

**Effect of Solitary Versus Group Rearing on Biological Aspects
of *Theridion spinitarse* Cambridge (Araneae: Theridiidae)
on *Spodoptera littoralis* Boisd. Larvae**

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ABSTRACT

Biological aspects of solitary versus group rearing of *Theridion spinitarse* Cambridge (Araneae: Theridiidae) on *Spodoptera littoralis* Boisd. Larvae under 30°C and 60-70% R.H. were considered. Developmental durations did not differ between the two situations. Males and females reached maturity after the fifth spiderling. Life cycle was 60.89, 63.33, 55.1 and 62.1 days for males and females under solitary and group rearing, respectively. Adult longevity, lifespan, fecundity of female and food consumption were recorded. Results indicated that group rearing favored better biological aspects than individual rearing under same conditions as well as female's specific data. Pre-oviposition period was shorter in group rearing compared with solitary one (i.e. 12.2 versus 25.73 days, respectively). Oviposition period was longer for group rearing with higher fecundity per female (i.e. 62.3 versus 41.82 days). Fecundity was 158.30 versus 99.00 eggs/female, respectively. It was concluded that better emulation of natural conditions for the organism results in more accurate biological aspects data.

Key words: *Theridion spinitarse*, Solitary versus group rearing, Life history, Fecundity, Theridiidae, Egypt.

INTRODUCTION

Spiders have a wide host range where they feed on arthropods and can play an important role in pest control. Knowledge of the biological characters for different spider species as predator of insect pests has been targeted by scientists around the world. Mass rearing of natural enemies is a key factor in biological control studies and their after evaluating their potential in bio-control.

Family Theridiidae is one of the largest families of spiders including 24 species of 10 genera in Egypt (El-Hennawy, 2006) from 2420 species and 121 genera all over the world (Platnick, 2014). *Theridion* is the largest genus of the theridiids and considered as one of the largest genera amongst all spiders (Levy and Amital, 1982). It has more than 587 species worldwide (Platnick, 2014), of which *Theridion spinitarse* Cambridge (Araneae: Theridiidae) is one of 8 species recorded of genus *Theridion* in Egypt (Ahmad and Heikal, 2016). *T. spinitarse* was firstly described from female specimens only collected on a low plant near Cairo by Cambridge (1876). Knoflach *et al.* (2009) re-described female specimens collected from Asswan, Egypt. Description of the male was conducted by El-Hennawy & Ahmad (In Press).

Biological characteristics of *T. spinitarse* at 25°C was reported by Ahmad and Heikal (2016).

A mass rearing method for *Erigone atra* (Blackwall) (Araneae: Linyphiidae) by feeding on *Collembola* species, *Lepidocyrtus lanuginosus* (Gmelin) (Entomobryidae) as a continuous available prey source. Once per week vestigial-wing fruit flies

of *Drosophila melanogaster* Meigen (Diptera: Drosophilidae) were provided as additional prey. In addition, the rearing boxes were filled with wood-wool serving spiders as points of contact for their webs. *E. atra* was bred over 12 generations in two years (Dinter, 2004).

Mass rearing of *Kochiura aulica* (Koch, 1838) was conducted and successfully used experimentally under green house as main predator for arthropod pests (Ahmad *et al.*, 2009).

This study aimed at evaluating solitary versus crowded rearing of *T. spinitarse* on *S. littoralis* second larval stage at 30±1°C and 75±10% R.H.

MATERIALS AND METHODS

Solitary rearing:

T. spinitarse adult females were collected from mango, citrus and grape trees in Fayoum, El-Sadat sector, Menoufia governorates. Identification of the species depended on the re-description of El-Hennawy and Ahmad (in press). Biological study of the spider was performed under constant temperature (i.e. 30 ±1°C) and 60 - 70% R.H. Newly hatched spiderlings were placed separately in plastic vials (3 cm diameter x 5 cm height). First and second spiderlings were fed, every two days, on *S. littoralis* 1st larval instars' stage. Later spiderlings were fed on 2nd instars. Thirty spiderlings were reared as replicates.

Group rearing:

Life cycle of *T. spinitarse* was studied in groups (5 individuals each) under the same laboratory conditions. Fifteen groups (as replicates) of five

newly hatched spiderlings were placed in a plastic cup with a semi-circular lid (250 ml). Spiderlings were fed, every two days, on *S. littoralis* 2nd instars.

Both types of rearing was monitored for total spiderling durations, longevity, life cycle duration, generation, survival, food consumption, sex ratio, number of egg sacs and eggs per female.

Rearing of *S. littoralis*:

S. littoralis was reared according to Ahmed (2009). All stages were kept in glass jars covered by muslin and cultured under room emperature. Larvae were reared on washed and dried leaves of castor-oil plant, *Ricinus communis* (L.). Larval feces were removed and old leaves were replaced by fresh ones every two days. As larvae reached the fifth stage, saw dust was placed in the jars for pupation. Pupae were collected and placed in separate jars. Newly emerged adults were allowed to mate. The rearing jars were lined with paper to provide an egg laying site. Egg masses were daily removed and transferred to clean jars. Larval stages from these egg masses were used as a prey for the spider.

RESULTS AND DISCUSSION

T. spinitarse developmental durations of solitary reared ones are presented in Table (1).

All replicates reached adult stage as 13 males and

17 females and both reached maturity after 5 stages of spiderlings. Total spiderlings durated 48.89 and 51.33 days for male and female; while adult longevity was 68.78 and 78.00 days for male and female, respectively. Life span averaged 129.67 and 141.33 days, respectively. Relative durations (at 25°C and 60-70% R.H.) for males and females were 67 & 72.27 days for total spiderlings; 93.17 & 83.00 days for adult longevity and 160.17 & 155.27 days for life span, respectively (Ahmad and Heikal 2016). Reduced obtained values were attributed to the higher temperature used in this study.

Food consumption of solitary reared *S. littoralis* larvae by *T. spinitarse* different stages at 30±1°C and 75±10% R.H. is presented in Table (2).

Average number of consumed preys during total spiderlings duration was 80.65 and 91.78 larvae by male and female, respectively. The average number of consumed preys during adult longevity was 68.78 and 222.78 larvae by male and female, respectively. Daily rate increased as the individuals grew. It increasead from 0.5 to 3.42 for males and from 0.58 to 2.9 for females (Table 2). Relative values (at 25°C and 60-70% R.H.) for males and females were 96 & 103.9 consumed preys during total spiderlings duration and 247.3 & 227.1 during adult longevity, respectively (Ahmad and Heikal, 2016). They reported daily rate as 1.1 to 2.7 and 1.2 to 2.8 for males and females, respectively.

Table (1): Developmental durations in days of solitary reared *T. spinitarse* on 2nd *S. littoralis* larvae at 30±1°C and 75±10% R.H.

Developmental stage	Male			Female		
	Mean	SD	Range	Mean	SD	Range
Incubation period	12.00	0.00	12.00	12.00	0.00	12.00
1st spiderling	5.00	2.12	4 – 10	5.33	2.65	4 - 10
2nd spiderling	8.33	3.20	7 – 14	9.44	2.55	7 - 14
3rd spiderling	10.11	2.42	5 – 14	13.33	6.61	11 - 24
4th spiderling	11.11	2.80	8 – 14	8.56	0.73	8 - 10
5th spiderling	14.33	3.32	9 – 18	14.67	4.80	9 - 22
Total spiderlings	48.89	4.11	40 - 54	51.33	4.50	48 - 62
Life cycle	60.89	4.11	52 - 66	63.33	4.50	60 - 74
Adult longevity	68.78	7.36	61 - 79	78.00	12.85	56 - 96
Life span	129.67	5.79	125-135	141.33	11.61	129 -162

Table (2): Food consumption of solitary reared *T. spinitarse* on *S. littoralis* larvae at 30±1°C and 75±10% R.H.

Developmental Stage	Male				Female			
	consumed larvae			Daily rate	consumed larvae			Daily rate
	Mean	SD	Range		Mean	SD	Range	
1st spiderling	2.33	0.50	2 - 3	0.50	3.44	2.96	2 – 10	0.58
2nd spiderling	8.00	3.00	6 - 14	1.03	9.33	5.07	5 – 21	0.94
3rd spiderling	16.11	2.62	14 - 20	1.75	22.78	8.50	14 – 35	1.92
4th spiderling	21.78	4.49	16 - 24	2.07	19.11	7.96	9 – 29	0.57
5th spiderling	32.33	7.09	22 - 40	2.34	37.11	9.16	27 – 47	2.62
Total spiderlings	80.65	12.84	60 - 91	1.64	91.78	12.96	82 – 121	1.79
Adult longevity	68.78	7.36	58 - 79	3.42	222.78	25.14	165 – 240	2.90

Table (3): Biological aspects of group reared *T. spinitarse* fed on 2nd *S. littoralis* larval stage of at 30±1°C and 75±10% R.H.

Parameter	Mean	SD	Range
Survival ratio	0.80	0.10	0.6 - 1
Sex ratio (males/total).	0.40	0.10	0.3 - 0.5
Male lifecycle (days)	55.10	2.00	49 - 56
Female lifecycle (days)	62.10	2.00	56 - 63
Longevity (days)	84.30	10.30	64 - 100
Prey consumption during spiderlings	197.27	3.86	192 - 202
Prey consumption during longevity	2030.93	268.08	1600 - 2500

Table (4): Female specific data of *T. spinitarse* for solitary versus group reared on *S. littoralis* 2nd stage at 30±1°C and 75±10% RH.

Parameter	Solitary rearing			Group rearing		
	Mean	S.D.	Range	Mean	S.D.	Range
Pre-oviposition period (days)	25.73	7.25	13-36	12.2	3.1	10 -19
Oviposition period (days)	41.82	13.25	20-58	62.3	11.1	40-80
Generation time (days)	81.33	5.07	75-89	67.3	2.5	66 - 72
Post-oviposition period (days)	15.45	6.36	6 - 26	9.9	1.7	5 -12
Number of eggs/egg sac	28.82	8.28	19-43	38.4	3.92	30-45
Number of egg sacs/female	3.55	0.82	3 - 5	4.13	0.99	2.80 -5.33
Fecundity/female	99	25.96	72-132	158.3	42.2	112-270

Biological aspects parameters of *T. spinitarse* group rearing are presented in Table (3).

Results indicated survival ratio as eighty percent and sex ratio as forty percent males. Individual spiderling durations for males and females were not possible within group rearing. Mean male and female life cycle was determined as 55.1 and 62.1 days, respectively. Mean prey consumption during spiderlings was 197.27 larvae/spiderling (regardless of sex). Prey consumption during longevity per group was determined as 2030.93 larvae/group (Table 3).

Female specific data of *T. spinitarse* for solitary versus group reared on 2nd stage of *S. littoralis* at 30±1°C and 75±10% R.H. are presented in Table 4.

Obtained results indicated that *T. spinitarse* group rearing gave better female specific values. Pre-oviposition period decreased from 25.73 to 12.2 days; while oviposition period increased from 41.82 to 62.3 days. Generation time decreased from 81.33 to 67.3 days; while fecundity/female increased from 99.00 to 158.30 eggs/female. Shorter generation time with greater fecundity would increase the capacity of a population increase (Birch, 1948).

Spider females hanged their egg sacs in the wiping in the upper part of the rearing container. It was concluded that group rearing in the selected containers (with semicircular cover) provided more proper site for oviposition. This reduced energy used by females in preparing proper site for egg sacs deposition. No social behavior was observed for this spider.

It was concluded that better emulation of natural conditions for the organism results in more accurate biological aspects results.

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