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IN VITRO SUSCEPTIBILITY OF *CAPSICUM ANNUUM* L. CULTIVARS TO SUCKING PESTS

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ABSTRACT

This study evaluated the resistance of six different Chilli (*Capsicum annuum* L.) cultivars to major sucking pests, specifically aphids (*Aphis gossypi* Glover) and whitefly (*Bemisia tabaci* Gennadius), under greenhouse conditions at College of Post Graduate Studies in Agricultural Sciences, Umiam, Meghalaya. The results revealed that among the six cultivars evaluated Arka Khyati demonstrated the lowest susceptibility to aphids (*Aphis gossypii* Glover), averaging 94 aphids per plant and 15.66 per leaf, with minimal damage indicated by a leaf distortion index of 0.33 and a chlorosis index of 0.00. Whereas, IPBC-313 exhibited the highest susceptibility, with 430 aphids per plant and 71.66 per leaf, showing severe damage reflected in a leaf distortion index of 4.33 and a chlorosis index of 3.33. In case of whitefly (*Bemisia tabaci* Gennadius) resistance, Arka Khyati again outperformed the others, with only 2.99 whiteflies settlement and an infestation index of 0.66, while IPBC-313 was highly susceptible, with 16.00 whiteflies settled and an infestation index of 5.00.
***Keywords*:** leaf distortion index, chlorosis index, *Aphis gossypii* Glover, *Bemisia tabaci* Gennadius, infestation index, Arka Khyati,

Introduction

Chilli, scientifically known as *Capsicum annuum* L., is a member of the Solanaceae family and is extensively grown worldwide. Chillies are rich in vitamins A and C, as well as minerals like potassium, magnesium, and manganese (Bhatt and Karnatak, 2020). The vibrant colour of chilli is attributed to the pigment "capsanthin," while their characteristic spiciness comes from the alkaloid "capsaicin." India is the largest producer of chilli worldwide, followed by China and Pakistan (Mondol and Patra, 2021) and contributes approximately one-fourth of the global chilli exports (Lakshmi *et al.*, 2021). Despite India's significant share in global Chilli production, its productivity and overall production are impacted by various factors. These include unfavorable climatic conditions, low-quality seeds, insect pests and diseases. In North East India the major sucking pests attacking Chilli crop are aphids (*Aphis gossypii* Glover) and whitefly (*Bemisia tabaci* Gennadius). *A. gossypii* and *B. tabaci* can cause damage up to 50 % of total Chilli production (Das, 2013). Host plant resistance (HPR) is an effective strategy for managing insect pests and vector-borne diseases in horticultural crops, including chilli. Host plant resistance operates through three mechanisms: antibiosis, where plants negatively impact insect biology; non-preference (antixenosis), where plants are less attractive to pests for feeding, shelter or oviposition; and tolerance, where plants can endure damage. For example, the whitefly (*B. tabaci*), a major pest that damaged chilli by feeding on phloem and transmitting viruses, showed reduced populations on resistant varieties (0.12 to 0.23 adults/leaf) (Jeevanandham *et al.*, 2018). Hence, the present study aims to reduce the reliance on chemical treatments and complement natural predation by incorporating resistant varieties into Integrated pest management practices.

Materials and Methods

The study accessed the susceptibility of six different chilli cultivars (Arka Khyati, RCH-1, Umorok, IPBC-313, Pusa Jawala, PBC-81) to *A. gossypii* and *B. tabaci* infestation. The research was conducted at the green house of the college of post graduate studies in agricultural sciences (CPGS-AS), central agricultural university (Imphal), Umiam, Meghalaya, India. *A. gossypi* were introduced into each cultivar by carefully placing ten adults on young leaves of each plant, and were covered with nets to prevent insect escape. After six weeks, damage was assessed based on criteria such as leaf distortion, chlorosis, honeydew secretion, and stunting (Frantz *et al*., 2004). *A. gossypi* population on each plant was determined by cumulative visual counts from each leaf. The aphid infestation index values were used to categorize cultivars into different resistance levels using the grading system given by Bakhetia and Sandhu (1973): 0.00–1.50 (Resistant), 1.51–2.50 (Moderately resistant), 2.51–3.50 (Susceptible), and >3.50 (Highly susceptible). Damage symptoms caused by *A. gossypi* infestation were assigned damage indices as follows: 0.00-0.04 (None to very mild), 0.50-1.49 (Mild), 1.50-2.49 (Moderate), 2.50-3.49 (Moderately severe), 3.50-4.49 (Severe), and 4.50-5.00 (Very severe). Similarly, the number of *B. tabaci* settling on each cultivar was recorded at 3, 6, and 9 days after introduction (Yadav *et al*., 2020). The whitefly infestation index of different cultivars was determined based on Banerjee and Kalloo's (1987) grading system as follows: 0.0 (Immune), 0.1-1.5 (Highly resistant), 1.6-2.5 (Resistant), 2.6-3.5 (Moderately susceptible), 3.6-4.5 (Susceptible), and 4.6-5.0 and above (Highly susceptible). The data from this in vitro evaluations of host susceptibility across different chilli cultivars to sucking pests were statistically analyzed using ANOVA in a Completely Randomized Block Design (CRD). To compare means and determine significant differences, Dunccan’s multiple range test was employed at a significance level of $p<0.05$. All analyses were conducted using statistical package for the social sciences (SPSS) version 22.0.

Results and Discussion

The *A. gossypi* infestation recorded on different chilli cultivars based on number of aphids per plant, number of aphids per leaf and damage symptoms is presented in Table 1. Among all the six different cultivars it was found that IPBC-313 exhibited the highest susceptibility, with 430 aphids/plant and 71.66 aphids/leaf and aphid infestation index (5.00) accompanied by severe damage indicators such as leaf distortion index (4.33) and chlorosis index (3.33). Whereas, Arka Khyati showed the least susceptibility, with 94 aphids/plant and 15.66 aphids/leaf and aphid infestation index of 0.01 with minimal damage (leaf distortion index 0.33, chlorosis index 0.33). These results were consistent with earlier research by Daryanto et al. (2021), who screened seven Chilli pepper varieties to check their resistance to *A. gossypii* and identified IPBC-313 as susceptible to *Aphis gossypii*, with high aphid settlements (139.54 aphids/leaf). Similarly, Kumar *et al*. (2021) evaluated seven chilli varieties for tolerance and susceptibility to sucking insect pests of chilli and throughout all the varieties Arka Khyati was categorized as resistant, while RCH-1, Moti Hira-31, Dhan Laxmi-21, Selection-5, and MY Selection-71 were moderately susceptible, and PS-64 as highly susceptible to sucking pests. Rahman *et al*. (2017) reported that out of 70 genotypes of chilli screened for their resistance against *A. gossypi,* germplasms AHM 219 (3.02 %), AHM 223 (3.23 %), IAH 156 (4.09 %), RT 30 (4.86 %), IAH 165 (4.92 %), and AHM 141 (5.18 %) had the lowest leaf infestation of *A. gossypii* and were found to be tolerant whereas, moderately tolerant (22 germplasm), susceptible (23 germplasm), and highly susceptible (19 germplasm). Similarly, Priyadarshini *et al*. (2019) screened six chilli cultivars against the sucking pests of chilli and found that in *A. gossypi* resistance, Bhangar (4.01 aphids/3 leaves) was found to be tolerant and Suryamukhi (5.48 aphids/3 leaves) was susceptible and for *B. tabaci*, Suryamukhi (1.32 whiteflies/3 leaves) was tolerant, and Akashi (1.99 whiteflies/3 leaves) was susceptible. Dhillon *et al*. (2018) conducted an experiment to evaluate the aphid damage index of six different varieties of mustard based on a range scale (0-5) and revealed that Heera variety was highly susceptible with damage index of 4.33 and PM 21 was found to have lower damage index of 3.00. In case of *B. tabaci* resistance recorded at 3,6 and 9 days after dusting, IPBC-313 cultivar recorded had the highest infestation with a total of 16 whiteflies settlement and an infestation index of 5.00, indicating high susceptibility, while Arka Khyati showed the highest resistance, with only 2.99 whiteflies settlement and an infestation index of 0.66. These results highlighted IPBC-313 as highly susceptible and Arka Khyati as the relatively resistant cultivar to *B. tabaci* infestation. These results are in line with the experiment conducted by Yadav *et al*. (2020) who screened 125 Chilli genotypes to evaluate the resistance to *B.tabaci*, conducting free-choice assay and observed that the attractiveness whiteflies to genotypes differed considerably. Due to lesser numbers of settled whiteflies and nymphs, genotypes like IHR 4283, IHR 4329, IHR 4300, IHR 4321, and IHR 4338 were found to be the least favoured, in contrast, genotypes like IHR 4586 A-1, IHR 4588, and IHR 4330 attracted the maximum numbers of whiteflies. Jeevanandham *et al*.

(2018) assessed 45 Chilli accessions under greenhouse conditions against *B. tabaci* by recording the number of adults settled on individual plants at 4, 8, 12, 24 and 48 hours after release and found that accessions P2, P4, ACC1, and ACC12 were less preferred for adult settlement whereas, P1, P3, P5, ACC10, ACC26, and ACC27 were highly preferred. Resistant accessions showed reduced pest population due to lower reproductive rates and extended developmental periods. Taggar *et al.* (2013) evaluated nine genotypes on the basis of whitefly resistance index against *B. tabaci* and recorded the genotypes KU 99-20 and NDU 5-7 as moderately resistant as they recorded WRI of 1.50. The genotypes IPU 02-043, KU 7-602, KU 7-605, KU 7-618 and Mash 1-1 recorded WRI ranging from 2.59 to 3.05 and hence were categorized as susceptible. The remaining two genotypes, viz. KU 7-504 and KU 7-505 recorded the highest WRI ranging from 3.66 to 3.70 and thus, were categorized as highly susceptible to *B. tabaci*.

Conclusion

The development of host plant resistance (HPR) is a feasible strategy for mitigating the impact of major insect pests of Chilli and preventing the transmission of diseases associated with their presence. The study highlighted the importance of cultivar selection in effectively managing aphid and whitefly infestations in Chilli. IPBC-313 consistently showed high susceptibility to whitefly and aphid infestation whereas, Arka Khyati exhibited strong resistance. Hence, evaluating different cultivars for resistance helps in selecting varieties that reduce crop losses and pesticide use.

Table 1: *Aphis gossypii* infestation and damage rating index recorded on different chilli cultivars

Cultivars	**Aphids per plant**	**Aphids per leaf**	**Aphids Infestation Index (AII)**	**Reaction**	**Leaf Distortion Damage Index**	**Category**	**Chlorosis Damage Index**	**Category**	**Honeydew Damage Index**	**Category**	**Stunting Damage Index**	**Category**
RCH-1 (T1)	232 ± 6.92^{c}	38.33 ± 1.15^{c}	3.33	Susceptible	2.33	Moderate	3.00	Moderately severe	2.00	Moderate	1.66	Moderate
Umorok (T2)	200 ± 3.46^{d}	33.33 ± 0.57^{d}	2.56	Susceptible	1.66	Moderate	2.66	Moderately severe	1.33	Mild	1.33	Mild
Pusa jawala (T3)	104 ± 9.16^{e}	17.33 ± 1.52^{e}	1.66	Moderately Resistant	0.66	Mild	0.66	Mild	0	None	1.00	Mild
Arka Khyati (T4)	92 ± 3.46^{e}	15.66 ± 0.57^{e}	0.00	Resistant	0.33	Very Mild	0.33	Very Mild	0	None	0.66	Mild
PBC-81(T5)	382 ± 6.00^{b}	64.00 ± 1.00^{b}	4.33	Highly Susceptible	3.33	Moderately severe	4.66	Very severe	3.33	Moderately severe	2.00	Moderate
IPBC-313(T6)	428 ± 3.46^{a}	71.66 ± 0.57^{a}	5.00	Highly Susceptible	4.33	Severe	3.33	Moderately severe	4.33	Severe	2.33	Moderate
CD (p=0.05)	**10.37**	**1.72**										
S.E. (m) (±)	**3.36**	**0.56**										

Table 2 : Settling response of *B. tabaci* recorded on different Chilli cultivars

Cultivars	**3 DAD**	**6 DAD**	**9 DAD**	**Total**	**Whitefly Infestation Index**	**Reaction**
RCH-1 (T_1)	4.00 ± 1.00^{a}	4.00 ± 1.00^{ab}	6.00 ± 1.00^{a}	14.00	3.66	Susceptible
Umorok (T_2)	3.00 ± 1.00^{ab}	3.33 ± 0.57^{bc}	4.00 ± 1.73^{a}	10.33	3.33	Moderately Susceptible
Pusa jawala (T_3)	1.66 ± 0.57^{b}	2.00 ± 1.73^{cd}	1.00 ± 0.00^{b}	4.66	1.66	Resistant
Arka Khyati (T_4)	1.33 ± 1.15^{b}	1.33 ± 0.57^{d}	0.33 ± 0.57^{b}	2.99	0.66	Highly Resistant
PBC-81 (T_5)	4.33 ± 1.15^{a}	4.33 ± 1.15^{ab}	5.33 ± 0.57^{a}	14.00	4.33	Susceptible
IPBC-313 (T_6)	4.66 ± 0.57^{a}	5.33 ± 0.57^{a}	6.00 ± 1.73^{a}	16.00	5.00	Highly Susceptible
C.D (p=0.05)	**1.67**	**1.82**	**2.01**			
S.E. (m) (±)	**0.54**	**0.59**	**0.65**			

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Author contribution statement

Subashi Baruah and Mahesh Pathak conceived and designed the research, Subashi Baruah conducted the experiment, Mahesh Pathak, Kenendy Ningthoujam, R.K Patidar and T. Rajesh and Jyotim Gogoi provided the data analysis tools, Subashi Baruah and Jyotim Gogoi analysed the data, Subashi Baruah and Mahesh Pathak wrote the manuscript. All authors read and approved the manuscript.

Conflict of interest

No conflict of interest

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