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

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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, BRDT-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-Deghairi, 2008) [12, 1]. 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.

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, EC 538380, IIHR 2486, EC 620421, 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 insect pests (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 significant least 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 *Bt* cotton.

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

Genotype	Summer season			
	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^{a}	0.53-0.82	0.71^{ef}
Sel 18	0.78-0.91	0.85^{ab}	0.53-1.02	0.76^{cde}
Superbug SPS	0.75-0.91	0.84^{abc}	0.71-0.95	0.83^{abcd}
VRT-101A	0.71-0.91	0.80^{cd}	0.64-0.82	0.72^{ef}
WIR 13708	0.78-0.96	0.83^{abc}	0.71-0.82	0.77^{cde}
WIR 3956	0.67-0.84	0.76^{d}	0.64-0.89	0.74^{def}
Sun Cherry	0.71-0.87	0.80^{cd}	0.56-0.91	0.77^{cde}
Arka Meghali	0.71-0.98	0.82^{abc}	0.62-0.89	0.78^{cde}
EC 538380	0.58-0.84	0.71^{ef}	0.62-0.93	0.71^{ef}
IIHR 2486	0.71-0.95	0.83^{abc}	0.60-0.89	0.72^{ef}
EC 620421	0.62-0.75	0.68^{ef}	0.49-0.78	0.60^{gh}
BRDT-1	0.60-0.82	0.71^{ef}	0.44-0.62	0.55^{h}
CLN 1621L	0.73-0.98	0.81^{bcd}	0.69-0.95	0.78^{bcde}
Pusa Rohini	0.73-0.85	0.81^{bcd}	0.56-0.93	0.80^{abcde}

Solanum peruvianum	0.53-0.73	0.67^{f}	0.56-0.84	0.66^{fg}
Solanum chilense yellow	0.75-0.89	0.81^{bcd}	0.78-1.00	0.88^{ab}
Solanum cheesmaniae	0.60-0.82	0.72^{e}	0.56-0.76	0.66^{fg}
Solanum pimpinellifolium	0.78-0.91	0.87^{a}	0.73-1.02	0.88^{a}
EC 538455	0.62-0.84	0.69^{ef}	0.58-0.84	0.73^{ef}
BRDT 3	0.75-0.93	0.85^{ab}	0.73-0.95	0.84^{abc}
SEm±	-	0.01	-	0.02
CD (p=0.05)	-	0.04	-	0.05
CV (%)	-	3.32	-	4.34

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

Table 2: Evaluation of different genotypes against sucking pests of tomato during *kharif* Season

Genotype	Kharif Season			
	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^{abc}	0.73-0.84	0.78^{bcde}
Sel 18	0.58-0.82	0.68^{cd}	0.65-0.89	0.77^{de}
Superbug SPS	0.58-0.87	0.74^{abc}	0.69-0.89	0.80^{abcde}
VRT-101A	0.62-0.87	0.77^{ab}	0.64-0.95	0.76^{de}
WIR 13708	0.62-0.91	0.73^{abc}	0.73-1.05	0.87^{a}
WIR 3956	0.58-0.87	0.73^{abc}	0.64-0.87	0.77^{cde}
Sun Cherry	0.60-0.84	0.73^{abc}	0.71-0.95	0.84^{abc}
Arka Meghali	0.62-0.89	0.71^{bcd}	0.64-0.95	0.85^{ab}
EC 538380	0.56-0.82	0.72^{abcd}	0.71-0.95	0.86^{ab}
IIHR 2486	0.60-0.80	0.70^{bcd}	0.75-0.95	0.82^{abcd}
EC 620421	0.38-0.78	0.57^{fg}	0.38-0.71	0.57^{h}
BRDT-1	0.49-0.78	0.60^{ef}	0.51-0.82	0.68^{fg}
CLN 1621L	0.58-0.82	0.74^{abc}	0.65-0.93	0.85^{ab}
Pusa Rohini	0.58-0.80	0.69^{cd}	0.62-0.95	0.83^{abcd}
Solanum peruvianum	0.38-0.65	0.53^{g}	0.51-0.75	0.64^{g}
Solanum chilense yellow	0.58-0.89	0.73^{abc}	0.75-1.02	0.87^{a}
Solanum cheesmaniae	0.51-0.85	0.69^{cd}	0.47-0.95	0.74^{ef}
Solanum pimpinellifolium	0.65-0.93	0.78^{a}	0.64-1.02	0.79^{abcde}
EC 538455	0.56-0.75	0.65^{de}	0.62-0.85	0.73^{ef}
BRDT 3	0.71-0.91	0.79^{a}	0.66-0.93	0.83^{abcd}
SEm±	-	0.02	-	0.02
CD (p=0.05)	-	0.05	-	0.06
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	RABI SEASON			
	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^{defg}	0.29-0.85	0.61^{bcde}
Sel 18	0.58-1.13	0.80^{abcd}	0.27-0.82	0.51^{gh}
Superbug SPS	0.60-1.00	0.81^{ab}	0.40-0.89	0.61^{bcde}
VRT-101A	0.60-0.98	0.80^{abc}	0.38-0.91	0.64^{bc}
WIR 13708	0.62-0.82	0.73^{fg}	0.29-0.89	0.61^{bcdef}
WIR 3956	0.62-0.93	0.79 ^{abcde}	0.29-0.78	0.58^{cdefg}
Sun Cherry	0.69-0.98	0.83^{a}	0.29-0.91	0.62^{bcde}
Arka Meghali	0.53-0.95	0.77^{bcdef}	0.33-0.93	0.66^{ab}
EC 538380	0.65-0.85	0.78^{bcdef}	0.31-0.95	0.64^{bc}
IIHR 2486	0.65-1.09	0.78^{bcdef}	0.31-0.85	0.64^{bc}
EC 620421	0.42-0.89	0.62^{hi}	0.18-0.64	0.45^{i}
BRDT-1	0.51-0.69	0.59^{i}	0.40-0.69	0.55^{efgh}
CLN 1621L	0.69-0.84	0.77^{bcdef}	0.53-0.91	0.71^{a}
Pusa Rohini	0.55-0.82	0.71^{g}	0.38-0.85	0.63^{bcd}
Solanum peruvianum	0.44-0.82	0.65^{h}	0.24-0.80	0.51^{hi}
Solanum chilense yellow	0.55-0.95	0.74^{efg}	0.22-0.89	0.62^{bcd}
Solanum cheesmaniae	0.45-0.75	0.63^{hi}	0.24-0.85	0.53^{gh}
Solanum pimpinellifolium	0.69-0.89	0.76^{cdefg}	0.36-0.82	0.56^{defgh}
EC 538455	0.45-0.73	0.63^{hi}	0.29-0.71	0.55^{fgh}
BRDT 3	0.69-0.93	0.77^{bcdef}	0.43-0.85	0.65^{ab}
SEm±	-	0.01	-	0.02
CD (p=0.05)	-	0.04	-	0.05
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.

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