POPULATION DYNAMICS OF TWO SPOTTED SPIDER MITE TETRANYCHUS URTICAE KOCH ON PARTHENOCARPIC CUCUMBER IN NET HOUSE

DILIP SHRIRAM GHONGADE* AND K S SANGHA

Department of Entomology; 1Department of Forestry and Natural Resources, Punjab Agricultural University, Ludhiana 141004
*Email: dilipghongade63@gmail.com (corresponding author)

ABSTRACT

A field experiment was conducted on parthenocarpic cucumber under.net house conditions, during 2016-2017 and 2017-18, to study the population dynamics of spider mite Tetranychus urticae Koch. The eggs and other active stages were observed, which revealed that egg (21.2 and 25.5 eggs/ten leaves) and active stages (15.2 and 18.8 active stage/ten leaves) were at peak during 22nd and 21st standard meteorological week, respectively during 2017 and 2018. Correlation coefficients with weather parameters showed a significant and positive relationship between temperature- with r values for temp_max, temp_min and Temp_avg with ‘r’ values being 0.55, 0.60 and 0.59, respectively (significant at p= 0.01). Relative humidity (RH_M and RH_avg) showed significant negative correlation (r = -0.59 and -0.51; significant at p= 0.01). The stepwise regression analysis revealed that Temp_min was the weather factor responsible in determining abundance of T. urticae and its buildup to the extent of 44%.

Key words: Tetranychus urticae, cucumber, temperature, relative humidity, correlation coefficients, regression analysis, population buildup

The protected cultivation is the most intensive method of crop production and provides protection to different plant growth stages from adverse environmental conditions. The protected environment also provides stable and congenial microclimate which is favourable for the multiplication of insect pests which in turn become one of the limiting factors for the successful crop production under protected environment (Van Lenteren, 2000; Slathia et al., 2018; Sood et al., 2018). Parthenocarpic cucumber, Cucumis sativus L. is one of the most important crops grown under protected environment. In India, the crop is affected wide array of insect and mite pests, and amongst them spider mites (Tetranychus ludeni Zacher, T. neocalidonicus Marc Andre and T. urticae Koch); tobacco caterpillar (Spodoptera litura F.); whiteflies [Bemisia tabaci (Gennadius) and Trialeurodes vaporariorum (Westwood)]; aphids [Myzus persicae (Sulzer) and Aphis gossypii Glover]; leaf miner [Liriomyza trifolii (Burgess)] are of importance (Singh et al., 2004; Sood et al., 2012; Ghongade and Sood, 2018; Sood et al., 2018).

In Punjab, two spotted spider mite, T. urticae is the predominant pest (Kaur et al., 2010), causing loss of quality, yield and ultimately death of the plants (Mondel and Ara, 2006; Kumaran et al., 2007). Sood et al. (2015) observed the loss in cucumber yield to the extent of 62.5%. Due to high reproductive potential and extremely short life cycle, combined with frequent acaricidal applications this mite species has developed resistance to almost all the conventional pesticides and is difficult to manage (Chiasson et al., 2004; Leeuwen et al., 2009; Hoy, 2011; Radadia et al., 2014; IRAC, 2017). Information regarding population buildup of T. urticae on parthenocarpic cucumber under protected environment is very scanty. Therefore, present study to generate information on its population dynamics.

MATERIALS AND METHODS

To study the population dynamics of T. urticae on parthenocarpic cucumber under naturally ventilated net house (105 m²) condition, an experiment was conducted at the experimental farm of Department of Vegetable Science, Punjab Agricultural University, Ludhiana, during February- June 2017, 2018. Parthenocarpic cucumber F₁ hybrid “Punjab Kheera-I” was used in this study. Nursery was raised in the growth chamber with seeds procured from the Department of Vegetable Science. In order to avoid any incidence of soil-borne diseases, the nursery was raised in soil-less medium comprising coopeat, perlite and vermiculite (3:1:1) in pro-trays having 98 cavities of 2.5 cm depth by sowing single seed in each cavity. The nursery was irrigated and inspected regularly to avoid insect pests and diseases.
Thirty-day old seedlings were transplanted in raised beds (15 cm) of 90 cm width, spaced 70 cm apart at a spacing of 70x30 cm. The seedlings were transplanted on 22\textsuperscript{nd} February (2017), and 25\textsuperscript{th} February (2018) for raising the summer crop (February-June). The crop was raised in an insecticide free environment following recommended practices (Anonymous, 2018). The plants were trained on single shoots and extra shoots were pruned regularly to optimize the growth. Basal dose of fertilizer (N: P: K:: 50: 50: 50 kg/ha) was applied at the time of transplanting. Subsequently, plant nutrition was supplied through water soluble complex fertilizer (19: 19: 19) through fertigation twice a week (@ 10 g/m\(^2\)), starting three weeks after transplanting and ceasing two weeks before final harvesting of the crop.

Stock culture of \textit{T. urticae} was maintained at room temperature on young potted plants of french bean throughout the present investigations to ensure availability of large number of mites required for artificial infestation of cucumber plants. Environmental parameters viz., minimum, maximum, average temperature and relative humidity were recorded daily with the help of digital thermo-hygrometer placed inside the polyhouse at canopy height. The experiment was laid out in randomized block design (RBD) and was replicated six times. For this, adults of \textit{T. urticae} were first released artificially and population was allowed to buildup naturally. For taking observations, population counts of \textit{T. urticae} (egg and active stages) were recorded from 3 spots per leaf on randomly plucked 10 leaves/ plot. These leaves were collected and kept in separate polythene bags and then brought to laboratory. The number of \textit{T. urticae} (egg and active stages)/ leaf was observed in stereozoom microscope at weekly intervals. From these, mean population/ 10 leaves was worked out (For analysis, all the 3 spots of randomly plucked 10 leaves per plot were pooled). The data were correlated with weather parameters using IBM SPSS 25 software, and stepwise multiple regression equation was worked out.

### RESULTS AND DISCUSSION

#### Population buildup

During summer 2017, population buildup of \textit{T. urticae} was recorded first during 4\textsuperscript{th} week of April, (17 SMW; 0.8 active stages; 1.5 eggs/ ten leaves; 38.9\textdegree C Temp\textsubscript{Max}, 23.5\textdegree C Temp\textsubscript{Min}, 56 \% RH\textsubscript{M} and 25 \% RH\textsubscript{E}, respectively) and it continued to infest the crop till 3\textsuperscript{rd} week of June (25 SMW; 2.2 active stages; 3.4 eggs/ ten leaves) (Figs. 1, 2). Initial population was very low and it increased gradually to attain maximum peak population during 4\textsuperscript{th} week of May (22 SMW; 15.2 active stages; 21.2 eggs/ ten leaves, respectively at 39.5\textdegree C Temp\textsubscript{Max}, 26.5\textdegree C Temp\textsubscript{Min}, 61 \% RH\textsubscript{M} and 36 \% RH\textsubscript{E}). During summer 2018, population buildup (egg and active stages) was more as compared to 2017 and the infestation commenced from 3\textsuperscript{rd} week of April (16 SMW; 0.6 active stages; 0.8 eggs/ ten leaves). \textit{T. urticae} incidence reached its peak during 3\textsuperscript{rd} week of May (21 SMW; 18.8 active stages; 25.5 eggs/ leaves; Temp\textsubscript{Max} = 42.1\textdegree C; Temp\textsubscript{Min} = 25.5\textdegree C; RH\textsubscript{M} = 44 \%; RH\textsubscript{E} = 18 \%) (Figs. 1,3). Thereafter, the incidence decreased

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**Fig. 1.** Seasonal incidence of \textit{T. urticae} (egg+ active stages) to check original
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Population dynamics

During 2017, the $\text{Temp}_{\text{Max}}$ and $\text{Temp}_{\text{Avg}}$ had significantly positive ($p=0.05$) correlation with population buildup of *T. urticae* ($r$ being 0.47 and 0.58); showed positive correlation ($r=0.63$, $p=0.01$) with $\text{Temp}_{\text{Min}}$ ($p=0.01$) (Table 1). During 2018, there existed a positive correlation with $\text{Temp}_{\text{Max}}$, $\text{Temp}_{\text{Min}}$ and $\text{Temp}_{\text{Avg}}$ ($r$ being 0.67, 0.61 and 0.65, respectively, $p=0.01$), and a negative one with $\text{RH}_{\text{M}}$ ($p=0.01$; $r=-0.71$), $\text{RH}_{\text{E}}$ ($p=0.05$; $r=-0.58$) and $\text{RH}_{\text{Avg}}$ ($p=0.01$; $r=-0.69$). Analysis revealed a significant and positive relationship with $\text{Temp}_{\text{Max}}$, $\text{Temp}_{\text{Min}}$, $\text{Temp}_{\text{Avg}}$ and *T. urticae* population, and $\text{RH}_{\text{M}}$ and $\text{RH}_{\text{Avg}}$ revealed a negative correlation (Table 1).

The minimum and maximum temperature affect the population buildup of *T. urticae* positively whereas, relative humidity resulted in a significant negative relationship under field conditions (Kanika et al., 2013; Monica et al., 2014). Hanafy et al. (2014)
reported positive correlation maximum and minimum temperature and maximum relative humidity, and a negative one with minimum relative humidity. Patil (2010), Kanika et al. (2013) and Meena et al. (2013) also observed that temperature (maximum and minimum) had a positive relationship and relative humidity a negative one. Desai et al. (2017) observed T. urticae population in rose grown under polyhouse conditions showing a significant positive correlation with minimum (r= 0.75) and average temperature (r= 0.61). Ghongade and Sood (2019 in cucumber under polyhouse revealed that the minimum and maximum temperature, and minimum relative humidity positively influence the population buildup of T. urticae. Step-wise multiple regression model revealed that T. urticae was influenced significantly by the Temp.\( _{\text{max}} \) (R\(^2\) being 0.44) (Table 2).

Thus, it can be concluded that the infestation of T. urticae on parthenocarpic cucumber initiated on 17\(^{th}\) and 16\(^{th}\) standard meteorological week (SMW) and the maximum incidence (egg and active stages) was observed during 22\(^{nd}\) and 21\(^{st}\) SMW, respectively in 2017 and 2018. Temp.\( _{\text{max}} \), Temp.\( _{\text{min}} \) and Temp.\( _{\text{Avg}} \) influenced its population buildup positively, whereas the RH\( _{\text{E}} \) had a negative correlation.

**REFERENCES**


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### Table 1. Correlation coefficients -T. urticae on cucumber (active stages) vs. weather factors

<table>
<thead>
<tr>
<th>Abiotic parameters</th>
<th>2017</th>
<th>2018</th>
<th>Pooled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Temp. (°C)</td>
<td>0.47*</td>
<td>0.67**</td>
<td>0.55**</td>
</tr>
<tr>
<td>Min. Temp. (°C)</td>
<td>0.63**</td>
<td>0.61**</td>
<td>0.60**</td>
</tr>
<tr>
<td>Avg. Temp. (°C)</td>
<td>0.58*</td>
<td>0.65**</td>
<td>0.59**</td>
</tr>
<tr>
<td>Morning RH (%)</td>
<td>0.45</td>
<td>-0.71**</td>
<td>-0.59**</td>
</tr>
<tr>
<td>Evening RH (%)</td>
<td>0.04</td>
<td>-0.58*</td>
<td>-0.31</td>
</tr>
<tr>
<td>Avg. RH (%)</td>
<td>-0.29</td>
<td>-0.69**</td>
<td>-0.51**</td>
</tr>
</tbody>
</table>

Regression equation (pooled, 2017, 2018) \[ Y = -9.275+0.589 T_{\text{min}} \]

Multiple R\(^2\) 0.44
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