Screening of tomato genotypes for tolerance or susceptibility against sucking pests under field condition

BC Anu, T Saha, S Akhtar and K Kumari

DOI: https://doi.org/10.22271/j.ento.2020.v8.i2m.6517

Abstract
A field experiment was conducted to screen out twenty genotypes of tomato (Solanum lycopersicon L.) to find out the relative tolerance/susceptibility against sucking pests (aphid and whitefly) at Vegetable Research Plot of Bihar Agricultural College, Sabour, Bhagalpur, Bihar during three different seasons (summer 2018, kharif 2018 and rabi 2018). All the tomato genotypes showed varying degree of responses. Out of the twenty genotypes, five (5) genotypes namely Solanum peruvianum, EC 620421, BRDJT-1, EC 538455 and Solanum cheesmaniae were considered tolerance/less susceptible to aphid and whitefly population in all the three seasons. Remaining other genotypes were considered susceptible.

Keywords: Tomato genotypes, screening, tolerance, sucking pests, susceptibility.

Introduction
Tomato (Solanum lycopersicon L.) is one of the most important and remunerative vegetable crops which have attained great popularity over the last century. It is one of the vital protective crops which provide a tremendous amount of vitamin C, a very good quantity of the mineral, manganese and vitamin E. However, like all other vegetable crops, tomato also faces some production hurdles due to various biotic and abiotic stresses. Tomatoes are subject to attack by quite a large spectrum of insect pests from the time of planting till the fruits are harvested. It is attacked by large number of insect pests from emergence in the seed bed until its harvest. Among them, whitefly (Bemisia tabaci Genn.), tomato fruit borer (Helicoverpa armigera Hubner), cotton aphid (Aphis gossypii Glov.), flea beetles (Podagrica puncticollis Weise), leaf miner (Liriomyza trifolii Burgess), thrips (Thrips tabaci and Frankliniella intosa Trybom), spider, mites etc. threaten to young plant-beds of tomato. Whitefly (B. tabaci) can alone cause 10–90% damage depending upon the severity of the infestation and crop stage (Setiawati, et al. 2009) [11]. Frequently, generalist herbivores, such as B. tabaci, are more affected by plant defense responses than specialists (Agrawal, 2000) [2]. Among the key insect pests, whitefly is one of the most dangerous pest having a pandemic distribution and damaging many vital crops including vegetables, tubers, fiber crops and ornamentals (Touhidul and Shunxiang, 2007 and Abdel-Baky and Al-Deghairy, 2008) [12, 13]. They are the serious economic pests of the crops with worldwide distribution and have extended their damage from tropics and sub-tropics to temperate climates in crops grown under open and protected environment (Lakshmarian, 2000) [7]. They are reported to act as vectors of several economically important viral plant pathogens (Byrne, et al. 1990) [5]. The phloem-feeding insect M. persicae is a generalist species on its host plant and has evolved to survive on a nutritionally imbalanced diet of phloem sap, compared with chewing insects (Zhu-Salzman, et al. 2004) [13]. The aphids suck plant juice and also inject toxic saliva into plants resulting in blighting of buds, curling of leaves and the appearance of brown spots on the foliage (Metcalf and Flint, 1978) [8]. A genotype exhibits tolerance or resistance by any of the three basic resistance mechanisms: preference-non preference, antibiosis and tolerance. Hence, the present experiment was carried out to understand the population fluctuation of sucking pests (whitefly and aphid) of tomato.

Corresponding Author: BC Anu
Department of Entomology, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India
Materials and Methods
A total of twenty (20) genotypes of tomato were collected from various parts of India namely, Arka Vikas, Sel 18, Superbug SPS, VRT-101A, WIR 13708, WIR 3956, Sun Cherry, Arka Meghali, BRDT-1, CLN 1621L, Pusa Rohini, Solanum peruvianum, S. chilense yellow, S. cheesmaniae, S. pimpinellifolium, EC 538455 and BRDT 3 were screened for their relative tolerance and susceptibility against sucking insects (aphid and whitefly). The plot size was 2m x 2m with spacing of 50cm x 50cm. The trial was laid out in Randomized block design (RBD) with three replications. The populations of whiteflies and aphids were recorded by counting the number of adults on top, middle and bottom leaves of each of 5 randomly selected plants per plot during morning hours at weekly intervals.

Statistical analysis
Mean populations of aphid and whitefly were calculated using Microsoft excel. The values of critical difference (CD) were analyzed at 5% level of significance. The table for analysis of variance (ANOVA) was set as explained by Gomez and Gomez (1983) [6]. After an ANOVA, mean separation was followed using Duncan multiple range tests were done for comparison test.

Results and Discussion
During summer season (2018), the mean performance of different tomato genotypes against sucking pests has been presented in the table 1. The range of aphid population among the diverse genotypes was 0.53 to 0.98 per three leaves per plant. Among the tomato genotypes tested under field condition, the minimum aphid population was recorded with Solanum peruvianum, EC 620421, EC 538455, BRDT-1 and Solanum cheesmaniae whereas, the maximum aphid population was noticed in Solanum pimpinellifolium, Arka Vikas and Sel 18. However, the range of whitefly population among the various genotypes was 0.44 to 1.02 per three leaves per plant. From the table 1, it is evident that the genotype BRDT-1, EC 620421, Solanum peruvianum and Solanum cheesmaniae showed least significant whitefly population as compared to other genotypes. The maximum whitefly population was recorded with Solanum pimpinellifolium, Solanum chilense yellow and BRDT 3. The present findings are in collaboration with earlier findings of Anitha and Nandihalli (2008) [4], who reported that the incidence of aphids was recorded from first week of April (6.01 aphids/3 leaves) in okra crop. In case of whitefly, similar finding was also reported by Anitha (2007) [3], who found that Activity of whitefly on summer started during first week of April 06 and reached a peak during last week of April 06 (14.91 whiteflies/3 leaves) and there was a decrease in whitefly abundance with the onset of monsoon.

Data pertaining to aphid and whitefly population in different genotypes during kharif season have been presented in table 2. During kharif season (2018), the aphid population among the genotypes was varied from 0.38 to 0.93 per three leaves per plant, respectively. Among the genotypes, the least amount of aphid population was noticed in Solanum peruvianum, EC 620421, BRDT-1, EC 538455 and Solanum cheesmaniae. Simultaneously, the maximum aphid population was recorded with BRDT 3, Solanum pimpinellifolium and VRT-101A. However, the whitefly population among different genotype varied from 0.38 to 1.05 per three leaves per plant. The minimum whitefly population was recorded in the genotypes EC 620421, Solanum peruvianum, BRDT-1, EC 538455 and Solanum cheesmaniae whilst, Solanum chilense yellow, EC 538380 and CLN 1621L showed maximum whitefly population as compared to other genotypes. Present findings are in line with the findings of Saha (2015) [9], who reported that, incidence of aphid on Kharif crop reached peak (27.23 aphids/3 leaves) during eighth week of sowing i.e. third week of July.

During rabi season (2018), range of aphid population varied from 0.42 to 1.13 per three leaves per plant among the genotypes (table 3). The genotype BRDT-1, EC 620421, Solanum cheesmaniae and Solanum peruvianum exhibited minimum aphid population as compared to other genotypes (table 3). Maximum aphid population was recorded in Superbug SPS, Sel 18 and VRT-101A. However, in case of whitefly, least population was noticed in EC 620421, Sel 18, Solanum peruvianum, Solanum cheesmaniae and EC 538455 whereas, maximum population was recorded with Arka Meghali, BRDT-3 and EC 538380. The present findings are in agreement with Sayala (2009) [10], who found that the high population of aphid was observed during the cropping season with peak population level at 46th SMW (3rd week of November). However, in whitefly, the occurrence of whitefly was not higher throughout the season but it reached at peak during 46th SMW (3rd week of November) with the population of 7.58 /3 leaves / plant in Br cotton.

Table 1: Evaluation of different genotypes against sucking pests of tomato during summer season

| Genotype       | Range of Aphid population (per 3 leaves per plant) | Mean Aphid population (per 3 leaves per plant) | Range of Whitefly population (per 3 leaves per plant) | Mean Whitefly population (per 3 leaves per plant) |
|----------------|--------------------------------------------------|-----------------------------------------------|-----------------------------------------------------|--------------------------------------------------|
| Arka Vikas     | 0.80-0.93                                        | 0.86~                                           | 0.53-0.82                                           | 0.71~                                            |
| Sel 18         | 0.78-0.91                                        | 0.85bc                                          | 0.51-1.02                                           | 0.76cde                                          |
| Superbug SPS   | 0.75-0.91                                        | 0.84abc                                         | 0.71-0.95                                           | 0.83abcd                                         |
| VRT-101A       | 0.71-0.91                                        | 0.80a~                                         | 0.64-0.82                                           | 0.72ef                                           |
| WIR 13708      | 0.78-0.96                                        | 0.83abc                                         | 0.71-0.82                                           | 0.77ef                                           |
| WIR 3956       | 0.67-0.84                                        | 0.76a~                                         | 0.64-0.89                                           | 0.74ef                                           |
| Sun Cherry     | 0.71-0.87                                        | 0.80a~                                         | 0.56-0.91                                           | 0.77ef                                           |
| Arka Meghali   | 0.71-0.98                                        | 0.82abc                                         | 0.62-0.89                                           | 0.78cde                                          |
| EC 538380      | 0.58-0.84                                        | 0.71a~                                         | 0.62-0.93                                           | 0.71a~                                           |
| IHR 2486       | 0.71-0.95                                        | 0.83abc                                         | 0.60-0.89                                           | 0.72ef                                           |
| EC 620421      | 0.62-0.75                                        | 0.68a~                                         | 0.49-0.78                                           | 0.60pb                                           |
| BRDT-1         | 0.60-0.82                                        | 0.71a~                                         | 0.44-0.62                                           | 0.53b                                            |
| CLN 1621L      | 0.73-0.98                                        | 0.81abcd                                        | 0.69-0.95                                           | 0.78bde                                          |
| Pusa Rohini    | 0.73-0.85                                        | 0.81bcd                                        | 0.56-0.93                                           | 0.80bde                                          |
### Table 2: Evaluation of different genotypes against sucking pests of tomato during kharif Season

| Genotype          | Range of Aphid population (per 3 leaves per plant) | Mean Aphid population (per 3 leaves per plant) | Range of Whitefly population (per 3 leaves per plant) | Mean Whitefly population (per 3 leaves per plant) |
|-------------------|---------------------------------------------------|-----------------------------------------------|-------------------------------------------------------|--------------------------------------------------|
| Arka Vikas        | 0.59-0.87                                         | 0.73<sup>abc</sup>                            | 0.73-0.84                                             | 0.79<sup>hijkl</sup>                              |
| Sel 18            | 0.58-0.82                                         | 0.68<sup>cd</sup>                            | 0.65-0.89                                             | 0.77<sup>kl</sup>                                  |
| Superbug SPS      | 0.58-0.87                                         | 0.74<sup>cd</sup>                            | 0.69-0.89                                             | 0.80<sup>hij</sup>                                 |
| VRT-101A          | 0.62-0.77                                         | 0.77<sup>ab</sup>                            | 0.64-0.95                                             | 0.76<sup>bc</sup>                                  |
| WIR 13708         | 0.62-0.91                                         | 0.73<sup>ab</sup>                            | 0.73-1.05                                             | 0.87<sup>a</sup>                                   |
| WIR 3956          | 0.58-0.83                                         | 0.73<sup>bc</sup>                            | 0.64-0.87                                             | 0.77<sup>abc</sup>                                 |
| Sun Cherry        | 0.60-0.84                                         | 0.73<sup>bc</sup>                            | 0.71-0.95                                             | 0.84<sup>cd</sup>                                  |
| Arka Meghal        | 0.62-0.89                                         | 0.71<sup>cd</sup>                            | 0.64-0.95                                             | 0.85<sup>abc</sup>                                 |
| EC 538380         | 0.56-0.82                                         | 0.72<sup>cde</sup>                           | 0.71-0.95                                             | 0.86<sup>ab</sup>                                  |
| IHR 2486          | 0.60-0.80                                         | 0.70<sup>cde</sup>                           | 0.75-0.95                                             | 0.82<sup>cde</sup>                                 |
| EC 620421         | 0.38-0.78                                         | 0.57<sup>ef</sup>                            | 0.38-0.71                                             | 0.57<sup>h</sup>                                   |
| BRDT-1            | 0.49-0.78                                         | 0.60<sup>ef</sup>                            | 0.51-0.82                                             | 0.68<sup>h</sup>                                   |
| CLN 1621L         | 0.58-0.82                                         | 0.74<sup>de</sup>                            | 0.65-0.93                                             | 0.85<sup>abc</sup>                                 |
| Pusa Rohini       | 0.58-0.80                                         | 0.69<sup>cd</sup>                            | 0.62-0.95                                             | 0.85<sup>cde</sup>                                 |
| Solanum peruvianum| 0.38-0.65                                         | 0.53<sup>a</sup>                            | 0.51-0.75                                             | 0.64<sup>bc</sup>                                  |
| Solanum chilense yellow | 0.58-0.89-1.02                                      | 0.73<sup>bc</sup>                            | 0.75-1.02                                             | 0.87<sup>a</sup>                                   |
| Solanum cheesmaniae | 0.51-0.85                                       | 0.69<sup>cd</sup>                            | 0.47-0.95                                             | 0.74<sup>d</sup>                                   |
| Solanum pimpinellifolium | 0.65-0.93                                      | 0.78<sup>a</sup>                            | 0.64-1.02                                             | 0.79<sup>abcde</sup>                               |
| EC 538455         | 0.56-0.75                                         | 0.65<sup>bc</sup>                            | 0.62-0.85                                             | 0.73<sup>abcde</sup>                               |
| BRDT 3            | 0.71-0.91                                         | 0.79<sup>bc</sup>                            | 0.66-0.93                                             | 0.85<sup>cde</sup>                                 |
| SEM±               | -                                                 | 0.02                                          | -                                                      | 0.02                                              |
| CV (%)             | -                                                 | 4.77                                          | -                                                      | 4.37                                              |

Mean in a column sharing same letter are not significantly different by DMR Test at P<0.05.

### Table 3: Evaluation of different genotypes against sucking pests of tomato during rabi Season

| Genotype          | Range of Aphid population (per 3 leaves per plant) | Mean Aphid population (per 3 leaves per plant) | Range of Whitefly population (per 3 leaves per plant) | Mean Whitefly population (per 3 leaves per plant) |
|-------------------|---------------------------------------------------|-----------------------------------------------|-------------------------------------------------------|--------------------------------------------------|
| Arka Vikas        | 0.56-0.98                                         | 0.75<sup>def</sup>                            | 0.29-0.85                                             | 0.61<sup>ef</sup>                                  |
| Sel 18            | 0.58-1.13                                         | 0.80<sup>gh</sup>                            | 0.29-0.82                                             | 0.51<sup>gh</sup>                                  |
| Superbug SPS      | 0.60-1.00                                         | 0.81<sup>a</sup>                            | 0.40-0.89                                             | 0.61<sup>ef</sup>                                  |
| VRT-101A          | 0.60-0.98                                         | 0.80<sup>abc</sup>                           | 0.38-0.91                                             | 0.64<sup>bc</sup>                                  |
| WIR 13708         | 0.62-0.82                                         | 0.73<sup>ab</sup>                            | 0.29-0.89                                             | 0.61<sup>de</sup>                                  |
| WIR 3956          | 0.62-0.93                                         | 0.79<sup>abcd</sup>                          | 0.29-0.78                                             | 0.58<sup>def</sup>                                 |
| Sun Cherry        | 0.69-0.98                                         | 0.83<sup>a</sup>                            | 0.29-0.91                                             | 0.62<sup>ef</sup>                                  |
| Arka Meghai       | 0.53-0.95                                         | 0.77<sup>cde</sup>                           | 0.33-0.93                                             | 0.66<sup>abc</sup>                                 |
| EC 538380         | 0.65-0.85                                         | 0.87<sup>bcd</sup>                           | 0.31-0.95                                             | 0.64<sup>bc</sup>                                  |
| IHR 2486          | 0.65-1.09                                         | 0.78<sup>def</sup>                           | 0.31-0.85                                             | 0.64<sup>bc</sup>                                  |
| EC 620421         | 0.62-0.89                                         | 0.82<sup>abc</sup>                           | 0.18-0.64                                             | 0.45<sup>bc</sup>                                  |
| BRDT-1            | 0.51-0.69                                         | 0.59<sup>a</sup>                            | 0.40-0.09                                             | 0.55<sup>cde</sup>                                 |
| CLN 1621L         | 0.69-0.84                                         | 0.77<sup>fg</sup>                            | 0.53-0.91                                             | 0.71<sup>ab</sup>                                  |
| Pusa Rohini       | 0.55-0.82                                         | 0.71<sup>fg</sup>                            | 0.38-0.85                                             | 0.63<sup>cde</sup>                                 |
| Solanum peruvianum| 0.44-0.82                                         | 0.65<sup>de</sup>                            | 0.24-0.80                                             | 0.51<sup>h</sup>                                   |
| Solanum chilense yellow | 0.55-0.95                     | 0.74<sup>def</sup>                           | 0.22-0.89                                             | 0.62<sup>ef</sup>                                  |
| Solanum cheesmaniae | 0.45-0.75                                         | 0.63<sup>a</sup>                            | 0.24-0.85                                             | 0.53<sup>gh</sup>                                  |
| Solanum pimpinellifolium | 0.69-0.89                             | 0.76<sup>defg</sup>                          | 0.36-0.82                                             | 0.56<sup>defgh</sup>                               |
| EC 538455         | 0.45-0.73                                         | 0.63<sup>a</sup>                            | 0.29-0.71                                             | 0.55<sup>gh</sup>                                  |
| BRDT 3            | 0.69-0.93                                         | 0.77<sup>def</sup>                           | 0.43-0.85                                             | 0.65<sup>de</sup>                                  |
| SEM±               | -                                                 | 0.01                                          | -                                                      | 0.02                                              |
| CV (%)             | -                                                 | 3.59                                          | -                                                      | 4.77                                              |

Mean in a column sharing same letter are not significantly different by DMR Test at P<0.05.
Conclusion
On the basis of screening of genotypes and mean population of sucking pests (aphid and whitefly) in all three (3) seasons (summer 2018, kharif 2018 and rabi 2018) it was concluded that among the twenty genotypes, five genotypes namely *Solanum peruvianum*, EC 620421, BRDT-1, EC 538455 and *Solanum cheesmaniae* were considered as tolerant/less susceptible to aphid and whitefly population.

Acknowledgement
The author is thankful to The Associate Dean-cum-Principal, Bihar Agricultural College, Sabour for providing financial grant to carry out the research work.

References
1. Abdel-Baky NF, Al-Deghairi MA. Role of host plantson the biological aspects and parasitism levels of *Ertemocerus mundus* Mercet (Hymenoptera: Aphelinidae), a parasitoid of *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae). Journal of Entomology. 2008; 5:356-368.
2. Agrawal AA. Host-range evolution: adaptation and trade-offs in fitness of mites on alternative hosts. Ecology. 2000; 81:500-508.
3. Anitha KR. Seasonal incidence and management of sucking pest of okra. M.Sc. (Agri.) Thesis, University of Agricultural Sciences, Dharwad, Karnataka, India. 2007.
4. Anitha KR, Nandihalli BS. Seasonal incidence of sucking pests in okra ecosystem. Journal of Agriculture Sciences. 2000; 21(1):137-138.
5. Byrne DN, Bellows Jr. TB, Parrella MP. Whiteflies in agricultural systems. In: Whiteflies: Their Bionomics, Pest Status and Management, D. Gerling (ed.). Intercept, Hants, United Kingdom, 1990, 227-261.
6. Gomez KA, Gomez RA. Statistical Procedure for Agriculture Research. John Willey and sons, New York. (2nd edition.), 1983, 28-411.
7. Lakshnianan KK. Whitefly - A global menace. Indian Farmer's Digest. 2000; 33(6-7):32.
8. Metcalf CL, Flint WP. Destructive and Useful Insects and Their Habits and Control. McGraw Hill International Book Co. Singapore, 1978, 1087.
9. Saha R. Seasonal incidence and management of sucking pests of okra. M.Sc. (Agri.) Thesis, Mahatma Phule Krishi Vidyapeeth Rahuri, Ahmednagar, Maharashtra, India, 2015.
10. Sayala S. Seasonal incidence of sucking insect pests on Bt cotton and their management through eco-friendly technique. M.Sc. (Agri.) Thesis, Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad, India, 2009.
11. Setiawati W, Adiarto BK, Gunaeni N. Preference and infestation pattern of *Bemisia tabaci* (Genn) on some tomato varieties and its effect on gemini virus infestation. Indonesian Journal of Agricultural Science. 2015; 2(1):57-64.
12. Touhidul M, Shunxiang R. Development and reproduction of *Bemisia tabaci* on three tomato varieties. Journal of Entomology. 2007; 4:231-236.
13. Zhu-Salzman K, Salzman RA, Ahn JE, Koiwa H. Transcriptional regulation of sorghum defense determinants against a phloem-feeding aphid. Plant Physiology. 2010; 134:420-431.