

## Control of two-spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae) by predators on potted plants

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**Abstract:** Three predators *Scolothrips sexmaculatus* Pergande, *Phytoseiulus persimilis* Athias – Henriot and *Stethorus punctillum* Weise were used to control two-spotted spider mite, *Tetranychus urticae* Koch on potted bean plants. Mite population increased exponentially on the untreated plants, but on the predator treated plants, increase of mite population was checked and remained within minimum number. Early release of predator checked the mite population earlier and kept it lower than on late released plants. All the three predators may be used as bio-control agents against two-spotted spider mite.

**Key words:** Control, *Tetranychus urticae*, *Scolothrips sexmaculatus*, *Phytoseiulus persimilis*, *Stethorus punctillum* and bio-control agents.

### Introduction

Bean is a very popular and important vegetable crop in Bangladesh. Two-spotted spider mite (TSSM) attacks bean plants and cause great damage to the plant resulting yield loss (Gapud, 1981). It is essential to control TSSM for better and quality product. Increasing public concern about pesticide application and the widely recognized problem of pesticide resistance in mites have justified the need for alternative strategies for mite control. It has been reported that two-spotted spider mite populations have developed resistance against many chemicals (Helle & Sabelis 1985, Herron *et al.*, 1993; Takafuji *et al.*, 2000). Development of resistance by TSSM to many acaricides has caused difficulties in controlling outbreaks by chemicals (Carbonaro *et al.*, 1986). Biological control strategies for tetranychid mite pests include various techniques, like use of predators/parasites, mite pathogens, resistant varieties of host plants etc. Predation is an important component of ecological aspects because through predators the flow of energy continues throughout a community. It also regulates the populations on which they feed and maintain the fitness of these prey populations (Price, 1997).

The six-spotted thrips *Scolothrips sexmaculatus* Pergande is one of the predators of spider mite. The larva of this thrips are also active predator of spider mite. An adult *S. sexmaculatus* consumes about 1000-3000 *T. urticae* during its lifetime (Hoddle, 2004).

*Phytoseiulus persimilis* Athias Henriot is also an important predator of spider mite in various parts of the world (Battaglia *et al.*, 1990; Castagnoli & Simoni 1999; Roy *et al.*, 1999; Trumble & Morse, 1993). This predaceous mite was accidentally introduced in Germany from Chili in 1958 (Dosse, 1958). From Germany, it was subsequently shipped to other parts of the world (Mc Murtry *et al.*, 1978).

The smallest lady beetle *Stethorus punctillum* Weise is another active predator of TSSM. Due to its

high voracity on TSSM, it is known as the mite destroyer. An adult can eat 75-100 mites per day (Raworth *et al.*, 1998). Roy *et al.*, (1999) reported *S. punctillum* as an effective predator of the Mc Daniel spider mite. It effectively reduced the high population of *T. urticae* infesting strawberry (Gracia Mari & Gonzalez Zamora, 1998).

Some promising predators currently being evaluated as biological control agent against tetranychid mites. The predators attack and consume eggs, larva, pupae and adults of *T. urticae*. According to Strong and Croft (1995), predators must be released at a rate that provides a high predator prey ratio; the larger the predator prey ratio, the better the biological control through release of predators.

The present research was designed to control *T. urticae* population by available predators. The used predators are: *Scolothrips sexmaculatus* Pergande, *Phytoseiulus persimilis* Athias – Henriot and *Stethorus punctillum* Weise.

### Materials and Methods

The experiment was conducted at three different times. Three different predators *S. sexmaculatus*, *P. persimilis* and *S. punctatum* were applied in September 2006, April 2007 and June 2007 respectively. For each predator fifteen bean seedlings were grown on clay pot in the premises of Department of Zoology, Rajshahi University. The bean seeds were bedded in the clay pot. The plants were allowed to grow on bamboo-made sticks at height of 1.5m from the ground. The bean seedlings were nourished properly with fertilizers and water. The pots were arranged in three groups (Five pots in a group) as A, B and C. The pots of each group were separately covered by nets. Pots of A was considered as control and B and C as treated.

### Mite infestation

The potted bean plants were infested with *T. urticae* when they were eight weeks old. The TSSM used for infestation was collected from laboratory culture, which

was maintained on potted bean plants in the premises of the Department of Zoology, Rajshahi University for more than two years. Each plant was infested with 20 adult female mites. The mites were released on the bean leaves at 0.5m height by placing the mite- containing plant parts on the host plant. All the 15 plants of three groups were infested with mites in similar way on the same day.

### Predator release

The predators *S. sexmaculatus*, *P. persimilis* and *S. punctatum* used in this experiment were collected from bean plants of Rajshahi City Corporation area, where they appeared naturally. They were cultured on *T. urticae* on mite infested potted bean plants in the laboratory for more than six months in the Department of Zoology, Rajshahi University. The predators were released on the plants of group B after one week of mite infestation and on the plants of group C after three weeks of mite infestation. On each plant 10 adult female predators were released of which five on the leaves at 1m height and other five on the leaves at 1.5m height for proper distribution. The predators were transferred on to the host leaf with the help of fine hair-brush.

### Counting

Mite population was checked every week on all the plants of group A, B and C continued up to the tenth week of mite infestation. In group B, predator counting was started after one week of mite infestation. But in the group C, where predators were released after three weeks of mite infestation, predator counting was started from fourth week of mite infestation and continued up to tenth week. During each count 15 bean leaves were collected from each group. Mite and predator population were checked on both the surface of each leaf.

### Results and Discussion

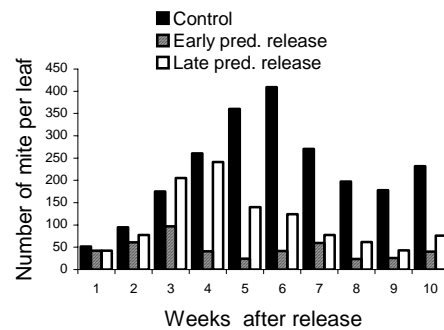
The mite population in three experiments treating with three different predators are shown in Figs. 1-3. The mite population remained higher on controlled plants where no predator was released. The mite number reached the peaks 409.26 (6th week, Fig. 1), 470.60 (10th week, Fig. 2), 679.20 (10th week, Fig. 3) per leaf in 1st, 2nd and 3rd experiment respectively.

With the release of *S. sexmaculatus* as predator to control mite, *T. urticae* population remained the highest 96.73 per leaf on which the predator was released after one week of mite infestation but it reached the highest 241.07 per leaf on which *S. sexmaculatus* was released after three week of mite infestation. But it reduced to only 24.00 and 43.33 per leaf in 8th and 9th week on early and late released plants respectively (Fig. 1).

*T. urticae* population remained the highest 37.93 per leaf in another experiment on which *P. persimilis* was released after one week of mite infestation but it

reached the highest 113.60 per leaf on which *P. persimilis* was released after three week of mite infestation. But it reduced to only 8.73 and 22.93 per leaf in the 10th week early and late released plants respectively (Fig. 2). *T. urticae* population remained the highest 69.80 per leaf of bean where the predator, *S. punctillum* was released after one week of mite infestation.

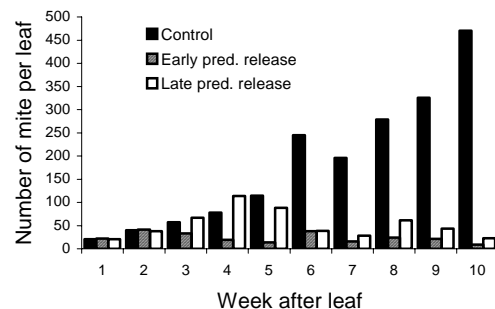
But it reached 121.00 per leaf where *S. punctillum* was released after three week of mite infestation. But it reduced to 23.87 and 22.93 per leaf due to early and late release on 8th and 10th week of mite infestation (Fig. 3).



**Fig.1.** Effect of *S. sexmaculatus* on *T. urticae* population on potted bean plants.

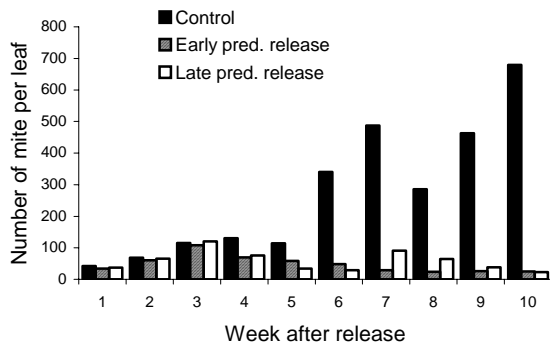
On the untreated plants, mite population increased exponentially and caused damage to the plants. But on the predator treated plants, increase of mite population was checked and remained lower. The plants also remained fresh in comparison to untreated plants. Early release of predator checked the mite population earlier and kept it lower than on late released plants.

The predator population on different groups of bean plants are presented in Table-1. Predator number increased gradually in all cases with little exception. Predators number differed significantly among the types of predators ( $F=2.83^*$ , 20/9, early release;  $F=5.90^{***}$ , 20/9, late release).



**Fig. 2.** Effect of *P. persimilis* on *T. urticae* population on potted bean plants.

Research on the control of TSSM by different predators has been done widely in various parts of the world. *S. sexmaculatus* is an important predatory thrips of the family Thripidae and have been reported to suppress *T. urticae* populations. Shih (1999) reported that *S. sexmaculatus* primarily predated on TSSM eggs. Control of *T. urticae* by *S. sexmaculatus* has been also reported by Hoddle (2004).



**Fig.3.** Effect of *S. punctillum* on number *T. urticae* opulation on potted bean.

**Table-1.** Number of different predators per leaf of potted bean plants.

| Weeks | <i>S. sexmaculatus</i> |              | <i>P. persimilis</i> |              | <i>S. punctillum</i> |              |
|-------|------------------------|--------------|----------------------|--------------|----------------------|--------------|
|       | Early release          | Late release | Early release        | Late release | Early release        | Late release |
| 1     | 0.00                   | 0.00         | 0.00                 | 0.00         | 0.00                 | 0.00         |
| 2     | 1.40                   | 0.00         | 1.60                 | 0.00         | 1.94                 | 0.00         |
| 3     | 6.20                   | 0.00         | 2.47                 | 0.00         | 2.47                 | 0.00         |
| 4     | 8.20                   | 1.74         | 5.60                 | 2.07         | 10.60                | 1.93         |
| 5     | 4.33                   | 8.07         | 6.86                 | 3.20         | 10.40                | 9.94         |
| 6     | 3.20                   | 8.13         | 6.80                 | 6.07         | 8.53                 | 12.67        |
| 7     | 3.60                   | 6.87         | 6.13                 | 5.60         | 6.13                 | 6.00         |
| 8     | 2.93                   | 6.06         | 13.47                | 14.06        | 5.73                 | 14.06        |
| 9     | 5.13                   | 8.47         | 10.53                | 11.20        | 14.80                | 23.20        |
| 10    | 3.06                   | 5.26         | 9.60                 | 14.40        | 12.87                | 5.40         |

*P. persimilis* is also important predatory mite of the family Phytoseiidae and have been reported to suppress *T. urticae* populations. *P. persimilis* can effectively reduce the number of acaricide applications by 87-92% in Crotons and 100% in *Areca palms* (Cashion *et al.*, 1994). However, chemical applications were often necessary to decrease spider mite densities to acceptable levels, even after predator release (Helle & Sabelis 1985). Trumble & Morse (1993) reported that adequate suppression of *T. urticae* can be achieved by releasing *P. persimilis* in combinations with abamectin applications. In their study after threshold levels were surpassed, predator release combined with compatible acaricides was more effective than using chemical or biological control tactics alone *P. persimilis* and *S.*

*punctillum* are being used in many countries as an alternative means to control two-spotted spider mite (Hoddle, 2004). Raworth *et al.* (1998) obtained an excellent result in controlling TSSM by releasing *S. punctillum* in tomato, pepper and cucumber in greenhouse in Canada.

The present experiment reveals that *T. urticae* increased exponentially upto the sixth week on controlled plants.. But on the plants where *S. sexmaculatus* were released, *T. urticae* population was checked effectively due to predation. Using *P. persimilis* and *S. punctillum* as predator, *T. urticae* population increased exponentially upto 10th week in controlled plot. Due to predation of predators *T. urticae* population reduced to the minimum number. The early release of predator reduced the mite population earlier in all the case.

It may be concluded from the present investigation that all the three predators are effective against *T. urticae* and can be used as a bio-control agent of the pest.

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