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Population dynamics of Zoophytophagous mirid bug, *Nesidiocoris tenuis* (Reuter) (Heteroptera: Miridae) and its prey, *Bemisia tabaci* Genn. (Homoptera: Aleyrodidae) on tomato (*Solanum lycopersicum* Mill)

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ABSTRACT: Regular surveys were undertaken to record the incidence of zoophytophagous mirid bug, *Nesidiocoris tenuis* (Reuter) (Heteroptera: Miridae*)* in different villages of Bangalore Urban District during *rabi* season of 2011- 2012 on tomato crop. Weekly field observations of *N. tenuis* and its prey *Bemisia tabaci* Genn. (Hemiptera: Aleyrodidae) were recorded on two tomato varieties *viz.,* Arka Sourabh and Arka Vikas at the Indian Institute of Horticultural Research (IIHR), Bangalore. Correlation analyses between abiotic factors and incidence of *N. tenuis* mean population/plant, considering both varieties, indicated positive correlation with minimum temperature and wind velocity. Morning relative humidity exhibited significant negative correlation, while maximum temperature, evening humidity, wind velocity, evaporation and rainfall showed non significant negative correlation with *N. tenuis*. Incidence of *B. tabaci* mean population/plant showed significant positive correlation with evening humidity while minimum temperature, morning humidity and rainfall exhibited non significant positive correlation. Maximum temperature, wind velocity and evaporation showed non significant negative correlation with the incidence of *B. tabaci*. Both nymphs and adults of *N. tenuis* were often found on the younger plant shoots inflicting feeding damage *viz.,* brown necrotic rings around leaf petiole and growing shoots. With increased population, the bugs were found also on the middle and lower part of the plants.

Keywords: *Nesidiocoris tenuis, Bemisia tabaci*, population dynamics, tomato

INTRODUCTION

Zoophytophagous insects are a special case of omnivory in which insects can feed on both plants and prey at the same developmental stage. The use of such plant-feeding predators for biological pest control has traditionally been neglected, mainly due to the risk of them feeding on crop plants and causing economically significant damage (Castane *et al.,* 2008). The mirid bug, *Nesidiocoris tenuis* **(**Reuter) (Heteroptera: Miridae) is one such plant-feeding predator with an increasing worldwide range of geographical distribution and also a generalist predator of insect pests. The bug is reported to prey on the white fly, *Bemisia tabaci* (Hemiptera: Aleyrodidae) and several other pests including *Tetranychus urticae, Spodoptera litura, Ephestia kuehniella* and *Tuta absoluta* (Patel, 1980; Raman and Sanjayan, 1984; Raman *et al.,* 1984; Sancheza and Lacasa, 2008; Urbaneja *et al*., 2005, 2009; Perdikis *et al.,* 2009; Hughes *et al.,* 2009).

Although much focus has been placed on the predator status of the bug, its expanding host range and potential to cause economic damage to crop deserves attention while using the bug as biocontrol agent. In India, it is reported as pest on sesame (Ahirwar *et al.,* 2009), tobacco (Patel, 1980), bottle gourds, tomatoes, and cucurbits (Patel, 1980; Reddy and Kumar, 2004). The period of higher risk in tomato crops exists when *N. tenuis* reaches high population peaks and its prey decreases to very low numbers due to predation (Sancheza, 2009). Different authors (Sancheza and Lacasa, 2008; Calvo *et al.,* 2009) have attributed the symptoms of *N. tenuis* damage on tomato ranging from poor fruit setting, flower drop, feeding spots on fruit, irregular shaped flowers, clusters and fruits under the conditions *viz.,* i) A large population of *N.tenuis* in the crop (100 or more bugs per plant or 50 bugs in the apical zone). ii) Few or no prey available. iii) Reduced fruit set caused by unfavorable climatic conditions or strong vegetative growth. iv) Sensitive crops and varieties, eg., cherry tomatoes and small-truss tomato types.

The life-cycle of the bug was completed in 29.3 days at 31°C on tobacco (Patel, 1980) and under temperate conditions the optimum temperature range for *N. tenuis* was established between 20 and 30°C (Sancheza *et al.,* 2009). However information on incidence of *N. tenuis* is scanty in Bangalore particularly with regard to varietal preference and prey-predator incidence on tomato. Hence, the present study was undertaken to record the incidence of *N. tenuis* on tomato in relation to plant varieties and prey, *B. tabaci* under Bangalore conditions.

MATERIALS AND METHODS

Village surveys

Regular weekly surveys were carried out in villages around IIHR, Bangalore *viz.,* Mathkur, Thorenagasandra, Kamakshipura, Agrahara, Madhgirihalli, Byatha, Gollahalli, Linganahalli, Thammarasnahalli and Thirumalapura to record *N. tenuis* incidence on tomato varieties grown in the region under field conditions. In the field, exact location of each sample collection site was recorded with a handheld Garmin e-trex, 12 Channel global positioning system (GPS) device to determine coordinates of each village. A systematic sampling was carried out in tomato fields that ranged between 1 to 2 acre in size. Within a field, five evenly located spots were selected from which recording of the bug/plant was carried out on 5 randomly selected plants in each spot.

Field observations at IIHR

Apart from village surveys, incidence of *N. tenuis* and *B.tabaci* was recorded under field conditions at weekly intervals at Indian Institute of Horticultural Research (N13^{0}08'05'' E77^{0}29'53'', altitude 2853 ft), Hessaraghatta, Bangalore during *rabi* 2011-2012. Recommended package of practices were followed for raising the tomato crop grown in 500 sq.m plots. The observations were carried out on 25 randomly selected plants of two semi-determinate tomato varieties *viz.,* Arka Sourabh and Arka Vikas during November 2011 to February 2012 starting from transplanting to final harvest of the crop. Both nymphs and adults of *N. tenuis* and *B. tabaci* were counted per plant. The weather data were obtained from the IIHR meteorological observatory. The data was subjected to correlation analysis to establish the relation between abiotic factors and the incidence of *N. tenuis* and *B. tabaci*. Paired sample t-test was applied to compare and determine the significance of incidence of *N.tenuis* in relation to *B.tabaci* on the two varieties of tomato. Analyses were carried out using the SPSS statistical package (11.5 version).

Mapping incidence of *N. tenuis* in India

Based on the literature available about the incidence of *N. tenuis* from different states of India in different crop ecosystems, a distribution map showing the states with *N.tenuis* incidence was mapped using DIVA-GIS program, widely used for mapping and geographic data analysis (Map 1).

RESULTS AND DISCUSSION

Map 1. DIVA-GIS generated map showing reported incidence of *N. tenuis* in different parts of India

Table 1. Correlations between weather parameters and incidence of *N. tenuis and B.tabaci*

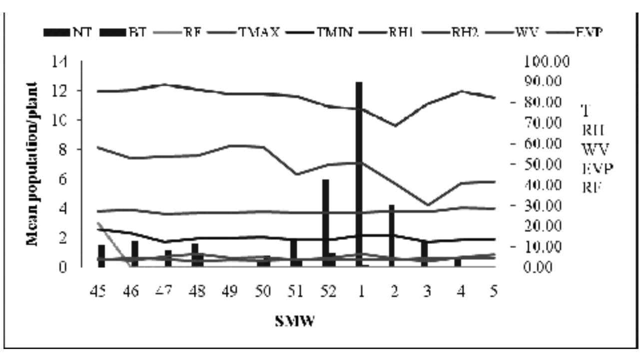
	TMAX	TMIN	RH1	RH2	WV	EVP	RF
NT	-.332	.054	**-.640***	-.098	.301	-.333	-.187
BT	-.184	.452	.496	**.578***	-.178	-.126	.413

Legends: NT=*Nesidiocoris tenuis*, BT =*Bemisia tabaci,* TMAX=Maximum temperature (^{0}C), TMIN=Minimum temperature (^{0}C), RH1= morning relative humidity (%), RH2=evening relative humidity (%), WV=Wind velocity (Kmph), EVP=Evaporation (mm) and RF=Rainfall (mm).

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Of the ten villages surveyed for *N. tenuis,* its incidence was recorded in all the villages except Thirumalapura. Correlation analyses (Table 1) between abiotic factors and incidence of *N. tenuis* mean population/plant, considering both varieties, indicated positive correlation with minimum temperature and wind velocity. Morning relative humidity exhibited significant negative correlation, while maximum temperature, evening humidity, wind velocity, evaporation and rainfall showed non significant negative correlation with *N. tenuis*. Incidence of *B. tabaci* mean population/plant showed significant positive correlation with evening humidity while minimum temperature, morning humidity and rainfall exhibited non significant positive correlation. Maximum temperature, wind velocity and evaporation showed non significant negative correlation with the incidence of *B. tabaci*. The graphical representation of the relationship between abiotic factors and incidence of *N. tenuis* and *B. tabaci* is depicted in Figure 1. Ahirwar *et al.,* (2009) reported the maximum incidence of nymphal and adult populations of *N. tenuis* during 32nd, 34th, 36th, and 37th meteorological weeks. In the present observations during *rabi* season, the incidence was maximum during 52nd SMW on Arka Vikas and 1st SMW on Arka Sourabh.

Studies on quantification of the damage potential and evaluation of the economic loss are in progress. Preliminary observations during the survey revealed symptoms of *N .tenuis* feeding on the tender shoots *viz.,* brown necrotic rings around leaf petiole and stems. With increased population, the bugs were found on the middle and lower part of the plants also. The peak densities of *N. tenuis* individuals per plant in tomato greenhouse and open field on a single tomato leaf were ranged to about 5 individuals (Arno *et al*., 2006; Sanchez, 2008). Patel (1980) reported 11-23 insects per bud and 2-5 insects per leaf pair as economic threshold level on tobacco. Reddy and Kumar (2004) recorded an average of 68.75 bugs/50 leaves during December 1998 in Bangalore while comparatively low incidence of *N. tenuis* was recorded during the present survey with a mean population of 1.76 and 2.75/plant on Arka Sourabh and Arka Vikas, respectively.



Legends: NT-AS=*Nesidiocoris tenuis* on Arka Sourabh, NT-AV=*N.tenuis* on Arka Vikas, BT =*Bemisia tabaci,* TMAX=Maximum temperature (^{0}C), TMIN=Minimum temperature (^{0}C), RH1= Morning relative humidity (%), RH2=Evening relative humidity (%), WV=Wind velocity (Kmph), EVP=Evaporation (mm) and RF=Rainfall (mm).

Fig. 1. Incidence of *Nesidiocoris tenuis and Bemisia tabaci* on tomato varieties in relation to abiotic factors.

During the observation period, the incidence of *N. tenuis*/plant and *B. tabaci*/plant between the two varieties of tomato was found to be non-significant. The calculated 'p' values for *N. tenuis* on the two varieties was 0.263 (t= -1.174, 12 df) and 0.371(t=0.928, 12 df) for *B. tabaci*. Damage symptoms inflicted by *N. tenuis* on tomato plants with low population density of *B. tabaci* were observed in the field with their ratios on Arka Sourabh and Arka Vikas at 2.33 and 5.58, respectively. Sancheza (2009) reported the probability of *N. tenuis* causing yield loss in tomato crops increased at *N. tenuis*: *B.tabaci* ratio > 0.168. However, in the present study, though the ratios worked out per whole plant basis was very high, attributing this due to the low incidence of whitefly on tomato, the pest status of *N. tenuis* on tomato could not be established based on the present observations. Therefore, the predation of *N. tenuis* on whiteflies needs to be further monitored both under open field and laboratory conditions. Damage incurring plant feeding predators are mostly generalist predators impacting several crop pests and are able to establish on crops early in the growing season, when pests colonize them, and continue on the target crop when prey is scarce (Castane *et al*., 2008). Thus, management programs must seek to minimize risks while maximizing benefits. The present observations confirm to the earlier observations of the incidence of the bug from the region (Reddy and Kumar, 2004) and emphasize the need for studies on the establishment of threshold levels of *N. tenuis* on tomato under Bangalore conditions to consider this predaceous insect as a pest.

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