhlii*, *Hippasa lycosina*, *Leucauge celebesiana*, *Neoscona shillongensis*, *Neoscona nautica*, *Oxyopes* sp., *Peucetia prasina*, *Salticus* sp. and *Zygeilla melonocrania* (*Zygiella melonocrania*). *Salticus* sp. was the most potential predator among the 13 species of spiders. Among the pests, *Aphis gossypii* followed by *Spodoptera litura* were consumed by majority of the spiders. Present study is different from earlier workers who reported maximum feeding ability of females in adult stage. However, present investigation male spiderlings up to 6th instar consumed maximum number of prey (jassid/ aphid) and males emerged earlier in 6th instar than females which emerged in 8th instar. In present study, 3 males were consumed by the female spiders and no study was carried out on separate feeding potential of both sexes.

IV. Conclusions and Suggestions

It is concluded from the result that:

1) Copulation period lasted up to 3 minutes
2) Females laid 57-65 eggs.
3) Hatching percent ranged between 80.77% to 81.51%.
4) Male adults emerged in 6th instar whereas; female adults emerged in 8th instar.
5) Male spiderlings consumed more number of prey up to 6th instar than female.
6) Female consumed male just after mating.
7) Mean incubation period lasted upto 14.66 ± 1.56 days
8) Male female ratio was 6:21.
9) Mean survivorship was 206.5 ± 3.21.

Suggestions

- More studies can be carried out to confirm present findings.
- Mortality factors need to be investigated.
- Biology of spider *Cheiracanthium melanostomun* can be carried out at different temperatures for rearing this predacious spider.
- Mass rearing of the spider should be done in lab for releases against pests in field.

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Research Publications: 1/ Suliman A. Ibrahim Ali, Samira A. Mohamed, Mohammed E. E. Mahmoud, Salih. A. I. Sabiel, Saqib Ali and **Arif Ali.** 2014. Monitoring of Tephritidae of Fruit Trees and Their Level of Infestation in South Kordofan State, Sudan. International Journal of Agriculture Innovations and Research, Volume 2, Issue 5, 2319-1473

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1/ Mohammed E. E. Mahmoud*[1], Suliman A. Ibrahim[1], Hassbelrasul A. Mohamed [2] Recommendation of Cruiser 350 FS (Thiamethoxam) against the green bug *Schizaphis graminum* (Rondani) and termite on Wheat in 80th meeting of the national pests and diseases committee , June 2009 in Agricultural Research Corporation ,Wad Medani , Sudan.

2/Mohammed E. E. Mahmoud*1 , Suliman A. Ibrahim [1] , Hassbelrasul A. Mohamed 2and Francis Leju Oji 1 Prospects of Using Cruiser®350 FS (thiamethoxam) to Control Greenbug Schizaphis graminum (Rond.) on Wheat. Persian Gulf Crop Protection Volume 1 Issue 4, December 2012 Pages 1-4.

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6/ Suliman A. Ibrahim Ali, Samira A. Mohamed , Mohammed E. E. Mahmoud[1], Salih .A.I.Sabiel, Saqib Ali and Arif Ali Monitoring of Tephritidae of Fruit Trees and Their Level of Infestation in South Kordofan State, Sudan.International Journal of Agriculture Innovations and ResearchVolume 2, Issue 5, ISSN (Online) 2319-1473.

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Suliman A. Ibrahim Ali**,** Samira A. Mohamed , Mohammed E. E. Mahmoud[1], Salih .A.I.Sabiel, Saqib Ali and Arif Ali Monitoring of Tephritidae of Fruit Trees and Their Level of Infestation in South Kordofan State, Sudan.International Journal of Agriculture Innovations and ResearchVolume 2, Issue 5, ISSN (Online) 2319-1473

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Table I: Mean development period of spider lings.

S.NO.	1st Instar	2nd Instar	3rd Instar	4th Instar	5th Instar	6th Instar (Adult Male)	7th Instar	8th Instar (Adult female)	Survival of spiders
R-1(Male)	12	20	17	38	18	29	0	0	211 days
R-2	12	23	16	38	20	25	31	30	241 days
R-3	11	23	15	38	19	0	0	0	114 days
R-4	11	24	13	40	19	28	31	28	263 days
R-5	11	20	21	37	16	28	32	33	209 days
R-6 (Male)	14	18	20	38	16	28	0	0	211 days
R-7 (Male)	14	20	16	40	18	27	0	0	222 days
R-8	12	23	17	37	19	29	32	31	221 days
R-9	13	21	15	0	0	0	0	0	53 days
R-10	13	18	17	40	18	28	31	29	254 days
R-11	11	23	17	37	18	28	31	30	228 days
R-12	11	24	18	35	18	30	31	30	254 days
R-13	15	21	17	38	18	30	0	0	142 days
R-14	15	20	17	38	19	27	28	27	240 days
R-15	11	16	18	38	19	31	34	33	214 days
R-16	11	21	20	39	17	27	29	28	243 days
R-17	11	22	19	39	18	0	0	0	114 days
R-18	12	23	15	41	18	27	31	30	268 days
R-19	13	21	15	41	15	24	33	0	172 days
R-20	15	18	19	38	18	25	34	33	256 days
Mean ± S.E	12.4 ± 0.33	20.95 ± 0.49	17.10 ± 0.45	36.50 ± 1.94	17.05± 0.93	23.55 ± 2.30	20.40. ± 3.44	18.10 ± 3.40	206.5 ± 3.21

R: Replication only R1, R6 and R7 males while all other Replication is females

Table II Pre-copulation period, pre-copulation, copulation, incubation period, Fecundity, fertility and Hatching % spider Cheiracanthium melanostomum under laboratory conditions

S. No. of Females	Precopulation period		Pre-copulation activity in petridishes	Copulation	Incubation	No of eggs laid by each female (Fecundity)	No of hatched spiderlings (Fertility)	Hatching %
	Male	F. Male						
1	134	196	30 seconds	4 minutes	15 days	65	53	81.53%
2	134	199	50 seconds	3 minutes	15 days	60	48	80%
3	135	196	30 seconds	4 minutes	14 days	57	46	80.70%
Mean ± S.E	134.33 ±0.57 days	197±1.73 days	36.66 ± 2.47 seconds	3.66 ± 0.78 minutes	14.66 ± 1.56 days	60.66 ± 3.17	49 ± 2.85	80.77% ± 3.66

R: Replication only R1, R6 and R7 males while all other Replication is females

Table III: Life table studies of one pair of spider Cheiracanthium melanostomum under laboratory conditions.

X (Stage of spiders)	Lx (No survived at the beginning)	Dx (Mortality)	D x F (Mortality Factors)	(qx) Mortality%
Eggs	65	17	Stress due to unknown factors	26.15
1st instar	48	6	-	12.5%
2nd instar	42	4	-	9.52%
3rd instar	38	3	-	7.89%
4th instar	35	4	-	11.42%
5th instar	31	1	-	3.22%
6th instar	30	1	-	3.33%
7th instar	29	1	-	3.44%
8th instar	28	1	-	3.57%
Sex ratio	Male: Female 6 : 21	-	-	-

R: Replication only R1, R6 and R7 males while all other Replication is females

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Table IV-A. Feeding efficiency of 1st instar spiderlings per 3-days and adult emergence period under laboratory conditions during from 20-10-2010 to 6-11-2010.

Replication	Date of Observations						
	20-22	23-25	26-28	29-31	1-3	4-6	Mean
R-1(Male)	1	2	1	1	1	1	1.16
R-6(Male)	1	0	1	1	2	0	0.83
R-7(Male)	1	1	0	1	1	1	0.83
Overall Mean							0.94
R-12 (Female)	1	0	0	1	0	1	0.5
R-14 (Female)	0	1	0	1	1	1	0.66
R-20 (Female)	1	1	1	1	1	1	1
Overall Mean							0.72

R: Replication only R1, R6 and R7 males while all other Replication is females

Table IV -B. Feeding efficiency of 2nd instar spiderlings per 3-days and adult emergence period under laboratory conditions during from 7-11-2010 to 24-11-2010.

Replication	Date of Observations						
	7-9	10-12	13-15	16-18	19-21	22-24	Mean
R-1(Male)	2	2	3	3	2	3	2.5
R-6(Male)	2	3	3	2	3	3	2.66
R-7(Male)	3	2	3	1	3	3	2.5
Overall Mean							2.55
R-12 (Female)	2	0	1	1	1	2	1.16
R-14 (Female)	1	2	2	1	2	1	1.5
R-20 (Female)	2	2	1	2	1	2	1.66
Overall Mean							1.44

R: Replication only R1, R6 and R7 males while all other Replication is females

Table IV –C. feeding efficiency of 3rd instar spiderlings per 3-days and adult emergence period under laboratory conditions during from 25-11-2010 to 12-12-2010.

Replication	Date of Observations						
	25-27	28-30	1-3	4-6	7-9	10-12	Mean
R-1 (Male)	4	5	5	6	5	6	5.16
R-6 (Male)	6	6	7	7	6	5	6.16
R-7 (Male)	6	6	5	6	7	6	6
Overall Mean							5.77
R-12 (Female)	3	4	3	4	2	5	3.5
R-14 (Female)	5	4	3	3	4	5	4
R-20 (Female)	4	5	4	4	4	5	4.33
Overall Mean							3.99

R: Replication only R1, R6 and R7 males while all other Replication is females

Table IV –D. feeding efficiency of 4th instar spiderlings per 3-days and adult emergence period under laboratory conditions during the period from 13-12-2010 to 20-1-2011.

Replication	Date of Observations												
	13-15	16-18	19-21	22-24	25-27	28-30	31-2	3-5	6-8	9-11	12-14	15-17	18-20	Mean
R-1(Male)	7	8	9	8	9	7	8	8	9	9	8	7	9	8.27
R-6 (Male)	9	8	9	8	8	7	9	9	8	8	9	9	9	8.45
R-7 (Male)	8	8	7	9	9	8	8	7	9	8	5	7	6	7.54
Overall Mean														8.08
R-12 (Female)	7	6	7	6	7	6	7	5	4	5	7	5	4	5.72
R-14 (Female)	5	4	5	7	6	4	5	6	5	4	5	6	7	5.45
R-20 (Female)	8	6	7	6	7	8	5	7	4	6	8	6	3	6.9
Overall Mean														6.02

R: Replication only R1, R6 and R7 males while all other Replication is females

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Table IV –E. Feeding efficiency of 5th instar spiderlings per 3-days and adult emergence period under laboratory conditions during time from (21-1-2011 to 7-2-2011)

Replication	Date of Observations						
	21-23	24-26	27-29	30-1	2-4	5-7	Mean
R-1(Male)	10	9	10	9	9	10	9.5
R-6 (Male)	11	9	10	11	10	9	10
R-7 (Male)	9	11	9	8	9	10	9.33
Overall Mean							9.61
R-12 (Female)	8	8	6	7	9	6	7.33
R-14 (Female)	8	8	7	6	7	5	6.83
R-20 (Female)	8	7	8	7	8	9	7.83
Overall Mean							8.47

R: Replication only R1, R6 and R7 males while all other Replication is females

Table IV – F. Feeding efficiency of 6th instar spiderlings per 3-days and adult emergence period under laboratory conditions during time from 21-1-2011 to 8-2-2011.

Replication	Date of Observations								
	13-15	16-18	19-21	22-24	25-27	28-30	31-2	3-5	6-8	Mean
R-1 (Male)	11	10	12	9	12	10	12	11	12	11
R-6 (Male)	11	11	12	9	10	11	12	9	11	10.66
R-7 (Male)	12	10	10	8	9	9	10	11	10	9.88
Overall Mean										10.51
R-12 (Female)	8	7	9	8	10	6	10	9	9	8.44
R-14 (Female)	9	8	8	8	9	10	9	8	8	8.55
R-20 (Female)	10	8	9	6	8	8	9	8	9	8.33
Overall Mean										8.44

R: Replication only R1, R6 and R7 males while all other Replication is females

Table IV -G. Feeding efficiency of 7th instar spiderlings per 3-days and adult emergence period under laboratory conditions during time from 9-2-2011 to 10 -3-2011.

Replication	Date of Observations									
	9-11	12-14	15-17	18-20	21-23	24-26	27-1	2-4	5-7	8-10
R-12 (Female)	9	8	10	8	10	7	10	10	9	8
R-14 (Female)	10	9	7	9	8	10	10	8	8	9
R-20 (Female)	10	8	9	6	8	8	9	8	9	7
Overall Mean										8.63

R: Replication only R1, R6 and R7 males while all other Replication is females

Table IV -H Feeding efficiency of 8th instar spiderlings per 3-days and adult emergence period under laboratory conditions during the time from 10-3-2011 to 9-4 -2011.

Replication	Date of Observations									
	11-13	14-16	17-19	20-22	23-25	26-28	29-31	1-3	4-6	7-9
R-12 (Female)	10	9	11	8	9	8	10	11	10	8
R-14 (Female)	10	10	8	9	7	9	9	9	10	6
R-20 (Female)	11	9	8	9	9	10	9	9	10	7
Overall Mean										9.06

R: Replication only R1, R6 and R7 males while all other Replication is females


Fig.I. Female Adult


Fig.II. Female eggs

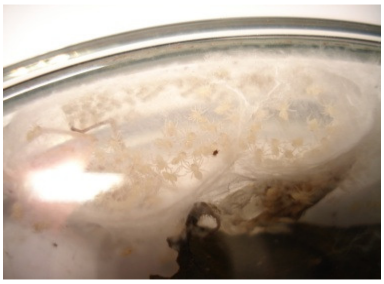
Fig.III. Hatching Eggs

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