Journal of Biological Control, 28(4): 221-224, 2014

Research Article

Feeding potential of *Stethorus pauperculus* (Weise) (Coccinellidae: Coleoptera) on tetranychid mites

H. S. GODHANI and ABHISHEK SHUKLA*
Department of Entomology, N.M. College of Agriculture Navsari Agricultural University, Navsari-396 450, Gujarat, India
**Corresponding author E-mail*: abhishekshukla@nau.in

ABSTRACT: The feeding potential of mite destroyer ladybird beetle, *Stethorus pauperculus* (Weise) were recorded on two mite species *viz*., *Oligonychus indicus* and *Tetranychus urticae* under the laboratory conditions during September-December 2013. For complete life cycle the predator *S. pauperculus* required 548.57±11.00 eggs or 38.20±6.60 larva or 275±6.46 nymphs or 150.07±6.88 adults of *O. indicus*, whereas in case of *T. urticae* it required 544.20±8.28 eggs, or 324.97±6.46 larvae or 249.07±7.65 nymphs or 132.43±4.36 adults.

KEY WORDS: *Stethorus pauperculus* (Weise), feeding potential, spider mites

(Article chronicle: Received: 24-07-2014; Revised: 04-11-2014; Accepted: 15-11-2014)

INTRODUCTION

There are many species coccinellid beetles which are acting as major biological control agents of agricultural pests such as aphids, thrips, mealy bugs and mites in different parts of the world. Among the different known species of coccinellid, the genus *Stethorus* has a worldwide distribution and is present in tropical rain forests, dry savannas, orchards and various crops of very different climates and in many ecosystems (Gordon and Anderson, 1979; Houston, 1980; Guoyue, 1996; Chazeau, 1985). It is estimated that 90 species of *Stethorus* are known around the world (Gouyue, 1996). Among them many are are primary predators of spider mites (McMurtry *et al*., 1970; Hoy and Smith, 1982; Charles *et al.,* 1985), and considered as very important biological control agents of spider mites in agricultural crops (Readshaw, 1975; Hull *et al.*, 1976, 1977). There are many species of *Stethorus* who feed upon a wide range of tetranychid species while some species such as *Stethorus keralicus* Kapur and *Stethorus gilvifrons* (Mulsant) are considered as specialists that feed upon *Raoiella macfarlanei* Pritchard and Baker and *T. urticae* Koch, respectively (Nageshchandra and ChannaBasavanna, 1983; Aydemir and Toros, 1990). Looking to the available literature at present, only *Stethorus punctillum* Weise is commercially produced as a mite predator (Copping, 2001). From India, Puttaswamy and ChannaBasavanna (1977) reported that *S. pauperculus* feeding on spider mites infesting papaya, papaw, castor, citrus, jasmine and various crops in Bangalore, India. It is also widely distributed in Indian subcontinent including Pakistan (Irshad, 2001). In India Puttaswamy and ChannaBasavanna (1977) recorded the biology of *S. pauperculus* feeding on *Tetranychus cucurbitae* Rahman and Sapra. The rwo spotted spider mite *T. urticae* is a serious pest of over 200 economically important crops such as cotton, corn, cucumber, tomato, bean, pepper and strawberries (Helle and Sabelis, 1985). *Stethorus punctillum* and *S. nigripes* Kapur were reported as key biological control agents for *T. urticae* (Copping, 2001). However, the potential of *S. pauperculus* against *T. urticae* and *Oligonychus indicus* Hirst is still unknown and the key biological attributes of the *S. pauperculus* as spider mite predators have rarely been investigated. Hence, the objective of this study was to investigate the feeding potential of *S. pauperculus* on different stages of both the tetranychid mites *i.e.*, *Oligonychus indicus* and *Tetranychus urticae*, to be used as a biological agent against tetranychid mites in the future.

The study on feeding potential of *S. pauperculus* on mite species *viz*., *O. indicus* and *T. urticae* were carried out in the Acarology Laboratory at 27 ºC to 31 ºC temperature and 60 to 90 per cent relative humidity. Set of 30 first instar larvae and newly emerged adults were taken for study on feeding potential.

Stock culture of *Stethorus pauperculus* and red spider mites

Stethorus pauperculus and its preys, *O. indicus* and *T. urticae* were collected from sorghum and okra fields of College farm, N.A.U., Navsari. A stock colony of *S. pauperculus* had been maintained in the laboratory at 25 ± 1ºC, 75 ± 5% RH and 12L:12 D photoperiod in a specially prepared cages containing okra and sorghum leaves infested with both the mite species respectively. From the stock culture mites were transferred onto fresh sorghum and okra leaves placed on moistened cotton pads (1.5 cm thick) in plastic trays. Rearing trays were kept under controlled conditions of 25 ± 1_C, 75 ± 5% RH and 12L:12D photoperiod. Withered and drying leaves were regularly replaced.

Feeding potential

For this purpose first instar larvae brought from stock culture, were kept in the Petri dishes. Larvae of *S. pauperculus* were reared separately to avoid cannibalism. A set of 30 larvae were provided with counted number of spider mites of both the species. The number of mites and its different stages consumed by each instar larvae were recorded separately and in this way feeding potential of each instar was computed.

The newly emerged adult beetles of S. pauperculus kept separately in Petri dishes. A set of 30 adults were provided with counted number of spider mites of both species. Number of mites and its different stages consumed were recorded and fresh food was provided daily. In this way the feeding potential of an adult was worked out using simple mean and standard deviations.

Feeding potential of *Stethorus pauperculus*

The data on the pattern of feeding of *S. pauperculus* on different stages of *O. indicus* and *T. urticae* are presented in Table 1 and 2.

First instar larva of *S. pauperculus* required 25.47±3.63 eggs or 25.23±1.69 larvae or 10.27±1.75 nymph or 5.80±1.76 adults of *O. indicus*. The second instar larvae required 33.87±2.24 eggs or 40.20±2.73 larvae or 20.00±2.57 nymphs or 9.93±2.18 adults of *O. indicus*. Similarly the third instar larvae required 42.50±3.21 eggs or 55.63±2.90 larvae or 39.70±2.06 nymphs or 20.17±2.16 adults of *O. indicus*. The fourth instar larvae of *S. pauperculus* required 69.80±2.25 eggs or 84.67±2.16 larvae or 51.17±2.28 nymphs or 20.67±2.48 adults of *O. indicus*. In case of adults, the male predators required on an average 174.87±7.93 eggs or 83.70±2.92 larvae or 73.30±2.66 nymphs or 41.93±2.27 adult *O. indicus*, while in case of adult female predators, they consumed 202.07±5.65 eggs or 90.77±3.00 larvae or 81.53±2.44 nymphs or 51.57±3.17 adults of *O. indicus*. For complete life cycle *S. pauperculus* required 548.57±11.00 eggs or 38.20±6.60 larvae or 275.97±6.46 nymphs or 150.07±6.88 adults of *O. indicus* (Table 1).

First instar larva of *S. pauperculus* required 23.77±2.52 eggs or 21.50±1.97 larvae or 7.57±2.05 nymphs or 5.50±1.35 adults of *T. urticae*. The second instar larvae of predator required 36.07±4.87 eggs or 33.13±2.65 larvae or 17.70±2.40 nymphs or 7.57±1.65 adults of *T. urticae*. In case of third instar larvae it consumed 53.40±3.26 eggs or 39.77±2.91 larvae or 35.73±2.42 nymphs or 18.53±2.30 adults of *T. urticae*. The fourth instar larvae consumed on an average 78.90±1.96 eggs or 66.40±2.96 larva or 45.03±2.78 nymphs or 15.67±2.39 adults of *T. urticae*. The adult male required 158.63±6.37 eggs or 77.27±2.60 larvae or 66.43±3.00 nymphs or 38.70±2.24 adults of prey *i.e. T. urticae* while the adult female predator required 193.43±3.64 eggs or 86.90±2.66 larvae or 76.60±3.49 nymphs or 46.47±2.73 adults of *T. urticae* for complete life cycle predator, *S. pauperculus* required 544.20±8.28 eggs or 324.97±6.46 larvae or 249.07±7.65 nymphs or 132.43±4.36 adults of *T. urticae* (Table 2).

It is revealed from the foregoing observations *S. pauperculus* showed more preference towards *O. indicus* for feeding than *T. urticae* as was evident from consumption rate. Among the different stages, the consumption of adult predator was found to be maximum than that of fourth instar larvae. On the whole, an individual predator required to feed on more numbers of eggs during their period of life followed by larval, nymphal and adult stages of both the prey mites. It was further found that there was more requirement of eggs by predator in preference to larval or nymphal stages as well as adult stages of spider mites, it was also found from earlier studies that when all other stages were available, the predator, *S. pauperculus* did not prefer adult. However, more preference was given for the feeding of immature stages.

All the 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 (Ragkou *et al.*, 2004 and Tanigoshi and McMurthy, 1977) in case of *S. punctum*, *S. punctillum* and *S. picipes*. The larval stages prefer immature stages of prey mites where as adult predator was mostly observed feeding on all the stages of prey mite. Tanigoshi and McMurthy, (1977) also reported similar feeding ability by *Stethorus* spp. Further, Ragkou *et al.* (2004) in their laboratory experiment on daily consumption and predation rate of different instars of *S. punctillum* feed-

ing on *T. urticae* reported that the first instar larva consumed 16.67, 18.56, 19.56 and 14.33 eggs, larvae, nymphs and adults, respectively. The consumption of adult prey is more or less similar to the present study according to them, the daily consumption of prey tends to be higher in the higher stages of predator, even in adult stage. This phenomenon is in agreement with the present results. The present study was also supported by Imani and Shishehbor (2011) from Iran, who also reported that the adult and fourth instar larvae of *S. gilvifrons* preferred to feed mostly eggs, followed by immature stages of the prey mite, *Eutetranychus orientalis* under laboratory conditions at constant temperature of 30 ºC. The predatory efficiency of *S. gilvifrons* increased during the growth of larval instars when reared on *Oligonychus coffeae* infesting tea at Nirar Dam (Tamil Nadu) and an adult consumed 205 eggs, 92.2 larvae, 81.8 nymphs and 52.4 adults' mites per day (Kandasamy *et al.* 2010).

ACKNOWLEDGEMENT

The authors are thankful to Professor and Head, Department of Entomology, N.M. College of Agriculture, Navsari, Principal and Dean, N.M. College of Agriculture, Navsari as well as the Director of Research and Dean Post Graduate Studies, Navsari Agricultural University, Navsari for providing all the necessary facilities during the course of the study.

Table 1. Feeding potential of *Stethorus pauperculus* against *Oligonychus indicus*

Stages of *Stethorus pauperculus*	Stages of sorghum mite, *Oligonychus indicus*								
	Egg		Larva		Nymph		Adult		
	Range	Mean± S.D.	Range	Mean± S.D.	Range	Mean± S.D.	Range	Mean± S.D.	
Larva	1st instar	20-31	25.47±3.63	22-28	25.23±1.69	07-13	10.27±1.75	03-09	5.80±1.76
	2nd instar	31-38	33.87±2.24	36-45	40.20±2.73	16-25	20.00±2.52	07-14	9.93±2.18
	3rd instar	37-48	42.50±3.21	51-61	55.63±2.90	36-44	39.70±2.06	16-25	20.17±2.16
	4th instar	66-74	69.80±2.25	81-89	84.67±2.16	48-55	51.17±2.28	17-26	20.67±2.48
Adult	Male	162-188	174.87±7.93	79-89	83.70±2.92	68-77	73.30±2.66	38-45	41.93±2.27
	Female	193-215	202.07±5.65	85-96	90.77±3.00	77-86	81.53±2.44	47-58	51.57±3.17
Total		526-570	548.57±11.00	366-395	380.20±6.60	259-287	275.97±6.46	136-164	150.07±6.88

Table 2. Feeding potential of *Stethorus pauperculus* against *Tetranychus urticae*

Stages of *Stethorus pauperculus*	Stages of two spotted red spider mite, *Tetranychus urticae*								
	Egg		Larva		Nymph		Adult		
	Range	Mean± S.D.	Range	Mean± S.D.	Range	Mean± S.D.	Range	Mean± S.D.	
Larva	1st instar	17-29	23.77±2.52	18-25	21.50±1.97	05-11	7.57±2.05	03-08	5.50±1.35
	2nd instar	27-44	36.07±4.87	27-39	33.13±2.65	14-21	17.70±2.40	05-11	7.57±1.65
	3rd instar	49-59	53.40±3.26	35-44	39.77±2.91	32-40	35.73±2.42	15-22	18.53±2.30
	4th instar	75-82	78.90±1.96	63-71	66.40±2.96	41-50	45.03±2.78	12-20	15.67±2.39
Adult	Male	148-170	158.63±6.37	74-82	77.27±2.60	62-71	66.43±3.00	35-43	38.70±2.24
	Female	186-199	193.43±3.64	83-91	86.90±2.66	71-85	76.60±3.49	42-51	46.47±2.73
Total		520-557	544.20±8.28	312-335	324.97±6.46	239-268	249.07±7.65	120-140	132.43±4.36

REFERENCES

Aydemir M, Toros S. 1990. Natural enemies of *Tetranychus urticae* Koch (Acarina: Tetranychidae) on bean plants in Erincan, pp. 261-271. *Proceedings of the Second Turkish National Congress in Biological Control*, CAB International, Oxon, UK.

Charles JG, Collyer E, White V. 1985. Integrated control of *Tetranychus urticae* with *Phytoseiulus persimilis* and *Stethorus bifidus* in commercial raspberry gardens. *New Zealand J Exp Agric.* **13**: 385- 393.

Chazeau J. 1985. Predaceous Insects, pp.211-246. *In:* W. Helle and M.W. Sabelis, eds. Spider mites-their biology, natural enemies and control, Vol.-1B. Elsevier Science Publishers, the Netherlands.

Copping LG. 2001. *The Biopesticide Manual*. 2nd ed. British Crop Protection Council, Surrey.

Gordon RD, Anderson DM. 1979. The genus *Stethorus* Weise (Coleoptera: Coccinellidae). *Coleopterist Bull.* **33**: 61-67.

Guoyue YU. 1996. A list on *Stethorus* Weise (Coleoptera: Coccinellidae) from China with description of a new species. *Entomotaxon.* **18**: 32-36.

Helle W, Sabelis MW. 1985. *Spider mites-their biology, natural enemies and control.* Vol.-A. Elsevier, Amsterdam.

Houston KJ. 1980. A revision of the Australian species of *Stethorus* Weise (Coleoptera: Coccinellidae). *J. Australian Entomol Soc.* **19**: 81-91.

Hoy MA, Smith KB. 1982. Evaluation of *Stethorus nigripes* (Coleoptera: Coccinellidae) for biological control of spider mites in California almond orchards. *Entomophaga* **27**: 301-310.

Hull LA, Asquith D, Mowery PD. 1976. Distribution of *Stethorus punctum* in relation to densities of the European red mite. *Environ Entomol.* **5**: 337-342.

Hull LA, Asquith D, Mowery PD. 1977. The mite searching ability of *Stethorus punctum* within an apple orchard. *Environ Entomol.* **6**: 684- 688.

Imani Z, Shishehbor P. 2011. Functional response of *Stethorus gilvifrons* (Coleoptera: Coccinellidae) to different densities of *Eutetranychus orientalis* (Acari: Tetranchidae) in laboratory. *Entomol Soc Iran* **31**(1): 29-40.

Irshad M. 2001. Distribution, hosts, ecology and biotic potentials of coccinellids of Pakistan. *Pakistan J Biol Sci.* **4**: 1259-1263.

Kandasamy P, Rajagopal S, Amsalingam R, Rahman VJ, Muraleedharan NN. 2010. Life table and predatory efficiency of *Stethorus gilvifrons* (Coleoptera: Coccinellidae), an important predator of the red spider mite, *Oligonychus coffeae* (Acari: Tetranychidae), infesting tea. *Exp Appl Acarology.* 50(2): 141-150.

McMurtry JA, Huffaker CB, Van de Vrie M. 1970. Ecology of tetranychid mites and their natural enemies: a review. I. Tetranychid enemies: their biological characters and the impact of spray practices. *Hilgardia*. **40**: 331-390.

Nageshchandra BK, ChannaBasavanna GP. 1983. *Stethorus keralicus* (Coleoptera: Coccinellidae) feeding *Raoiella macfarlanei* infesting rose apple. *Acarol Newsletter.* **13**:3.

Puttaswamy, Channabasavanna GP. 1977. Biology of *Stethorus pauperculus* Weise (Coleoptera: Coccinellidae), a predator of mites. *Mysore J Agric Sci.* **11**: 81-89.

Ragkou VS, Athanassiou CG, Kavallieratos NG, Tomanovic´ Z. 2004. Daily consumption and predation rate of different *Stethorus punctillum* instars feeding on *Tetranychus urticae. Phytoparasitica* **32**(2): 154-159.

Readshaw JL. 1975. The ecology of tetranychid mites in Australian orchards. *J Appl Ecol.* **12**: 473- 495.

Tanigoshi LK, McMurtry JA. 1977. The dynamics of predation of *Stethorus picipes* (Coleoptera: Coccinellidae) and *Typhlodromus floridanus* on the prey *Oligonychus punicae* (Acarina: Phytoseiidae, Tetranychidae). Part I. Comparative life history and life table studies. *Hilgardia* **45**(8): 237-261.