Journal of Biological Control, 26 (3): 279–282, 2012

Research Note

Efficacy of predators against the two spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae)

S. JEYARANI*, R. JAGANNATH SINGH and K. RAMARAJU
Department of Agricultural Entomology, Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore 641 003, Tamil Nadu, India
**Corresponding author: E-mail: jeyajawahar@sify.com*

ABSTRACT: Survey conducted for inventorying the natural enemies of *Tetranychus urticae* Koch revealed the occurrence of predatory insects *viz., Stethorus pauperculus* (Weise) (0.00 to 8.65 %), *Oligota* sp. (0.00 to 5.98 %), *Scolothrips* sp. (0.00 to 5.69 %) and predatory mite, *Amblyseius longispinosus* (Evans) (0.00 to 6.43 %) in okra growing areas of Coimbatore district. Investigations on the predatory potential of these predators against *T. urticae* under laboratory conditions showed that the adult female of *S. pauperculus* consumed significantly more number of 167.14 eggs / 63.71 nymphs / 61.42 adults of *T. urticae* per day per individual. The grubs of *S. pauperculus* were as voracious as the adults and the predation increased with the advancement of larval stages. Similarly, adult *Scolothrips* sp. and *A. longispinosus* were more efficient than the immatures in devouring the prey. However, in case of *Oligota* sp., the grub stage recorded the maximum consumption of prey mite by devouring 81.28 eggs / 45.71 nymphs / 15.14 adults of *T. urticae* per day per individual.

KEY WORDS: *Tetranychus urticae, Stethorus pauperculus, Oligota* sp., *Scolothrips* sp., *Amblyseius longispinosus*

(Article chronicle: Received:23-4-2012 Revised: 3-8-2012 Accepted: 21-8-2012)

The two spotted spider mite, *Tetranychus urticae* Koch (Acari.: Tetranychidae), is an extremely polyphagous herbivore, feeding on a wide range of host plant species including vegetables throughout the world (Navajas, 1998). In India, *T. uritcae* infests cotton, brinjal, okra, cucurbits, castor, spinach and cowpea throughout the year and causes significant loss in yield (Srinivasa and Sugeetha, 1999). Among the vegetables, okra is severely infested by *T. urticae* resulting in heavy yield loss. Damage due to *T. urticae* includes reduction in crop yield as well as aesthetic injuries because of the webbings produced by the mites. Though, many non chemical control strategies are advocated under the Integrated Pest Management umbrella, farmers rely on chemical pesticides for the management of *T. urticae* which resulted in development of resistance to almost all the available groups of acaricides all over the world (Devine *et al.*, 2001). This wide spread acaricide resistance has been a major obstacle in the cost effective integrated mite management programme (Cho *et al*., 1995).

The importance of biological control in pest management is well recognised all over the world, in the recent past. Inventory on the predatory complex is a vital component to identify the locally adapted, dominant, efficient species that can be promoted as promising candidate predator for the management of *T. urticae*. Keeping this in view, the present investigation was carried out to inventory the predators of *T. urticae* and to identify a potential predator that could be very well accommodated in the integrated mite management programmes on okra.

A field survey on the occurrence of natural enemies against *T. urticae* was undertaken in eleven okra growing blocks of Coimbatore district. Mite infested okra leaves were collected randomly from ten plants from ten different fields in each location and were observed for the diversity of predators present. The collected predator specimens were identified by experts/based on available literature. The percentage of fields with the predators was worked out.

The red spider mites, *T. urticae* were collected from okra (variety – Vaishnavi, US Agriseed and Mahyco-10) fields, mass reared and maintained in the glass house by following the method developed by Krishnamoorthy (1988). Okra plants were raised in pots once in a week for culturing *T. urticae*. Thirty day old plants were inoculated with *T. urticae* with the help of camel hair brush or by keeping the already infested leaves on fresh plants in order to transfer the mites. Then freshly potted plants were transferred besides the older plants at periodic intervals to transfer the mites from older one to fresh so as to maintain the continuous culture of *T. urticae*. The mites from the culture were used for various experiments.

Based on the survey, four species of predators *viz. Sthethorus pauperculus* (Weise), *Amblyseius longispinosus* (Evans), *Scolothrips* sp. and *Oligota*, sp were collected from different localities where okra was being cultivated. Mass culturing of *S. pauperculus* was carried out by using the prey mites, *T. urticae* as per the method developed by Perumalsamy *et al.* (2007) and, *A. longispinosus* was cultured by following the method developed by Mallik *et al*. (1999). The *Scolothrips* sp. and *Oligota*, sp. were not amenable for culturing hence, the field collected insects were used for the predatory potential studies.

The predatory efficiency of different stages of the predatory coccinellid, *S. pauperculus* was evaluated under laboratory condition by providing known number of eggs (200 nos.), nymphs (100 nos.) and adults (100 nos.) of prey mites. To assess the predation on eggs, many gravid females of *T. urticae* were released on the okra leaf kept over a petridish (10 cm dia.) lined with moist cotton wool for egg laying. After 24 hours, the adults were removed and known numbers of eggs were maintained in each leaf arena with seven replications. To assess the predation on nymphs and adults, prey mites were released separately in known numbers on okra leaves. The number of each stages of prey consumed by the predator was recorded after 24 hours.

Similar study was also carried out for the predatory efficiency of co-occurring *Oligota* sp., *Scolothrips* sp. and *A. longispinosus* against *T. urticae*. For assessing the predation, 100 nos. each of eggs, nymphs and adults of *T. urticae* were offered separately for the *Oligota* sp. and for *Scolothrips* sp. while for *A. longispinosus*, 20 nos. each of eggs, nymphs and adults of *T. urticae* were offered separately. The number of each stages of prey consumed by the predator was recorded after 24 hours.

The data obtained from different laboratory experiments were subjected to analysis of variance using AGRES ver. 7.01, Pascal International software solutions and the means were separated by DMRT available in the package (Gomez and Gomez, 1994).

Among the predators, *S. pauperculus* followed by *A. longispinosus* and *Oligota* sp. were recorded as the predominant species. Natural occurrence of *S. pauperculus, Stethorus gilvifrons* (Mulsant), *Stethorus punctillum* (Weise), *Oligota pygmaea* (Solier), *Oligota oviformis* Casey, *Oligota kashmirica benefice* Naomi and *A. longispinosus* on phytophagous mites were documented by several workers (Ragkou *et al*., 2004; Perumalsamy *et al*., 2007). The activity of natural enemies was often hampered by the indiscriminate use of pesticides (Armstrong and Jones, 1996). Mani *et al*. (2005) also reported that the application of conventional / broad spectrum insecticides interfere with the activity of naturally occurring biocontrol agents in horticultural ecosystem, which could be overcome by the use of non conventional chemicals, botanicals and biopesticides.

Predatory potential of spider mite predators

Studies showed that all the predators tested were effective against *T. urticae* in the order of efficacy *viz., S. pauperculus* > *Oligota* sp. > *A. longispinosus.*

Predatory potential of different stages of *S. pauperculus* showed that early instar larvae preferred to feed on eggs and immature stages of *T. urticae*. The adult female of *S. pauperculus* consumed significantly more number of 167.14 eggs / 63.71 nymphs / 61.42 adults of *T. urticae* per day per individual than male (Table 1). It is in confirmation with earlier findings of Houck (1991) and Perumalsamy *et al*. (2007). According to them, adults and larvae belonging to tribe Stethorini often prefer mite eggs over other pest life stages.

The predatory efficiency increased with the advancement of developmental stages. Similar results were also reported by Raworth (2001) where the number of *T. urticae* eggs consumed by *S. punctillum* larvae increased with increased growth stage. In the present investigation, maximum consumption of mites was observed on the penultimate day of the larval period and also by the adult females. It was in confirmation with the findings of Perumalsamy *et al*. (2007) in *Stethorus* sp. against *Oligonychus coffeae* (Nietner). Ragkou *et al*. (2004) also reported similar findings in *S. punctillum* against *T. urticae*.

Studies on the predatory potential of *Oligota* sp. revealed that both grubs and adults preferred to feed on both immature stages and adults of *T. urticae*. The maximum consumption was recorded in grub stage (81.28 eggs, 45.71 nymphs and 15.14 adults/ day/individual) (Table 1). This is in line with the earlier findings of Perumalsamy *et al*. (2007) on *O. pygmea* against *O. coffeae*.

The *Scolothrips* sp., preferred to feed more on the eggs and nymphs of the *T. urticae* than the adults (Table 1). Naher *et al.* (2005) observed that an adult *Scolothrips*

Table 1. Predatory potential of *Stethorus pauperculus, Oligota* sp., *Scolothrips* sp. and *Amblyseius longispinosus* on *Tetranychus urticae*

Predator	Stage of Predator*	Stage of the prey mite (No. consumed per day)		
		Eggs	Nymphs	Adults
Stethorus pauperculus	I Instar	21.14 (4.58) [a]	8.85 (2.91) [b]	6.85 (2.51) [c]
	II Instar	28.85 (5.17) [a]	21.70 (4.52) [b]	12.71 (3.51) [c]
	III Instar	38.14 (6.00) [a]	41.71 (6.40) [a]	30.57 (5.47) [b]
	IV Instar	56.71 (7.48) [a]	55.42 (7.40) [a]	31.00 (5.47) [b]
	Male	153.85 (10.77) [a]	61.14 (7.77) [b]	48.14 (6.87) [c]
	Female	167.14 (11.28) [a]	63.71 (7.91) [b]	61.42 (7.75) [c]
Oligota sp.	Grub	81.28 (8.82) [a]	45.71 (6.65) [b]	15.14 (3.58) [c]
	Adult	64.42 (7.98) [a]	27.71 (5.05) [b]	12.71 (3.51) [c]
Scolothrips sp.	Nymph	7.00 (2.74) [a]	6.50 (2.65) [b]	3.75 (2.06) [c]
	Adult	8.50 (3.00)[a]	7.75 (2.87)[b]	4.00 (2.12)[c]
Amblyscius longispinosus	Nymph	4.14 (2.00) [a]	3.14 (1.64) [a]	2.00 (1.25) [b]
	Adult	5.42 (2.22) [a]	4.00 (1.95) [b]	3.85 (1.94) [b]

* Mean of seven replications in each treatment
Values in parentheses are Sqr $\sqrt{(x + 0.5)}$ transformed values.
In a row, means followed by a common letter(s) are not significantly different by DMRT ($P = 0.05$)

sexmaculatus (Au) consumed 38.47 immature and 114.33 eggs per day separately. The result of the present experiment in concurrence with earlier reports by Parvin *et al*. (2010).

Predatory efficiency of *A. longispinosus* against *T. urticae* showed that nymphs and adults of predatory mite, *A. longispinosus* preferred to feed mostly on early stages of the prey (Table 1). Rasmy *et al.* (1982) and Zou *et al*. (1986) also reported that the *Typhlodromus mangiferus* (Zaher) and *Amblyseius pseudolongispinosus* (Xin) respectively showed more preference towards the eggs and nymphs of *T. urticae*. Among the stages of predator, a high predation rate was observed in adults. Similar results were obtained by Ball (1980) in *Neoseiulus fallacies* (Garman) against *Tetranychus mcdanieli* (McGregor).

Among the four predators, the predatory efficicacy of *S. pauperculus* is significantly higher followed by *Oligota* sp., *Scolothrips* sp. and *A. longispinosus.*

Significantly high predatory efficacy coupled with amenability for culturing of *S. pauperculus* enhances its scope for the bio-suppression of *T. urticae*. Further, the full potential of *S. pauperculus* as predators of spider mites will only be realized when cultural and chemical management practices are truly integrated with biological control based on field experimentation (Biddinger *et al*., 2009).

ACKNOWLEDGEMENT

The authors thankfully acknowledge Dr. J. Poorani, Principal Scientist, NBAII, Bangalore for identifying the species of coccinellid predator.

REFERENCES

Armstrong DA, Jones DJ. 1996. Field evaluation of microbial insecticides of cotton bollworms and their natural enemies. *Nigerian J Sci.* **30**: 72–75.

Ball JC. 1980. Development, fecundity and prey consumption of four species of predacious mites (Phytoseiidae) at two constant temperatures. *Env Entomol.* **9**: 298–303.

Biddinger DJ, Weber DC, Hull LA. 2009. Coccinellidae as predators of mites: Stethorini in biological control. *Biol Control*. **51**: 268–283.

Cho JR, Kim YJ, Ahn YJ, Yoo JK, Lee JO. 1995. Monitoring of acaricide resistance in field collected populations of *Tetranychus urticae* (Acari: Tetranychidae) in Korea. *Korean J Appl Entomol.* **31**: 40–45.

Devine GJ, Barber M, Denholm I. 2001. Incidence and inheritance of resistance to METI-acaricides in European strains of the two spotted spider mite (*Tetranychus urticae*) (Acari: Tetranychidae). *Pest Manag Sci.* **57**: 443–448.

Gomez KA, Gomez AA. 1994. *Statistical procedures for Agricultural Research*. John Wiley and Sons. New York. pp. 207–215.

Houck, M.A. 1991. Time and resource partitioning in *Stethorus punctum* (Coleoptera: Coccinellidae). *Environ Entomol.* **20**: 494–497.

Krishnamoorthy A. 1988. A simple method for mass rearing of an exotic predaceous Phytoseiid mite, *Phytoseiulus persimilis* A.H. *J Biol Control.* **2**(1): 53–55.

Mallik B, Ramesh Vaidya H and Harish Kumar M. 1999. Mass production of the predator *Amblyseius longispinosus* (Acari: Phytoseiidae) – A Model. *J Acarol.* **15**(1 & 2): 15–17.

Mani M, Krishnamoorthy A, Gopalakrishnan C. 2005. Biological control of lepidopterous pests of Horticultural crops in India. *Annals Rev Agric Res.* **26**(1): 39–49.

Parvin MMST, Ali Asgar MD and Mainul Haque M. 2010. Voracity of Three Predators on Two-Spotted Spider Mite, *Tetranychus Urticae* Koch (Acari: Tetranychidae) and their Developmental Stages. *Res J Agric Biol. Sci*. **6**(1): 77–83.

Naher N, Islam W and Haque MM. 2005. Predation of three predators on two-spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae). *J Life and Earth Sci.* **1**: 1–4.

Navajas, M. 1998. Host plant associations in the spider mite, *Tetranychus urticae* (Acari: Tetranychidae): insights from molecular phylogeography. *Expl Appl Acarol.* **22**: 201–214.

Perumalsamy K, Babu A, James SP and Muraleedharan N. 2007. Life History and Predatory Efficiency of *Stethorus* sp. Mulsant (Coleoptera: Coccinellidae) an Important Predator of Red Spider Mite Infesting Tea, pp. 130-136. In: Ignacimuthu, S.and Jayaraj, S. (Eds.). *Recent Trends in Insect Pest Management.* Elite Publishing House, Chennai.

Ragkou CG, Athanassiou NG and Kavallieratos M. 2004. Daily Consumption and Predation Rate of Different *Stethorus punctillum* Instars Feeding on *Tetranychus urticae. Phytoparasitica* **32**(2): 154–159.

Rasmy AH, Hafez SM and Elsawy SA. 1982. Influence of prey species and stages on predatory efficiency and development of two phytoseiid mites. *Entomophaga* **27**(2): 135–139.

Raworth DA. 2001. Development, larval voracity, and greenhouse releases of *Stethorus punctillum* (Coleoptera: Coccinellidae). *Can Entomol.* **133**: 721– 724.

Srinivasa N and Sugeetha J. 1999. Bioeffectiveness of certain botanicals and synthetic pesticides against okra spider mite *Tetranychus macfarlanei*. *J Acarol.* **15**(2): 1–5.

Zou P, Gao JR and Ma EP. 1986. A study of food preference and predatory capacity of *Amblyseius pseudolongispinosus*. *Nat Enemies of Insects*. **8**(3): 137–141.