

Biology of *Stethorus punctillum*, a Potential Predator of *Tetranychus ludeni*

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ABSTRACT

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Stethorus spp. are among natural enemies of spider mites so far identified in the world. In this study, biology and feeding ability of *Stethorus punctillum* were studied as predator of the spider mite *Tetranychus ludeni*, under laboratory conditions (27°C, 65% RH). The predator completed its developmental stages (egg, four instars larvae, and pupae) within an average of 17.35 ± 7.12 days (15-29 days). The 4 instars larvae took only 44.55% of the total developmental time. Mean life history of the predatory completed in 37 ± 12.5 days with an average ovipositional period of 15.32 ± 10.25 days. The daily and total fecundity recorded are 7.8 ± 3.3 and 121 ± 22.5 eggs, respectively. Concerning the consumption of the prey, 6.19 active mite stages were needed by the predator to lay down an egg. The abilities of predation of the four larval instars constituted 16.47% of prey consumption and the mean daily prey consumption during the predatory life span was recorded as 26.45 of active spider mites.

Keywords : Biology, predation, *Stethorus punctillum*, *Tetranychus ludeni*

Most of *Stethorus* species identified so far in the world are reported as tetranychid predators in all agro-ecosystems. Several of them have been identified as a potential biological control agents of spider mites in agricultural crops (9). The degree of their adaptation as well as their efficiency in controlling mite populations observed

varies with the species and the environmental conditions (3). Out of the 1200 spider mite species reported in the world (1), only few percentage of them are considered major phytophagous mites in many agricultural crops. Investigation into the potential use of predatory mites or insects to control mite pests received a greater attention for a reduction of chemical damages to the environment. The voracious feeding of injurious mites by *Stethorus* spp. keep them as appropriate effective biological control agents, particularly on tetranychid mites (7). The sixty species of these small coccinellid

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identified so far (3) are well capable to reduce extensive damages caused by mite pests. This group of mite predator's mites possess higher daily rate of oviposition, total fecundity and longevity (8) with better adaptability to hot climate conditions than predatory mites which are generally less active or their population remained insufficient to compete with mite pest outbreaks. The searching ability of this winged predators, enable them for better locating and identifying mite colonies under outdoor (2) and indoor conditions (11) as compared to other acarine natural enemies. According to Haffaker and Rosen (4), a predator is a reliable regulator of its prey at low densities, if he has a great capacity for research, which would enable it to prevent the prey of causing economic damage. A similar concept has also been demonstrated by Larry *et al.* (6), if a predator is an effective regulator of its prey, it is able to regulate its population at low densities and prevents inflict damage to the host plant. In this context, the voracious mite predator's, *Stethorus punctillum* (Palearctic species), is reported as one of the most important biocontrol agents of spider mite in agricultural crops and is now released in North America to control *Tetranychus urticae* (10). The study of the life history and the feeding behavior of this predator under laboratory conditions may evaluate its predatory impacts on spider mite pest for better utilization in integrated mite control program.

S. punctillum was found widely distributed on many field, orchard and ornamental crops during summer months and a population was collected for mass rearing and biological activities to be studied under laboratory conditions (27°C, 65% R.H.). The rearing of *S. punctillum* was established in the laboratory under

room conditions from May to July. The predator was collected and kept in plates containing infested bean leaves by prey mites (*Tetranychus ludeni*). Eggs of the predator laid within the first three days were transferred singly into infested mulberry leaf with known number of mobile *T. ludeni* stages. Each mulberry leaf was placed on the wet cotton wool in a 10 cm diameter glass Petri dish with the upper side down. Twenty sets were studied until larvae reach adult maturity for determining individual life cycle. Daily prey consumption by *S. punctillum* at four larval and adult stages (pre-oviposition and oviposition periods) were studied by putting abundant and constant number (more than 50 active prey mite stages) of *T. ludeni* on each Petri dish at 24 hours intervals. The killed mites were removed from leaf and active prey mite stages substituted them on infested leaf. The fresh mulberry leaf with prey mites was also substituted at every three days to regulate food preys supply through predator life span. The incubation period and other developmental stages were recorded at the same interval periods to determine developmental stage, longevity, daily and total fecundity of the predator.

The developmental stages of *S. punctillum* observed as egg, four larval instars, pupa and adult with the pattern of predations on prey mites and feeding potentiality are given in Table 1. **Egg** is elongated, oval and generally pale creamy color. Gradual color changes occur from creamy to orange during the incubation period. Eggs are scattered singly on leaf lamina and adhere tightly to the leaf surface (Fig. 1). An average of 5.50 ± 2.60 days was required to hatch out into larva (Table 1) and no mortality was recorded on egg predator hatching. **Larva** is blackish in color with many long branched hairs and

black patches on upper surface of the body (Fig. 2). The four larval stages were completed within 7.73 ± 3.24 days (Table 1) which constituted 45% of the total developmental time, while *Stethorus picipes* was about 60% when reared on *Oligonychus punicae* at laboratory conditions (12). The larval periods during I and II instars were shorter and more active with a preference to prey eggs and larvae. The same phenomenon for III and IV instars utilizing more nymphal prey stages was recorded. As the larva matures, it becomes reddish, at first on the edges of the body, and just prior to pupation, the entire larva turns into reddish (Fig. 2). Total *T. ludeni* consumed by all four instars larvae of *S. punctillum* constituted 16.47%, while Ragkou *et al.* (9) reported an amount of *T. urticae* consumption during larval stages of *S. punctillum* of 53.4% in the laboratory conditions. **Pupa** is the only inactive stage of the coccinellid with flattened blackish color at early pupal stage that turned later into orange reddish before emerging as adult stage (Fig 3). This period varied between 3 to 9 days with mean of 3.45 ± 2.83 days (Table, 1). Tanigoshi and McMurtry (12) reported that pre-pupa (0.5-0.97 day) and pupa (3.33-3.83 days) stages constituted about 30% of developmental time for female of *S. picipes* when reared on *O. punicae* in the laboratory conditions. Small blackish **adult** predator emerged from pupa (Fig. 4) and searched different sites of leaf lamina for *T. ludeni*. The egg to adult developmental stages under similar environmental conditions lasted 17.35 ± 7.12 days (Table 1) and this was higher than normal developmental stages of prey mite. Tanigoshi and McMurtry (12) reported that combined development duration of female and male of *S. picipes* when reared on *O. punicae* at 22-26°C, was 16.88 and 17.32 days, respectively.

Oviposition: The egg laying was initiated within the first three days when the adult reached maturity. The 40 to 50% of total fecundity was observed within the first 7 days of ovipositional period. The maximum daily fecundity recorded (10-11 eggs/day) was found correlated with the peak of predation ability (Table, 1). The daily and total fecundity of *S. punctillum* observed were 7.8 ± 3.3 and 121 ± 22.5 eggs, respectively. The pattern of egg depositing on leaf surface was irregular. Eggs were laid either singly or in the form of patches (4-5 eggs/ site). Mean daily and total fecundity of *S. picipes* reared on *O. punicae* were reported as 3.70 and 221 eggs. **Predation capacity:** All prey stages were attacked by the four larval stages as well as the adult predator. This kind of prey feeding was also reported by some researchers (6, 9, 12). But larval stages of the predator prefer immature stages of prey mites whereas adult predator was mostly observed feeding either on deutonymphal or adult prey mite. Chazeau (3) also reported similar feeding ability by *Stethorus* spp. The silk woven by spider mites was reported as a barrier of predation while these phenomena was observed without any negative effect on the rate of prey mite feeding by *S. punctillum*. This was due to the strong mandibles of the predator which enable it to locate mites under webs and to lift them to an other site. The period of predation according to the size of mites varied and complete feeding of a prey mite took between 30 seconds to one minute. In this concern, Hassel *et al.* (5) reported that the functional response of a natural enemy derives from its attack rate and the handling time devoted to search individual prey. A maximum of 79 prey mite stages was consumed by this primary mite predator within 24 hours. On an average of 37 days life span of *S. punctillum*, this

predator fed on 979.05 ± 177.5 mites (26.12 active mite stages/day). The amount feeding by *S. punctillum* in present finding was found two-three times more than consumption capacity of other predatory mites and if released at critical mite pest

time, considerable reduction in mite population would happen.

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RESUME

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Stethorus spp. sont parmi les ennemis naturels des acaréens phytophages identifiés dans le monde. Dans cette étude, la biologie et la capacité prédatrice de *Stethorus punctillum* sont étudiées en tant que prédateur de l'acarien phytophage *Tetranychus ludeni* au laboratoire (27°C, 65% HR). La durée de développement des différents stades (oeuf, quatre stades larvaires et nymphe) est en moyenne de 17.35 ± 7.12 jours (15-29 jours). Les 4 stades larvaires durent seulement 44.55% de toute la durée de développement. La longévité moyenne du prédateur est de 37 ± 12.5 jours avec une période d'oviposition moyenne de 15.32 ± 10.25 jours. Les fécondités quotidiennes et totales enregistrées sont 7.8 ± 3.3 et 121 ± 22.5 oeufs, respectivement. Concernant l'alimentation sur la proie, 6.19 stades actifs de l'acarien devraient être consommés par le prédateur pour déposer un oeuf. Les capacités de prédation des 4 stades larvaires ont constitué 16.47% de la consommation de la proie et le nombre moyen de proies avalées pendant la durée de vie du prédateur était de 26.45 acaréens phytophages actifs.

Mots clés : Biologie, prédation, *Stethorus punctillum*, *Tetranychus ludeni*

ملخص

عربابي، مسعود وجاناردان سينغ. 2008. الخصائص الحيوية للنوع *Stethorus punctillum* كمفترس مؤثر للأكاروس الضار *Tetranychus ludeni*. *Tunisian Journal of Plant Protection* 3: 95-100.

تعتبر أنواع الجنس *Stethorus* من بين الأعداء الطبيعية للأكاروسات الضارة للنبات المعروفة في العالم. يتمثل هذا العمل في دراسة مخبرية (درجة حرارة 27 ورطوبة نسبية 65 %) للخصائص الحيوية والمقدرة التغذوية للنوع *Stethorus punctillum* كمفترس للأكاروس الضار *Tetranychus ludeni*. أكمل المفترس مراحل التطورية (البيضة، الأطوار اليرقية الأربعة، العذراء) خلال مدة زمنية تتراوح من 15 إلى 29 يوماً بمعدل 17.35 ± 7.12 يوماً. أخذت الأطوار اليرقية الأربعة 44.55% فقط من المدة التطورية الكلية. بلغ متوسط المدة الزمنية للدورة الحياتية للمفترس 37 ± 12.5 يوماً مع معدل للمدة الزمنية للإباضة قدره 15.34 ± 10.25 يوماً. بلغت الخصوبة اليومية والكلية 7.8 ± 3.3 و 121 ± 22.5 بيضة، على التوالي. أما بالنسبة لاستهلاك الفريسة فيحتاج المفترس إلى تناول 6.18 طور نشط من الأكاروس لوضع بويضة واحدة. مثلت القدرة الافتراضية خلال الأطوار اليرقية الأربعة 16.47% من استهلاك الفريسة وكان المعدل اليومي للإستهلاك خلال الدورة الحياتية للمفترس 26.54 أكاروساً نشطاً.

كلمات مفتاحية : افتراس، علم الأحياء، *Stethorus punctillum*، *Tetranychus ludeni*

Table 1. Life cycle and feeding capacity of *Stethorus punctillum* reared on *Tetranychus ludeni* under laboratory conditions

Developmental stage	Biology (days)				Feeding rate (number of mites)			
	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD
Incubation	4	9	5.50	2.69				
Larva	5	12	7.73	3.23	79	211	138.50	34.75
Pupa	3	9	3.45	2.85				
Adult	15	29	17.35	7.12				
Preoviposition	4	9	4.55	1.68	85	177	91.55	31.60
Oviposition	14	31	15.32	10.25	541	1098	749.00	158
Daily Fecundity	4	11	7.8	3.3				
Total Fecundity	56	139	121	22.75				
Longevity	26	63	37	12.50				
Total prey consumption					697	1457	979.05	177.75

SD = Standard deviation

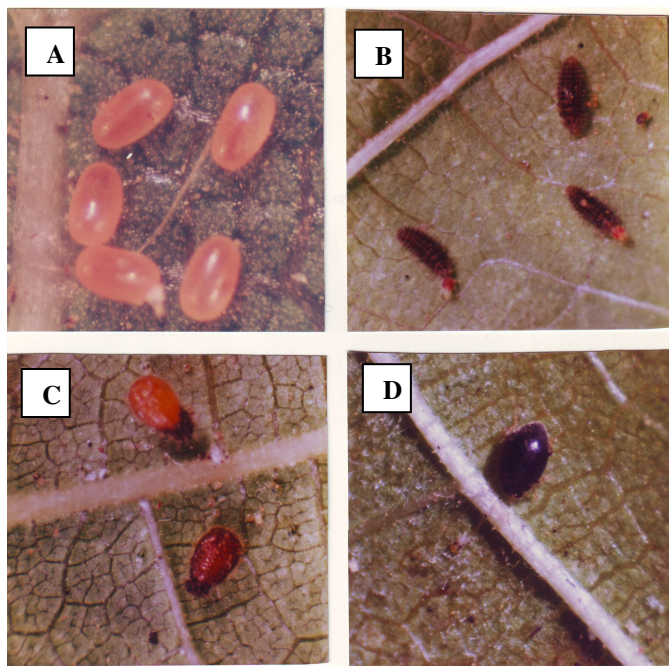


Fig. 1. The four development stages of *Stethorus punctillum*, A: Egg, B: Larva, C: Nymph, D: Adult.

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