



P-ISSN: 2349-8528

E-ISSN: 2321-4902

IJCS 2020; 8(1): 971-979

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Received: 04-11-2019

Accepted: 06-12-2019

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Screening chilli genotypes for whitefly (*Bemisia tabaci* Genn.) resistance: A vector for chilli leaf curl virus

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DOI: <https://doi.org/10.22271/chemi.2020.v8.i1m.8372>

Abstract

Whiteflies (*Bemisia tabaci*) are one of the most important insect-pests of chilli worldwide mainly due to their role in transmission of Begomoviruses like Chilli Leaf Curl Virus (ChL CV). In this study, selected chilli genotypes (N = 125) including wild and cultivated species were evaluated against whitefly using free choice assays and parameters like number of whiteflies settled and nymphal population (both early and late stage) were considered to identify less preferred genotypes. The genotypes were also evaluated for plant traits namely trichome density, leaf colour and biochemical content (phenols and flavonoids). The results showed that the whitefly population and nymphal density were significantly different among the genotypes evaluated. Whitefly settlers and their nymphal density were positively correlated with the leaf non-glandular trichomes. The chilli genotypes viz., IHR 4283, IHR 4329, IHR 4300, IHR 4321, IHR 4338 recorded the less numbers of whiteflies as well as nymphs and grouped as the least preferred genotypes. On the contrary, the genotypes IHR 4586 A-1, IHR 4588 and IHR 4330 recorded the highest numbers of whiteflies. The role of plant traits in whitefly resistance in chilli was discussed in detail.

Keywords: *Capsicum* species, whitefly, host plant resistance, trichomes, phenols & flavonoids

Introduction

Capsicum sp. is a globally important commodity used as a vegetable, spice, medicinal herb, and ornamental plant. There are several types under *Capsicum* sp. commonly known as hot pepper, bell pepper, sweet pepper, bird eye pepper, paprika (Family: Solanaceae). It is originated in South America (Peru) and Mexico is considered as a secondary centre of origin and diversity. It is native to tropical and subtropical regions but has spread rapidly around the world (Barro *et al.*, 1998) [1]. *Capsicum* sp. is introduced in India by Portuguese traders in 1498 and it's become an indispensable commodity in every cuisine due to its pungency, spicy taste, appealing colour and flavour.

The cultivation and yield of chillies are frequently hampered in India by several insect pests, of which the whitefly (*Bemisia tabaci* Genn.; Hemiptera: Aleyrodidae), has become a serious threat in recent years not only by causing direct feeding damage but also by indirect transmission of plant Begomoviruses viz., chilli leaf curl virus (ChLCV) (Morales, 2007; Kumar *et al.*, 2015; Padhi *et al.*, 2017) [2, 3, 4] in semi-persistent manner. Therefore, identifying the sources of resistance to this dreadful vector will serve as a key for the sustainable management of this disease in long run and also limit the indiscriminate use of pesticides.

The present study aims to identify the sources of resistance for whitefly, *B. tabaci* incidence in chilli genotypes (*Capsicum* hereafter). Morphological plant traits like leaf lour, trichome density (both adaxial and abaxial) and biochemical components (phenols and flavonoids) were correlated with whitefly population to find out the possible plant traits that contribute to the mechanism of resistance.

Materials and Methods**Plant materials**

Seeds of selected chilli genotypes/lines/varieties were obtained from the Division of Vegetable Crops, ICAR-Indian Institute Horticultural Research (IHR), Bengaluru. Selected lines were

sown at two mm depth in 50 cell pro-trays and 45 days old seedlings were transplanted in the insect proof net house. For all experiments 60 days old seedling are used.

Whiteflies

The initial culture of whiteflies was collected from the Division Entomology and Nematology ICAR-Indian Institute of Horticultural Research, Bengaluru. Whiteflies were maintained on brinjal (*Solanum melongena* L.) plants inside insect proof net house (Firdaus *et al.*, 2011) [5].

Screening methodology

All the *Capsicum* genotypes were screened inside screen house through free choice method. For free choice test, whiteflies were collected from brinjal plants using aspirators and dusted carefully on to chilli plants continuously for three days and the data on the number of whiteflies settled on each accession was recorded on 3, 6 and 9 days after dusting (DAD). After 15 days, the infested leaves (n=10) were selected randomly in each accession and observations were recorded on the total number of early stage nymphs (ESN) and late stage nymphs (LSN) using the fully automated Leica M205A stereo microscope.

Plant traits

Observations on morphological and biochemical traits of genotypes were studied at flowering stage (60 Days after Transplanting-DAT).

Trichomes: The number of leaf trichomes [both glandular (GT) and non-glandular (NGT)] was recorded by randomly selecting three matured leaves per genotype. In each leaf three discs were made (each measuring 0.8 cm in diameter) using a cork borer and the number of trichomes were counted from both abaxial (Ab) and adaxial (Ad) surfaces using the fully automated Leica M205A stereo microscope.

Leaf colour: A total of three matured leaves were selected randomly from each genotype and scored using RHS colour chart (The Royal Horticultural Society, Fifth edition, 2007) and scoring was done according to the colour intensity (4-20).

Total phenolics and flavonoids: Leaf samples were collected from each genotype and the estimation of phenols and flavonoids was done as per procedure described by Singleton and Rossi (1965) [6] and Bao *et al.* (2005) [7] with little modification.

Statistical analyses

The data obtained were subjected to ANOVA, correlation analysis and Principal Component Analysis (PCA) using SPSS software.

Result and Discussion

Whitefly settlers

Numbers of whiteflies settled on genotypes at 3 DAD ($P<0.0001$), 6 DAD ($P<0.0001$) and 9 DAD ($P<0.0001$) varied significantly. The number of whiteflies settled on accessions varied from 0.33 to 26.33, 0.30 to 35.67 and 0.30

to 34.27 at 3 DAD, 6 DAD and 9 DAD respectively. The mean total numbers of whiteflies settled varied from 1.46 to 96.27. Mean numbers whiteflies settled was found highest at 9 DAD followed by 6 DAD and 3 DAD, while mean total whiteflies settled were 12.51 ± 11.57 (Table S1).

The genotypes viz., IHR 4647, IHR 4647-1, IHR 4321, IHR 4338, IHR 4591, IHR 4283, IHR 4291, IHR 4492, IHR 4329, IHR 4588-1, IHR 4585 and IHR 4300 recorded significantly ($P<0.0001$) less numbers of whiteflies at 3 DAD and the genotypes viz., IHR 4586 A-1, IHR 4290-1, IHR 4290, IHR 4588, IHR 4586 A and IHR recorded significantly ($P<0.0001$) the highest numbers of whiteflies after 3 DAD (Table S1).

The genotypes that recorded significantly ($P<0.0001$) less numbers of whiteflies at 6 DAD were IHR 4291, IHR 4329, IHR 4300, IHR 4355, IHR 3991, IHR 4338, IHR 4283, and IHR 4321, while genotypes IHR 4586 A-1, IHR 4588, IHR 2452, IHR 3024-1, IHR 4290-1 and IHR 4330 recorded significantly ($P<0.0001$) the highest numbers of whiteflies after 6 DAD (Table S1).

At 9 DAD, the genotypes viz., IHR 4300, IHR 4329, IHR 4338, IHR 4283, IHR 4355, IHR 3991, IHR 4308, IHR 4292 and IHR 4291 recorded significantly ($P<0.0001$) less numbers of whiteflies. The genotypes, IHR 4586 A-1, IHR 4588, IHR 4330, IHR 3024-1, IHR 2452, IHR 4290-1, and IHR 4418 recorded significantly ($P<0.0001$) the highest numbers of whiteflies at 9 DAD (Table S1).

Nymphal population

Among the genotypes, the number of early stage nymphs (ESN), late stage nymphs (LSN) and the total nymphs varied significantly from 0.10 to 7.00 ($P<0.0001$), 0.30 to 8.40 ($P<0.0001$), and 0.25 to 7.70 ($P<0.0001$) respectively. The lowest numbers of LSN were recorded in IHR 4338, IHR 4641, IHR 4647-1, IHR 4283, IHR 4408, IHR 4585, IHR 4284 and IHR 4329, while the highest numbers of LSN were noticed in IHR 4586 A-1, IHR 4588, IHR 4290-1, IHR 3291, IHR 4330 and IHR 3024-1. Similarly, the lowest numbers of ESN were recorded in IHR 4283 and IHR 4338 while, the highest numbers of ESN were noticed in IHR 4586 A-1, IHR 3291, IHR 4290-1, IHR 4588 and IHR 3024-1.

In the present study total 125 chilli genotypes were evaluated against whiteflies. There were large differences observed between genotypes for whitefly preference, whitefly population, oviposition and nymphal density. In free choice of screening the genotypes IHR 4283, IHR 4329, IHR 4300, IHR 4321 and IHR 4338 showed less numbers of whitefly population and nymphal density indicating possible antixenosis and antibiosis. Similarly Firdaus *et al.* (2011) [5] reported that *C. annuum* accessions showed highly resistant reaction in no-choice and free choice tests. Genotypes such as Chawa, Blanco, Maax and X'catic were found less susceptible to *B. tabaci* (Ballina-Gomez *et al.*, 2013) [8] and Amaxito, Tabaquero, and Simojovel showed resistance to whitefly (Latournerie-Moreno *et al.*, 2015) [9]. Genotypes IAC-1544, IAC-1545 and IAC-1579 showed antibiosis mechanisms for whitefly (Pantoja *et al.*, 2017) [10] and the genotypes CA 9, CA28 and ACC 05 have displayed strong antiemetic and antibiotic effect against *B. tabaci* (Jeevanandham *et al.*, 2018) [11] can be good source of resistance.

Table S1: Summary of ANOVA of various insect parameters recorded during free choice screening against whitefly

Genotypes	Whitefly population (Mean± SE)				
	Number of adults settled*			Number of nymphs**	
	3 DAD	6 DAD	9 DAD	ESN	LSN
IHR 4283	0.70±0.26 (1.27±0.10)	0.70±0.21 (1.28 ±0.08)	0.40±0.16 (1.17±0.07)	0.20±0.13 (1.08±0.06)	0.30±0.15 (1.12±0.06)
IHR 4329	1.60±0.37 (1.58±0.11)	1.20±0.29 (1.45 ±0.10)	0.80±0.25 (1.31±0.09)	0.50±0.22 (1.20±0.09)	0.50±0.17 (1.21±0.07)
IHR 4355	1.00±0.30 (1.38±0.11)	0.40±0.16 (1.17 ±0.07)	0.50±0.17 (1.21±0.07)	0.60±0.22 (1.24±0.09)	0.60±0.34 (1.22±0.12)
IHR 3991	1.20±0.25 (1.46±0.08)	0.40±0.16 (1.17 ±0.07)	0.50±0.17 (1.21±0.07)	1.20±0.44 (1.42±0.15)	1.10±0.50 (1.37±0.15)
IHR 4320	2.30±0.37 (1.79±0.10)	0.90±0.38 (1.33 ±0.12)	0.70±0.30 (1.27±0.10)	0.80±0.33 (1.30±0.11)	1.90±0.35 (1.67±0.11)
IHR 4296	2.30±0.47 (1.77±0.14)	1.50±0.27 (1.56±0.09)	0.70±0.21 (1.28±0.08)	2.30±0.56 (1.75±0.16)	1.80±0.55 (1.59±0.18)
IHR 4308	1.60±0.37 (1.57±0.12)	1.30±0.21 (1.50±0.08)	0.50±0.17 (1.21±0.07)	1.70±0.52 (1.57±0.16)	1.10±0.31 (1.41±0.11)
IHR 4315	4.50±1.11 (2.24±0.23)	3.80±1.04 (2.08±0.23)	1.00±0.30 (1.38±0.10)	3.90±0.78 (2.14±0.20)	4.50±0.75 (2.28±0.18)
IHR 4017	4.90±1.08 (2.34±0.21)	2.20±0.42 (1.76±0.11)	3.10±0.55 (1.98±0.14)	3.70±0.90 (2.06±0.23)	3.60±0.65 (2.09±0.17)
IHR 4342	2.80±0.59 (1.90±0.15)	1.30±0.30 (1.49±0.10)	2.00±0.39 (1.69±0.12)	1.20±0.39 (1.43±0.13)	1.20±0.25 (1.46±0.09)
IHR 4284	3.20±0.61 (2.00±0.15)	2.70±0.56 (1.87±0.16)	0.30±0.15 (1.12±0.06)	0.30±0.15 (1.12±0.06)	0.50±0.22 (1.20±0.09)
IHR 4325	3.20±0.29 (2.04±0.07)	3.30±0.37 (2.05±0.10)	4.40±0.37 (2.31±0.08)	1.90±0.43 (1.66±0.13)	1.60±0.37 (1.57±0.12)
IHR 4311	4.70±1.29 (2.26±0.25)	3.10±1.18 (1.88±0.25)	0.90±0.23 (1.35±0.09)	1.30±0.34 (1.48±0.12)	1.90±0.57 (1.64±0.15)
IHR 4299	3.80±0.44 (2.17±0.10)	4.80±0.55 (2.39±0.11)	4.80±0.29 (2.40±0.06)	3.10±0.61 (1.97±0.16)	3.40±0.43 (2.08±0.10)
IHR 4292	2.00±0.45 (1.69±0.13)	1.20±0.36 (1.44±0.12)	0.50±0.17 (1.21±0.07)	1.30±0.45 (1.45±0.15)	0.90±0.31 (1.34±0.11)
IHR 4290	12.60±0.85 (3.67±0.12)	6.90±1.10 (2.75±0.19)	6.20±0.74 (2.65±0.14)	0.50±0.22 (1.20±0.09)	0.60±0.22 (1.24±0.09)
IHR 4291	0.80±0.20 (1.32±0.08)	0.10±0.10 (1.04±0.04)	0.50±0.17 (1.21±0.07)	3.50±1.18 (1.97±0.26)	1.40±0.50 (1.48±0.15)
IHR 3449	1.10±0.31 (1.41±0.11)	0.80±0.25 (1.31±0.09)	0.70±0.21 (1.28±0.08)	3.80±0.74 (2.12±0.19)	1.10±0.41 (1.39±0.14)
IHR 4290-1	16.40±1.98 (4.11±0.24)	11.70±1.75 (3.48±0.26)	10.70±1.91 (3.32±0.27)	6.10±0.72 (2.63±0.13)	6.20±1.94 (2.45±0.36)
IHR 4329	0.80±0.20 (1.32±0.08)	0.20±0.13 (1.08±0.06)	0.30±0.15 (1.12±0.06)	0.90±0.31 (1.34±0.11)	0.50±0.22 (1.20±0.09)
IHR 4300	0.90±0.18 (1.36±0.07)	0.30±0.15 (1.12±0.06)	0.10±0.10 (1.04±0.04)	1.70±0.42 (1.59±0.13)	1.20±0.53 (1.40±0.16)
IHR 4299-1	4.00±0.56 (2.21±0.12)	3.40±0.31 (2.09±0.07)	5.10±0.59 (2.44±0.12)	1.40±0.45 (1.49±0.15)	3.90±0.43 (2.19±0.10)
IHR 4306	2.50±0.43 (1.84±0.11)	1.60±0.31 (1.59±0.09)	1.60±0.27 (1.60±0.08)	1.50±0.43 (1.53±0.14)	2.90±0.50 (1.94±0.13)
IHR 4493	1.50±0.17 (1.57±0.05)	1.80±0.25 (1.65±0.09)	3.80±0.25 (2.18±0.06)	1.90±0.48 (1.64±0.16)	2.60±0.43 (1.86±0.13)
IHR 4321	0.60±0.16 (1.25±0.07)	0.80±0.20 (1.32±0.08)	1.30±0.15 (1.51±0.05)	0.70±0.30 (1.26±0.11)	1.70±0.30 (1.62±0.10)
IHR 4330	9.30±0.40 (3.20±0.06)	11.40±0.65 (3.51±0.09)	13.00±0.68 (3.73±0.09)	5.70±0.65 (2.56±0.13)	4.20±0.49 (2.26±0.11)
IHR 3980	3.20±0.33 (2.04±0.08)	2.70±0.21 (1.92±0.06)	2.90±0.23 (1.97±0.06)	1.80±0.55 (1.59±0.17)	3.00±0.39 (1.98±0.10)
IHR 4323	2.00±0.26 (1.72±0.08)	2.00±0.26 (1.72±0.08)	2.90±0.23 (1.97±0.06)	1.00±0.33 (1.37±0.12)	2.30±0.30 (1.80±0.08)
IHR 4298	1.20±0.13 (1.48±0.04)	1.70±0.21 (1.63±0.07)	2.20±0.25 (1.78±0.07)	1.30±0.30 (1.49±0.10)	1.60±0.43 (1.56±0.14)
IHR 4492	0.80±0.13 (1.33±0.06)	1.30±0.30 (1.49±0.10)	2.00±0.15 (1.73±0.04)	1.50±0.34 (1.54±0.11)	2.60±0.43 (1.86±0.12)
IHR 4301	2.00±0.26 (1.72±0.08)	2.10±0.23 (1.75±0.07)	2.40±0.22 (1.83±0.06)	1.10±0.35 (1.40±0.12)	2.20±0.36 (1.76±0.11)
IHR 4444	1.30±0.15 (1.51±0.05)	1.40±0.16 (1.54±0.05)	2.60±0.16 (1.89±0.04)	0.60±0.27 (1.23±0.10)	3.10±0.38 (2.00±0.10)
IHR 4338	0.60±0.22 (1.24±0.09)	0.60±0.16 (1.25±0.07)	0.30±0.21 (1.12±0.08)	0.10±0.10 (1.04±0.04)	0.40±0.22 (1.16±0.08)
IHR 4342-1	4.70±0.78 (2.33±0.18)	2.20±0.25 (1.78±0.07)	1.30±0.30 (1.49±0.10)	0.60±0.22 (1.24±0.09)	1.60±0.40 (1.57±0.13)
IHR 3240	9.20±0.85 (3.17±0.14)	5.40±0.76 (2.49±0.15)	4.20±0.70 (2.24±0.15)	0.90±0.28 (1.34±0.10)	4.70±1.51 (2.23±0.28)
IHR 3241	1.30±0.15 (1.51±0.05)	0.80±0.13 (1.33±0.06)	1.50±0.22 (1.57±0.07)	1.10±0.23 (1.43±0.09)	2.20±0.36 (1.76±0.11)
IHR 3529	0.90±0.23 (1.35±0.09)	0.90±0.10 (1.37±0.04)	1.60±0.16 (1.61±0.05)	0.50±0.17 (1.21±0.07)	1.50±0.27 (1.56±0.09)
IHR 4502	3.60±0.99 (2.06±0.20)	3.50±0.85 (2.05±0.18)	3.70±0.58 (2.13±0.14)	0.50±0.17 (1.21±0.07)	1.10±0.31 (1.41±0.11)
IHR 4500	1.90±0.23 (1.69±0.07)	1.50±0.17 (1.57±0.05)	2.40±0.22 (1.84±0.06)	0.80±0.29 (1.30±0.11)	1.70±0.30 (1.62±0.10)
IHR 4550	2.80±0.29 (1.94±0.07)	1.90±0.31 (1.68±0.09)	2.10±0.18 (1.75±0.05)	0.90±0.28 (1.34±0.10)	1.90±0.23 (1.69±0.07)
IHR 4453	5.50±1.52 (2.42±0.27)	3.60±0.86 (2.07±0.19)	2.50±0.56 (1.81±0.16)	0.60±0.31 (1.22±0.11)	2.50±0.58 (1.81±0.16)
IHR 4493	3.80±0.42 (2.17±0.10)	3.80±0.47 (2.16±0.12)	7.10±0.43 (2.84±0.08)	1.60±0.43 (1.56±0.14)	2.80±0.36 (1.93±0.09)
IHR 4408	3.00±0.33 (1.98±0.09)	1.30±0.30 (1.49±0.09)	0.90±0.10 (1.37±0.04)	0.20±0.13 (1.08±0.06)	1.00±0.26 (1.39±0.10)
IHR 4641	2.20±0.53 (1.74±0.15)	1.30±0.34 (1.48±0.11)	1.10±0.28 (1.42±0.09)	0.10±0.10 (1.04±0.04)	1.10±0.53 (1.37±0.16)
IHR 4642	4.20±1.00 (2.19±0.21)	3.00±0.49 (1.96±0.13)	2.20±0.44 (1.75±0.13)	0.60±0.22 (1.24±0.09)	2.00±0.26 (1.72±0.08)
IHR 4575	1.70±0.47 (1.59±0.13)	2.70±0.47 (1.89±0.12)	2.50±0.40 (1.84±0.11)	0.60±0.22 (1.24±0.09)	1.50±0.60 (1.48±0.18)
IHR 4643	1.10±0.35 (1.40±0.12)	1.70±0.26 (1.63±0.08)	1.00±0.30 (1.38±0.11)	0.40±0.27 (1.15±0.10)	0.90±0.31 (1.34±0.11)
IHR 4644	4.20±0.61 (2.25±0.13)	7.40±0.82 (2.86±0.16)	7.60±0.40 (2.93±0.07)	3.60±0.34 (2.13±0.08)	2.90±0.55 (1.92±0.15)
IHR 4576	2.80±0.29 (1.94±0.07)	3.40±0.37 (2.08±0.09)	3.90±0.28 (2.21±0.06)	1.20±0.33 (1.44±0.11)	1.50±0.34 (1.54±0.11)
IHR 4577	4.30±0.63 (2.27±0.13)	6.00±0.42 (2.64±0.08)	5.80±0.47 (2.60±0.09)	0.90±0.28 (1.34±0.10)	1.70±0.34 (1.61±0.11)
IHR 4645	1.60±0.31 (1.59±0.10)	3.60±0.37 (2.13±0.09)	5.50±0.22 (2.55±0.04)	1.90±0.41 (1.66±0.13)	2.00±0.42 (1.69±0.13)
IHR 4578	2.40±0.54 (1.79±0.14)	5.60±0.31 (2.56±0.06)	5.30±0.52 (2.49±0.11)	2.70±0.37 (1.90±0.09)	2.80±0.39 (1.92±0.12)
IHR 4646	2.00±0.33 (1.71±0.09)	3.90±0.35 (2.20±0.08)	5.00±0.42 (2.44±0.09)	1.00±0.33 (1.37±0.12)	2.10±0.31 (1.74±0.09)
IHR 4647	0.30±0.15 (1.12±0.06)	1.80±0.36 (1.64±0.11)	4.00±0.33 (2.23±0.07)	0.50±0.22 (1.20±0.09)	1.40±0.27 (1.53±0.09)
IHR 4647-1	0.40±0.16 (1.17±0.07)	1.30±0.58 (1.44±0.16)	1.60±0.22 (1.60±0.07)	0.10±0.10 (1.04±0.04)	1.10±0.23 (1.43±0.09)
IHR 4579	3.20±0.47 (2.01±0.13)	4.70±0.26 (2.38±0.06)	4.30±0.34 (2.29±0.07)	1.40±0.31 (1.52±0.11)	2.00±0.42 (1.69±0.13)
IHR 4579-1	4.40±0.65 (2.29±0.14)	5.50±0.43 (2.54±0.09)	5.60±0.58 (2.55±0.11)	2.40±0.45 (1.80±0.13)	1.80±0.42 (1.63±0.13)
IHR 4648	3.50±0.69 (2.05±0.18)	4.50±0.34 (2.34±0.07)	5.40±0.45 (2.52±0.09)	0.80±0.36 (1.29±0.13)	2.00±0.33 (1.70±0.11)
IHR 4580	3.60±0.50 (2.11±0.12)	4.90±0.43 (2.41±0.09)	8.10±0.53 (3.01±0.09)	3.40±0.48 (2.06±0.14)	2.10±0.38 (1.73±0.12)
IHR 4580-1	8.20±0.70 (3.01±0.12)	7.30±0.47 (2.87±0.09)	7.30±0.37 (2.87±0.07)	2.40±0.45 (1.79±0.14)	2.40±0.37 (1.82±0.10)
IHR 4649	1.20±0.25 (1.46±0.09)	1.50±0.31 (1.55±0.10)	4.20±0.29 (2.27±0.06)	1.20±0.33 (1.44±0.11)	1.40±0.31 (1.52±0.11)
IHR 4649-1	2.50±0.45 (1.84±0.12)	4.00±0.65 (2.19±0.15)	7.30±0.63 (2.86±0.11)	4.50±0.81 (2.28±0.19)	1.90±0.31 (1.68±0.10)
IHR 4681	3.30±0.47 (2.05±0.11)	4.00±0.78 (2.16±0.19)	10.20±0.6 (3.34±0.09)	2.50±0.34 (1.84±0.11)	3.90±0.38 (2.20±0.09)
IHR 4582	6.20±0.57 (2.66±0.11)	5.30±0.42 (2.50±0.09)	8.70±0.40 (3.11±0.06)	2.40±0.50 (1.79±0.15)	3.00±0.42 (1.98±0.10)

IHR 4650	5.20±0.70(2.45±0.14)	7.30±1.12(2.82±0.20)	10.30±0.62(3.35±0.09)	2.70±0.45(1.88±0.13)	3.30±0.37(2.06±0.09)
IHR 4583	2.10±0.46(1.72±0.13)	1.40±0.31(1.52±0.10)	1.70±0.30(1.62±0.10)	1.00±0.33(1.37±0.12)	2.20±0.33(1.76±0.11)
IHR 4583-1	1.20±0.29(1.45±0.10)	5.20±1.69(2.34±0.28)	10.40±0.79(3.36±0.11)	4.30±0.56(2.28±0.12)	2.70±0.42(1.90±0.11)
IHR 4651	1.10±0.18(1.44±0.06)	0.90±0.18(1.36±0.07)	1.50±0.22(1.56±0.08)	1.10±0.23(1.43±0.09)	0.60±0.31(1.22±0.11)
IHR 4584	2.60±0.62(1.85±0.15)	1.80±0.44(1.62±0.14)	2.70±0.21(1.92±0.06)	1.00±0.26(1.39±0.10)	1.00±0.21(1.40±0.08)
IHR 4585	0.90±0.10(1.37±0.04)	1.10±0.38(1.40±0.13)	1.70±0.15(1.64±0.05)	0.20±0.20(1.07±0.07)	1.20±0.25(1.46±0.09)
IHR 4585-1	2.20±0.44(1.75±0.12)	3.50±0.34(2.11±0.08)	5.70±0.34(2.58±0.07)	2.50±0.60(1.80±0.17)	2.10±0.31(1.74±0.09)
IHR 4632	4.30±0.62(2.27±0.13)	3.60±0.50(2.11±0.12)	4.50±0.27(2.34±0.06)	1.20±0.33(1.44±0.11)	1.90±0.31(1.68±0.10)
IHR 4586	1.30±0.42(1.46±0.13)	2.00±0.56(1.67±0.16)	3.50±0.37(2.11±0.09)	1.40±0.22(1.53±0.08)	1.10±0.35(1.40±0.12)
IHR 4631	1.50±0.17(1.57±0.05)	2.00±0.26(1.72±0.08)	2.90±0.18(1.97±0.05)	0.60±0.22(1.24±0.09)	1.70±0.30(1.62±0.10)
IHR 4631-1	1.50±0.27(1.56±0.09)	1.10±0.41(1.39±0.13)	2.70±0.45(1.89±0.11)	0.60±0.34(1.22±0.12)	2.20±0.29(1.77±0.08)
IHR 4652	7.80±0.47(2.96±0.08)	8.40±0.56(3.05±0.09)	9.50±0.45(3.23±0.07)	3.20±0.44(2.02±0.11)	3.30±0.47(2.03±0.14)
IHR 4652-1	4.80±0.44(2.39±0.09)	6.50±0.48(2.73±0.09)	8.00±0.45(2.99±0.07)	2.10±0.35(1.73±0.11)	2.80±0.36(1.93±0.09)
IHR 4653	3.90±0.46(2.19±0.10)	6.90±0.46(2.80±0.09)	8.90±0.82(3.12±0.13)	1.70±0.37(1.60±0.12)	2.90±0.23(1.97±0.06)
IHR 4653-1	2.50±0.45(1.84±0.12)	4.00±0.65(2.19±0.15)	4.80±0.55(2.38±0.11)	1.70±0.30(1.62±0.10)	2.40±0.31(1.83±0.09)
IHR 4586 A	9.50±1.10(3.20±0.18)	9.20±0.49(3.19±0.08)	10.20±0.61(3.34±0.09)	3.50±0.34(2.11±0.08)	3.80±0.55(2.16±0.12)
IHR 4586 A-1	26.20±1.89(5.19±0.18)	35.60±1.57(6.04±0.13)	34.30±1.71(5.93±0.14)	7.00±0.88(2.79±0.16)	8.40±1.11(3.01±0.19)
IHR 4654	8.30±0.60(3.04±0.10)	8.00±0.39(2.99±0.07)	9.80±0.55(3.28±0.08)	2.20±0.42(1.75±0.12)	4.70±0.56(2.36±0.12)
IHR 4654-1	7.80±0.73(2.94±0.12)	7.50±0.60(2.90±0.11)	8.40±0.62(3.05±0.10)	2.30±0.47(1.76±0.15)	3.50±0.50(2.09±0.12)
IHR 4587	5.10±0.31(2.46±0.06)	6.20±0.53(2.67±0.10)	7.60±0.31(2.93±0.05)	1.60±0.45(1.55±0.15)	3.00±0.33(1.99±0.08)
IHR 4587-1	6.40±0.85(2.68±0.15)	8.10±0.31(3.01±0.05)	8.30±0.34(3.05±0.06)	2.00±0.33(1.70±0.11)	3.00±0.26(1.99±0.07)
IHR 4588	13.40±1.25(3.76±0.17)	14.90±1.12(3.96±0.15)	15.30±0.91(4.02±0.12)	6.90±0.55(2.79±0.10)	5.90±0.77(2.57±0.19)
IHR 4588-1	0.50±0.17(1.21±0.07)	0.70±0.21(1.28±0.08)	0.90±0.18(1.36±0.07)	0.70±0.26(1.27±0.10)	1.50±0.34(1.54±0.11)
IHR 4588-2	4.00±0.83(2.17±0.18)	3.90±0.48(2.19±0.11)	4.00±0.60(2.20±0.13)	2.20±0.42(1.75±0.12)	2.10±0.31(1.74±0.09)
IHR 4589	1.30±0.21(1.50±0.08)	1.90±0.35(1.68±0.10)	1.80±0.39(1.64±0.12)	1.50±0.31(1.55±0.10)	1.00±0.30(1.38±0.11)
IHR 4655	2.60±0.37(1.87±0.10)	3.80±0.25(2.18±0.06)	4.00±0.30(2.23±0.07)	2.80±0.39(1.92±0.12)	2.60±0.48(1.85±0.14)
IHR 4590	3.70±0.34(2.16±0.08)	5.00±0.30(2.44±0.06)	3.10±0.23(2.02±0.06)	1.90±0.31(1.68±0.10)	1.70±0.37(1.60±0.12)
IHR 4590-1	7.00±0.93(2.78±0.17)	5.80±0.70(2.58±0.13)	6.10±0.41(2.65±0.08)	3.70±0.42(2.15±0.10)	2.10±0.55(1.69±0.17)
IHR 4590-2	5.20±0.25(2.49±0.05)	7.40±0.27(2.90±0.05)	5.60±0.34(2.56±0.07)	1.40±0.22(1.53±0.08)	2.10±0.57(1.69±0.16)
IHR 4503	5.90±0.31(2.62±0.06)	7.90±0.43(2.98±0.07)	7.60±0.34(2.93±0.06)	2.60±0.40(1.87±0.11)	1.80±0.44(1.62±0.14)
IHR 3024	4.80±0.33(2.40±0.07)	5.70±0.40(2.58±0.08)	5.40±0.37(2.52±0.07)	1.30±0.30(1.49±0.10)	1.90±0.23(1.69±0.07)
IHR 3024-1	8.80±0.57(3.12±0.09)	12.30±0.54(3.64±0.07)	11.60±0.34(3.55±0.05)	5.60±0.64(2.53±0.14)	4.90±0.48(2.41±0.10)
IHR 3024-2	1.10±0.18(1.44±0.06)	1.40±0.16(1.54±0.05)	1.50±0.17(1.57±0.05)	1.00±0.26(1.39±0.10)	1.90±0.28(1.69±0.08)
IHR 4591	0.70±0.21(1.28±0.08)	0.90±0.18(1.36±0.07)	1.10±0.18(1.44±0.06)	1.40±0.31(1.52±0.11)	0.70±0.26(1.27±0.10)
IHR 3813	1.40±0.16(1.54±0.05)	2.00±0.21(1.72±0.06)	1.70±0.21(1.63±0.07)	1.40±0.27(1.53±0.09)	1.90±0.23(1.69±0.07)
IHR 4656	7.80±0.33(2.96±0.06)	9.60±0.78(3.23±0.13)	9.00±0.49(3.15±0.08)	3.90±0.74(2.15±0.18)	4.60±0.50(2.35±0.10)
IHR 4357	5.60±0.50(2.55±0.10)	7.00±0.47(2.82±0.09)	6.40±0.37(2.71±0.07)	2.30±0.37(1.79±0.11)	2.60±0.31(1.88±0.08)
IHR 4364	2.60±0.31(1.88±0.08)	3.30±0.26(2.07±0.06)	4.00±0.30(2.23±0.07)	1.70±0.40(1.60±0.13)	2.10±0.38(1.73±0.12)
IHR 3926	1.10±0.18(1.44±0.06)	2.40±0.16(1.84±0.04)	3.40±0.22(2.09±0.05)	1.60±0.22(1.60±0.07)	1.40±0.40(1.49±0.1)
IHR 1732	1.60±0.43(1.57±0.12)	2.10±0.28(1.74±0.08)	2.60±0.16(1.89±0.04)	1.50±0.34(1.54±0.11)	1.80±0.20(1.66±0.06)
IHR 3438	1.10±0.18(1.44±0.06)	1.40±0.16(1.54±0.05)	2.50±0.27(1.86±0.07)	0.60±0.27(1.23±0.10)	2.00±0.21(1.72±0.06)
IHR 4431	1.00±0.15(1.41±0.06)	1.40±0.16(1.54±0.05)	2.10±0.31(1.74±0.09)	1.50±0.27(1.56±0.09)	2.30±0.30(1.80±0.08)
IHR 3453	3.40±0.22(2.09±0.05)	4.30±0.21(2.30±0.05)	4.70±0.21(2.38±0.04)	1.70±0.40(1.59±0.14)	2.00±0.26(1.72±0.08)
IHR 3580	1.10±0.18(1.44±0.06)	1.60±0.16(1.61±0.05)	1.60±0.16(1.61±0.05)	1.20±0.33(1.44±0.11)	1.20±0.33(1.44±0.11)
IHR 3581	3.40±0.16(2.09±0.04)	3.60±0.27(2.14±0.06)	4.70±0.34(2.38±0.07)	1.30±0.37(1.47±0.12)	1.40±0.43(1.49±0.14)
IHR 4418	7.40±0.60(2.88±0.10)	8.40±0.50(3.06±0.08)	10.60±2.18(3.32±0.26)	3.80±0.57(2.14±0.15)	4.20±0.42(2.26±0.09)
IHR 4518	3.50±0.31(2.11±0.08)	4.10±0.23(2.25±0.05)	4.40±0.45(2.31±0.10)	1.20±0.33(1.44±0.11)	3.00±0.26(1.99±0.07)
IHR 4507	4.50±0.27(2.34±0.06)	5.00±0.37(2.44±0.08)	6.00±0.33(2.64±0.07)	2.70±0.37(1.89±0.11)	2.30±0.34(1.79±0.11)
IHR 4608	0.90±0.18(1.36±0.07)	1.20±0.13(1.48±0.04)	1.30±0.15(1.51±0.05)	1.00±0.33(1.37±0.12)	2.10±0.41(1.72±0.12)
IHR 3849	1.50±0.17(1.57±0.05)	2.40±0.31(1.83±0.09)	2.30±0.26(1.80±0.07)	1.40±0.37(1.50±0.13)	1.80±0.42(1.63±0.13)
IHR 4657	5.20±0.42(2.48±0.09)	7.20±0.42(2.86±0.07)	8.10±0.61(3.00±0.10)	3.90±0.46(2.19±0.11)	2.50±0.34(1.84±0.11)
IHR 4517	6.50±0.40(2.73±0.08)	8.60±0.65(3.08±0.11)	8.50±0.65(3.07±0.10)	3.10±0.59(1.97±0.15)	3.50±0.34(2.11±0.08)
IHR 2050	1.70±0.21(1.63±0.07)	2.30±0.15(1.81±0.04)	2.50±0.17(1.87±0.05)	1.30±0.40(1.46±0.14)	2.20±0.29(1.77±0.08)
IHR 3443	2.10±0.18(1.75±0.05)	2.50±0.17(1.87±0.05)	3.20±0.20(2.04±0.05)	1.00±0.33(1.37±0.12)	1.90±0.23(1.69±0.07)
IHR 3011	7.40±0.56(2.88±0.10)	8.20±0.47(3.03±0.08)	8.40±0.37(3.06±0.06)	3.40±0.27(2.09±0.06)	2.00±0.42(1.69±0.13)
IHR 1485	1.30±0.26(1.49±0.09)	2.20±0.25(1.78±0.07)	2.20±0.25(1.78±0.07)	0.70±0.26(1.27±0.10)	1.10±0.31(1.41±0.11)
IHR 2451	6.80±0.39(2.79±0.07)	9.90±0.59(3.29±0.09)	9.20±0.44(3.19±0.07)	4.00±0.73(2.15±0.20)	4.40±0.43(2.31±0.09)
IHR 2452	11.20±0.61(3.48±0.09)	12.40±0.62(3.65±0.08)	10.90±0.46(3.44±0.07)	3.40±0.76(2.01±0.20)	4.30±0.72(2.26±0.15)
IHR 3014	1.80±0.13(1.67±0.04)	2.60±0.31(1.88±0.08)	3.90±0.38(2.20±0.09)	0.90±0.23(1.35±0.09)	1.20±0.33(1.44±0.11)
IHR 3291	7.40±0.48(2.89±0.08)	8.80±0.66(3.12±0.11)	8.40±0.45(3.06±0.07)	6.10±1.34(2.56±0.25)	7.80±1.36(2.88±0.23)
IHR 500	2.90±0.23(1.97±0.06)	2.60±0.22(1.89±0.06)	4.10±0.46(2.24±0.10)	1.00±0.30(1.38±0.11)	1.20±0.33(1.44±0.11)
C.D.	1.56 (0.32)	1.45 (0.3)	1.35 (0.25)	1.21 (0.34)	1.30 (0.34)
P-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
SE	0.56 (0.11)	0.52 (0.11)	0.49 (0.09)	0.44 (0.12)	0.47 (0.12)
C.V.	47.34 (17.53)	39.86 (15.84)	33.51 (12.69)	73.11 (24.14)	64.92 (22.01)

Morphological and biochemical traits**Trichomes**

Significant differences were found for the glandular (GT) and non-glandular (NGT) trichome densities among the *Capsicum* genotypes on the both adaxial (Ad) as well abaxial (Ab) surfaces of leaves Glandular trichomes on adaxial surface (GTAd): $F = 316.079$; $P < 0.0001$; Glandular trichomes on abaxial surface (GTAb): $F = 193.863$; $P < 0.0001$; Non-glandular trichomes on adaxial surface (NGTAd): $F = 65.192$; $P < 0.0001$; Non-glandular trichomes on abaxial surface (NGTAb): $F = 47.581$; $P < 0.0001$ (Table S2). The GTAd and GTAb varied from 0.00 to 82.89 (Mean: 18.97 ± 15.79) and from 0.11 to 110.78; (Mean: 22.10 ± 24.88) respectively (Table S2). Similarly, significant differences were found for the NGTAd and NGTAb among the genotypes (NGTAd: Range: 0.00 to 76.33, Mean: 16.17 ± 15.82 ; $F = P < 0.0001$; NGTAb: Range: 0.00 to, Mean: 284.78 ; $F = 65.192$, $P < 0.0001$ respectively).

Glandular trichomes

The lowest numbers of glandular trichomes (GT) on the adaxial surface of leaves were found in IHR 4283, IHR 4290, IHR 4291, IHR 4290-1, IHR 4300, IHR 3529, IHR 4631-1, IHR 4655, IHR 4656 and IHR 3011 while, the highest numbers of glandular trichomes on the adaxial surface of leaves were found in IHR 3991, IHR 4017, IHR 4306, IHR 4338, IHR 4342-1, IHR 4299, IHR 4647, IHR 4648, IHR 4651 and IHR 2451 (Table S2).

The lowest numbers of glandular trichomes on the abaxial surface of leaves were recorded in IHR 4355, IHR 4308, IHR 4290, IHR 4290-1, IHR 4300, IHR 4298, IHR 4656, IHR 4357, IHR 2050 and IHR 3011 while, the highest numbers of glandular trichomes on the abaxial surface of leaves were found in IHR 4645, IHR 4648, IHR 4582, IHR 4583, IHR 4651, IHR 4585, IHR 4653-1, IHR 4654, IHR 2451 and IHR 500 (Table S2).

Non Glandular trichomes

The lowest numbers of non-glandular trichomes (NGT) on the adaxial surface of leaves were found (Table S2) in IHR 4308,

IHR 4017, IHR 4444, IHR 3241, IHR 4580, IHR 4586, IHR 3438, IHR 4431, IHR 4608 and IHR 3443 while, The highest numbers of glandular trichomes on the adaxial surface of leaves were found in IHR 4299, IHR 4299-1, IHR 4330, IHR 3980, IHR 4644, IHR 4576, IHR 4646, IHR 1732, IHR 4418 and IHR 2451. The lowest numbers of glandular trichomes on the abaxial surface of leaves were found in IHR 4355, IHR 4308, IHR 4291, IHR 4492, IHR 4444, IHR 4631, IHR 4586 A, IHR 3580, IHR 4608 and IHR 3443 while, the highest numbers of glandular trichomes on the abaxial surface of leaves were recorded in IHR 4299, IHR 4290, IHR 4290-1, IHR 3529, IHR 4453, IHR 4641, IHR 4656, IHR 4357, IHR 1732 and IHR 4418.

Leaf colour

The leaf colour intensity of genotypes under investigation varied from Green (139C, 138B, 138A, 137D, 137C, 137B, 137A, N137D, N137C, N137B, N137A, 139A) to Green Purple groups (N186A) with intensity scores of 5.33 to 20.00 with an average total of 11.12 ± 2.78 (Table S2). The highest colour intensity of leaves was observed in the genotypes IHR 4283, IHR 4300, IHR 4299-1, IHR 4588-1, IHR 4588-2, IHR 4590-1, IHR 3024-1, IHR 4608, IHR 3443 and IHR 2451 while, the lowest colour intensity of leaves was observed in the genotypes IHR 4315, IHR 3240, IHR 4641, IHR 4575, IHR 4643, IHR 4644, IHR 4648, IHR 4582, IHR 4631 and IHR 3926.

Total phenolics

Significant differences were found for total phenolics among the genotypes ($F = 98.673$; $P < 0.0001$). The total phenolics (mg/g) ranged from 7.86 to 33.27 (Table S2) with an average total of 14.05 ± 3.83 . The lowest content of phenolics were estimated in the genotypes IHR 4325, IHR 4291, IHR 4585, IHR 4652, IHR 4653-1, IHR 4590, IHR 4590-1, IHR 4503, IHR 3813 and IHR 3849, whereas, the highest content of phenolics were estimated in the genotypes IHR 3991, IHR 4290-1, IHR 4321, IHR 4330, IHR 4298, IHR 3240, IHR 3241, IHR 4649, IHR 2050 and IHR 3011.

Table S2: Summary of ANOVA of various morphological and biochemical plant traits

Genotypes	Variables (Mean± SE)						
	Glandular Trichomes (Mean± SE)		Non-Glandular Trichomes (Mean± SE)		Total Phenols (mg/g) Mean± SE	Total Flavonoids (mg/g)	Leaf Colour
	Adaxial	Abaxial	Adaxial	Abaxial			
IHR 4283	32.67±1.20(5.80±0.10)	16.00±0.58(4.12±0.07)	3.67±0.88(2.14±0.21)	8.33±1.67(3.03±0.29)	12.78±0.03	11.74±0.07	20.00±0.00
IHR 4329	8.67±0.33(3.11±0.05)	18.67±0.67(4.43±0.08)	22.67±1.20(4.86 ±0.12)	64.33±21.65(7.83±1.41)	19.76±0.45	11.06±0.17	9.33±0.33
IHR 4355	0.00±0.00 (1.00±0.00)	0.00±0.00(1.00±0.00)	0.67±0.67(1.24 ±0.24)	0.00±0.00(1.00±0.00)	18.32±0.00	9.68±0.03	14.00±0.00
IHR 3991	52.33±1.76(7.30±0.12)	20.33±0.67(4.62±0.07)	2.00±1.00(1.67 ±0.33)	5.33±0.33 (2.52±0.07)	21.93±0.19	11.98±0.05	14.00±0.00
IHR 4320	19.33±0.88(4.51±0.10)	55.33±1.20(7.51±0.08)	11.33±5.93(3.15 ±1.10)	11.67±4.63(3.43±0.68)	17.33±0.00	9.65±0.00	9.67±0.33
IHR 4296	12.00±1.16(3.60±0.16)	18.00±0.58(4.36±0.07)	22.67±3.18(4.84 ±0.32)	31.33±6.64(5.62±0.59)	18.46±0.67	5.22±0.12	9.67±0.33
IHR 4308	4.00±0.58(2.23±0.13)	0.33±0.33(1.14±0.14)	0.00±0.00(1.00 ±0.00)	0.67±0.33(1.28±0.14)	17.58±0.34	7.95±0.07	13.00±0.00
IHR 4315	34.00±1.00(5.92±0.09)	8.67±1.20(3.10±0.19)	20.33±4.70(4.55 ±0.55)	87.00±1.16(9.38±0.06)	17.79±0.00	9.71±0.05	8.00±0.00
IHR 4017	55.67±1.45(7.53±0.10)	12.00±0.00(3.61±0.00)	0.00±0.00(1.00 ±0.00)	13.67±1.45(3.82±0.19)	11.61±0.34	8.09±0.73	9.00±0.00
IHR 4342	22.33±0.88(4.83±0.09)	6.00±0.00(2.65±0.00)	6.00±2.08(2.59 ±0.39)	22.00±10.02(4.56±1.06)	15.18±0.25	6.25±0.03	13.00±0.00
IHR 4284	22.67±1.20(4.86±0.12)	12.33±0.33(3.65±0.05)	37.33±1.86(6.19 ±0.15)	71.67±8.97(8.49±0.52)	16.22±0.04	8.04±0.21	12.67±0.33
IHR 4325	7.33±0.33(2.89±0.06)	5.33±0.33(2.52±0.07)	39.33±3.38(6.34 ±0.26)	128.00±46.00(11.03±1.92)	9.05±0.23	6.07±0.04	13.00±0.00
IHR 4311	40.00±1.53(6.40±0.12)	36.33±0.88(6.11±0.07)	21.33±0.33(4.73 ±0.04)	55.67±12.02(7.45±0.78)	11.59±0.42	4.31±0.14	14.00±0.00
IHR 4299	83.00±1.53(9.16±0.08)	15.67±0.33(4.08±0.04)	76.33±11.35(8.75 ±0.63)	284.33±46.91(16.78±1.39)	18.32±0.59	3.22±0.04	10.00±0.00
IHR 4292	9.67±0.33(3.27±0.05)	7.33±0.67(2.88±0.12)	6.00±2.00(2.58 ±0.42)	28.00±3.22(5.37±0.30)	10.27±0.03	8.51±0.02	10.00±0.00
IHR 4290	0.33±0.33(1.14±0.14)	0.33±0.33(1.14±0.14)	26.00±9.64(5.02 ±0.94)	200.33±31.28(14.10±1.16)	19.80±0.00	9.65±0.00	10.00±0.00
IHR 4291	0.33±0.33(1.14±0.14)	1.00±0.00(1.41±0.00)	1.00±0.58(1.38 ±0.21)	0.00±0.00(1.00±0.00)	8.14±0.82	3.35±0.02	10.00±0.00
IHR 3449	18.00±0.58(4.36±0.07)	31.67±0.88(5.71±0.08)	4.67±2.03(2.29 ±0.47)	78.67±30.99(8.44±2.06)	11.25±0.03	2.91±0.16	14.00±0.00
IHR 4290-1	1.33±0.33(1.52±0.11)	0.67±0.33(1.28±0.14)	21.00±2.89(4.67 ±0.31)	177.67±3.76(13.37±0.14)	20.49±0.00	7.12±0.00	13.00±0.00
IHR 4329	13.33±0.88(3.78±0.12)	0.67±0.33(1.28±0.14)	5.33±1.33(2.49 ±0.26)	37.00±5.00(6.14±0.40)	20.05±0.05	6.04±0.04	14.00±0.00
IHR 4300	0.00±0.00(1.00±0.00)	0.33±0.33(1.14±0.14)	6.67±0.33(2.77 ±0.06)	18.00±1.00(4.36±0.12)	14.63±0.00	4.73±0.00	20.00±0.00
IHR 4299-1	23.33±0.67(4.93±0.07)	54.67±0.67(7.46±0.05)	68.33±2.73(8.32 ±0.17)	171.00±12.53(13.10±0.49)	11.11±0.22	3.57±2.92	20.00±0.00
IHR 4306	50.67±1.20(7.19±0.08)	1.00±0.00(1.41±0.00)	8.33±0.88(3.05 ±0.14)	4.33±1.45(2.27±0.32)	12.10±0.22	2.91±0.09	14.00±0.00

IHR 4493	12.67±0.67(3.70±0.09)	32.67±1.20(5.80±0.10)	10.67±1.33(3.40 ±0.20)	34.00±6.51(5.86±0.58)	11.87±0.22	3.39±0.04	13.00±0.00
IHR 4321	26.33±0.67(5.23±0.06)	40.67±0.88(6.45±0.07)	7.00±3.61(2.59 ±0.81)	29.33±11.20(5.24±1.21)	21.89±0.50	6.99±0.12	13.00±0.00
IHR 4330	3.33±0.33(2.08±0.08)	14.33±1.45(3.91±0.19)	60.00±8.74(7.77 ±0.58)	138.67±21.67 (11.75±0.89)	20.87±0.00	11.94±0.05	10.00±0.00
IHR 3980	12.67±0.33(3.70±0.05)	1.67±0.33(1.63±0.11)	48.33±5.36(7.00 ±0.37)	30.67±1.45(5.62±0.13)	17.62±0.29	2.76±0.04	10.00±0.00
IHR 4323	4.67±0.33(2.38±0.07)	12.33±0.67(3.65±0.09)	29.33±2.33(5.50 ±0.21)	94.00±13.80(9.70±0.70)	19.86±0.25	8.43±0.00	9.00±0.00
IHR 4298	14.00±1.16(3.87±0.15)	0.33±0.33(1.14±0.14)	1.33±0.33(1.52 ±0.11)	1.67±0.88(1.58±0.30)	20.10±0.00	9.51±0.00	12.33±0.33
IHR 4492	36.33±0.33(6.11±0.03)	8.00±0.58(3.00±0.10)	1.33±1.33(1.41 ±0.41)	0.67±0.33(1.28±0.14)	12.81±0.00	3.69±0.00	12.00±0.00
IHR 4301	6.00±0.58(2.64±0.11)	1.00±0.00(1.41±0.00)	0.67±0.67(1.24 ±0.24)	1.33±0.33(1.52±0.11)	16.02±0.00	7.21±0.03	14.00±0.00
IHR 4444	18.00±0.58(4.36±0.07)	1.00±0.58(1.38±0.21)	0.00±0.00(1.00 ±0.00)	0.00±0.00(1.00±0.00)	13.63±0.04	3.21±0.01	13.00±0.00
IHR 4338	59.00±1.73(7.74±0.11)	18.33±0.67(4.40±0.08)	7.67±3.76(2.76 ±0.72)	29.33±12.91(5.28±1.12)	12.07±0.13	2.20±0.05	12.67±0.33
IHR 4342-1	44.67±0.67(6.76±0.05)	1.00±0.00(1.41±0.00)	7.67±0.88(2.94 ±0.15)	104.67±20.04 (10.18±1.01)	17.01±1.63	8.31±0.67	13.67±0.33
IHR 3240	13.33±0.33(3.79±0.04)	2.67±0.33(1.91±0.09)	20.67±2.03(4.64 ±0.22)	98.33±11.39(9.94±0.56)	33.27±2.05	16.84±0.77	6.00±0.00
IHR 3241	11.67±0.67(3.56±0.09)	4.33±0.33(2.31±0.07)	0.67±0.67(1.24 ±0.24)	15.67±0.33(4.08±0.04)	22.07±0.44	11.91±0.21	8.33±0.33
IHR 3529	31.00±0.58(5.66±0.05)	10.00±0.58(3.31±0.09)	5.33±0.67(2.51 ±0.14)	186.67±30.47 (13.61±1.09)	14.99±0.28	6.07±0.06	9.00±0.00
IHR 4502	0.67±0.33(1.28±0.14)	1.33±0.88(1.47±0.29)	1.00±0.00(1.41 ±0.00)	43.33±4.91(6.64±0.36)	14.56±0.00	4.79±0.03	10.00±0.00
IHR 4500	13.33±0.33(3.79±0.04)	4.33±0.88(2.29±0.19)	17.67±1.86(4.31 ±0.22)	158.00±10.26 (12.60±0.40)	13.27±0.03	4.89±0.01	9.00±0.00
IHR 4550	11.33±0.88(3.51±0.13)	1.00±0.00(1.41±0.00)	8.00±2.31(2.95 ±0.40)	24.00±2.00(4.99±0.20)	13.83±0.04	5.19±0.09	11.00±0.00
IHR 4453	33.33±1.20(5.86±0.10)	2.33±0.33(1.82±0.09)	6.67±1.33(2.75 ±0.26)	220.33±18.28 (14.85±0.63)	15.20±0.00	5.76±0.02	13.00±1.00
IHR 4493	20.33±1.45(4.61±0.16)	2.33±0.33(1.82±0.09)	21.00±2.52(4.67 ±0.28)	83.00±14.22(9.10±0.80)	18.54±0.09	7.03±0.02	11.00±0.00
IHR 4408	9.67±0.67(3.26±0.10)	1.00±0.00(1.41±0.00)	5.67±0.67(2.58 ±0.13)	11.33±1.45(3.50±0.21)	10.27±0.03	2.64±0.14	11.00±0.00
IHR 4641	25.00±1.16(5.10±0.11)	43.67±2.03(6.68±0.15)	36.33±2.40(6.10 ±0.20)	212.67±4.37(14.62±0.15)	13.32±0.28	4.50±0.01	6.00±0.00
IHR 4642	25.00±1.00(5.10±0.10)	14.00±0.58(3.87±0.08)	31.00±0.58(5.66 ±0.05)	49.33±4.18(7.08±0.30)	11.80±0.96	4.33±0.11	12.67±2.33
IHR 4575	12.33±0.67(3.65±0.09)	4.00±0.00(2.24±0.00)	8.33±0.33(3.05 ±0.05)	6.00±0.58(2.64±0.11)	12.01±0.19	3.41±0.11	5.33±0.33
IHR 4643	11.33±1.45(3.50±0.21)	32.33±0.33(5.77±0.03)	7.67±1.20(2.93 ±0.20)	28.00±3.06(5.37±0.28)	14.64±0.49	5.32±0.00	6.00±0.00
IHR 4644	7.67±0.33(2.94±0.06)	14.67±0.33(3.96±0.04)	46.67±1.86(6.90 ±0.14)	101.67±4.26(10.13±0.21)	13.40±0.03	4.00±0.02	5.33±0.33
IHR 4576	5.00±0.58(2.44±0.12)	9.67±2.33(3.23±0.36)	43.67±0.33(6.68 ±0.03)	156.67±6.69(12.55±0.26)	11.27±0.49	1.74±0.02	9.00±0.00
IHR 4577	25.67±0.67(5.16±0.06)	50.67±1.45(7.19±0.10)	22.33±0.88(4.83 ±0.09)	69.00±3.00(8.36±0.18)	13.34±0.04	3.09±0.04	8.67±0.33
IHR 4645	36.00±1.53(6.08±0.13)	68.67±1.20(8.35±0.07)	38.00±1.16(6.24 ±0.09)	83.00±1.53(9.16±0.08)	12.35±0.27	2.59±0.02	9.00±0.00
IHR 4578	22.00±1.73(4.79±0.18)	54.33±0.67(7.44±0.05)	36.67±1.20(6.14 ±0.10)	87.00±0.58(9.38±0.03)	12.68±0.00	3.02±0.00	14.00±0.00
IHR 4646	11.67±0.88(3.56±0.13)	30.67±1.76(5.62±0.16)	46.67±1.76(6.90 ±0.13)	96.00±3.06(9.85±0.16)	12.84±0.03	4.15±0.01	13.00±0.00
IHR 4647	71.67±3.84(8.52±0.23)	56.33±0.33(7.57±0.02)	5.00±2.00(2.39 ±0.39)	64.00±6.81(8.04±0.42)	11.81±0.27	3.71±0.01	13.67±0.33
IHR 4647-1	35.00±0.58(6.00±0.05)	9.00±0.58(3.16±0.09)	4.00±1.53(2.19 ±0.33)	25.33±2.73(5.12±0.27)	12.68±0.24	2.73±0.00	13.00±0.00
IHR 4579	14.00±0.58(3.87±0.08)	22.33±0.88(4.83±0.09)	22.00±3.06(4.77 ±0.33)	66.67±1.86(8.22±0.11)	14.99±0.28	6.86±0.05	13.33±0.67
IHR 4579-1	22.33±0.88(4.83±0.09)	18.67±1.20(4.43±0.13)	27.67±1.45(5.35 ±0.14)	52.00±4.04(7.27±0.28)	12.84±0.28	3.59±0.06	11.00±0.00
IHR 4648	49.00±1.53(7.07±0.11)	103.00±2.52(10.20±0.12)	8.67±1.86(3.08 ±0.32)	82.00±1.16(9.11±0.06)	14.42±0.07	4.42±0.02	8.00±0.00
IHR 4580	28.67±1.76(5.44±0.16)	63.67±0.88(8.04±0.06)	0.00±0.00(1.00 ±0.00)	1.00±0.00(1.41±0.00)	12.98±0.06	1.73±0.04	13.00±0.00
IHR 4580-1	22.00±0.58(8.40±0.06)	49.33±2.19(7.09±0.16)	25.00±2.08(5.09 ±0.20)	34.67±3.76(5.96±0.32)	13.70±0.04	1.91±0.05	12.33±0.33
IHR 4649	40.00±0.58(6.40±0.05)	12.00±1.53(3.59±0.21)	9.67±2.85(3.19 ±0.48)	104.67±4.98(10.27±0.24)	21.18±0.00	9.06±0.00	13.00±0.00
IHR 4649-1	9.00±1.53(3.14±0.25)	1.33±0.33(1.52±0.11)	16.00±1.16(4.12 ±0.14)	31.00±5.20(5.62±0.46)	17.48±0.09	7.57±0.01	14.00±0.00
IHR 4681	13.00±1.16(3.74±0.16)	10.00±0.00(3.32±0.00)	24.33±0.33(5.03 ±0.03)	86.33±2.96(9.34±0.16)	12.32±0.00	2.02±0.05	9.00±0.00
IHR 4582	19.67±1.67(4.54±0.18)	65.67±1.20(8.16±0.07)	27.67±1.76(5.35 ±0.16)	59.00±3.06(7.74±0.20)	12.62±0.06	1.78±0.07	8.00±0.00
IHR 4650	42.67±0.88(6.61±0.07)	57.33±0.88(7.64±0.06)	14.33±0.88(3.91 ±0.11)	28.67±4.91(5.41±0.47)	11.82±0.06	2.17±0.14	9.00±0.00
IHR 4583	30.67±0.88(5.63±0.08)	98.33±2.40(9.97±0.12)	2.33±0.33(1.82 ±0.09)	4.67±0.88(2.37±0.19)	16.10±0.00	5.74±0.03	8.67±0.33
IHR 4583-1	19.33±0.88(4.51±0.10)	41.33±2.40(6.50±0.18)	13.33±0.67(3.78 ±0.09)	37.00±0.58(6.16±0.05)	14.71±0.00	5.10±0.00	9.00±0.00
IHR 4651	60.67±1.86(7.85±0.12)	89.67±2.67(9.52±0.14)	1.67±0.33(1.63 ±0.11)	7.67±0.88(2.94±0.15)	15.63±0.25	4.69±0.03	9.67±1.67
IHR 4584	14.00±1.00(3.87±0.13)	63.00±0.58(8.00±0.04)	29.67±0.33(5.54 ±0.03)	55.00±4.16(7.47±0.28)	11.54±0.00	1.97±0.00	10.00±0.00
IHR 4585	28.67±1.67(5.44±0.15)	67.00±1.53(8.25±0.09)	3.33±0.33(2.08 ±0.08)	31.33±1.67(5.68±0.15)	9.40±0.27	2.00±0.12	8.67±0.67
IHR 4585-1	22.33±1.76(4.82±0.19)	54.00±1.00(7.42±0.07)	21.67±0.33(4.76 ±0.04)	43.67±1.20(6.68±0.09)	12.95±0.03	1.99±0.02	11.00±0.00
IHR 4632	10.33±0.88(3.36±0.13)	23.67±1.20(4.96±0.12)	15.33±0.33(4.04 ±0.04)	26.67±5.24(5.22±0.48)	11.75±0.21	1.88±0.01	13.00±0.00
IHR 4586	14.33±1.45(3.91±0.19)	30.67±3.93(5.60±0.36)	0.33±0.33(1.14 ±0.14)	9.00±0.58(3.16±0.09)	11.96±0.00	2.42±0.03	9.00±0.00
IHR 4631	5.33±0.33(2.52±0.07)	17.33±0.67(4.28±0.08)	5.33±0.67(2.51 ±0.14)	0.67±0.33(1.28±0.14)	10.24±0.00	1.35±0.03	6.00±0.00
IHR 4631-1	0.33±0.33(1.14±0.14)	1.33±0.33(1.52±0.11)	7.67±1.20(2.93 ±0.20)	4.67±0.88(2.37±0.19)	11.99±0.03	1.49±0.01	14.00±0.00
IHR 4652	12.00±0.58(3.60±0.08)	7.67±0.33(2.94±0.06)	22.33±2.33(4.82 ±0.25)	92.33±4.70(9.66±0.25)	8.65±0.00	1.73±0.05	13.00±0.00
IHR 4652-1	9.67±1.67(3.25±0.25)	32.67±0.33(5.80±0.03)	12.33±0.33(3.65 ±0.05)	63.33±4.06(8.01±0.25)	10.95±0.00	2.34±0.00	14.00±0.00
IHR 4653	7.67±0.33(2.94±0.06)	16.67±0.33(4.20±0.04)	7.00±0.58(2.83 ±0.10)	20.00±1.53(4.58±0.16)	11.42±0.03	4.22±0.14	13.00±0.00
IHR 4653-1	10.67±0.33(3.42±0.05)	72.00±0.58(8.54±0.03)	19.33±0.88(4.51 ±0.10)	51.67±4.10(7.25±0.29)	9.56±0.34	2.40±0.12	13.00±0.00
IHR 4586A	29.67±0.88(5.54±0.08)	15.33±1.20(4.04±0.15)	6.00±0.58(2.64 ±0.11)	0.33±0.33(1.14±0.14)	15.98±0.45	2.14±0.15	12.00±0.00
IHR 4586 A-1	7.67±0.33(2.94±0.06)	26.33±0.88(5.23±0.08)	28.33±2.67(5.40 ±0.25)	10.00±0.58(3.31±0.09)	11.62±0.03	2.01±0.02	14.00±0.00
IHR 4654	30.00±2.00(5.56±0.18)	43.00±2.08(6.63±0.16)	4.67±0.67(2.37 ±0.14)	15.00±1.00(4.00±0.13)	11.73±0.95	2.86±0.07	13.00±0.00
IHR 4654-1	41.00±2.08(6.48±0.16)	64.33±0.67(8.08±0.04)	7.33±0.33(2.89 ±0.06)	26.33±2.40(5.22±0.23)	12.10±0.22	3.26±0.04	9.00±0.00
IHR 4587	9.67±0.33(3.27±0.05)	52.67±1.20(7.33±0.08)	12.33±0.88(3.65 ±0.12)	31.67±2.03(5.71±0.18)	11.30±0.03	3.47±0.02	8.00±0.00
IHR 4587-1	6.33±0.33(2.71±0.06)	9.67±0.67(3.26±0.10)	0.67±0.33(1.28 ±0.14)	3.33±0.33(2.08±0.08)	11.85±0.41	1.73±0.04	13.00±0.00
IHR 4588	7.00±0.00(2.83±0.00)	2.00±0.00(1.73±0.00)	7.67±1.45(2.92 ±0.25)	3.33±0.67(2.07±0.17)	16.79±0.04	6.94±0.16	13.00±0.00
IHR 4588-1	21.67±1.33(4.76±0.14)	38.67±2.03(6.29±0.16)	7.33±0.33(2.89 ±0.06)	11.33±0.33(3.51±0.05)	10.40±0.06	2.35±0.00	14.00±0.00
IHR 4588-2	9.33±0.88(3.21±0.14)	13.00±1.53(3.73±0.20)	9.33±0.33(3.21 ±0.05)	22.67±0.88(4.86±0.09)	10.12±0.02	1.35±0.05	14.00±0.00
IHR 4589	8.67±1.20(3.10±0.19)	4.67±0.33(2.38±0.07)	10.00±0.58(3.31 ±0.09)	35.33±1.76(6.02±0.15)	15.50±0.04	6.97±0.03	13.00±0.00
IHR 4655	1.00±0.00(1.41±0.00)	2.33±0.33(1.82±0.09)	6.67±0.33(2.77 ±0.06)	1.33±0.33(1.52±0.11)	11.54±0.00	4.55±0.08	8.67±0.33
IHR 4590	8.67±1.86(3.08±0.32)	10.33±0.67(3.36±0.10)	11.00±0.58(3.46 ±0.08)	33.00±1.53(5.83±0.13)	7.86±0.02	0.99±0.10	9.00±0.00
IHR 4590-1	4.67±0.67(2.37±0.14)	2.67±0.88(1.88±0.24)	25.00±0.58(5.10 ±0.06)	8.67±2.19(3.07±0.34)	9.38±0.25	1.15±0.00	14.00±0.00
IHR 4590-2	9.33±0.67(3.21±0.11)	6.33±0.88(2.70±0.16)	13.00±0.58(3.74 ±0.08)	47.67±2.96(6.97±0.22)	12.81±0.00	2.61±0.05	9.00±0.00
IHR 4503	16.67±0.33(4.20±0.04)	34.00±3.00(5.91±0.25)	15.00±1.53(3.99 ±0.19)	5.67±1.86(2.52±0.40)	9.88±0.26	1.37±0.07	8.00±0.00
IHR 3024	15.00±0.58(4.00±0.07)	14.67±2.03(3.94±0.26)	14.33±0.88(3.91 ±0.11)	37.00±3.06(6.15±0.25)	16.83±1.71	10.34±0.05	8.00±0.00
IHR 3024-1	4.00±0.58(2.33±0.13)	13.00±1.53(3.73±0.21)	15.33±1.33(4.04 ±0.16)	33.33±2.91(5.85±0.25)	15.47±0.57	7.51±0.10	14.00±0.00
IHR 3024-2	16.00±0.58(4.12±0.07)	1.00±0.58(1.38±0.21)	9.67±1.20(3.26 ±0.18)	6.33±0.67(2.70±0.13)	10.68±0.00	2.89±0.03	9.00±0.00
IHR 4591	25.67±1.20(5.16±0.12)	35.00±2.31(5.99±0.19)	7.00±1.00(2.82 ±0.17)	1.33±0.33(1.52±0.11)	13.70±0.04	6.87±0.01	13.00±0.00
IHR 3813	5.33±0.33(2.52±0.07)	35.33±0.88(6.03±0.07)	10.00±0.00(3.32 ±0.00)	43.00±4.36(6.62±0.33)	10.08±0.03	1.75±0.02	8.00±0.00
IHR 4656	0.33±0.33(1.14±0.14)	0.67±0.33(1.28±0.14)	40.33±1.45(6.43 ±0.11)	285.00±17.69 (16.90±0.53)	14.18±0.25	5.12±0.00	9.33±0.33

IHR 4357	2.00±0.58(1.72±0.17)	0.67±0.67(1.24±0.24)	27.33±3.84(5.30 ±0.35)	213.33±12.13 (14.63±0.42)	12.20±0.00	3.88±0.03	9.00±0.00
IHR 4364	24.00±0.58(5.00±0.06)	1.33±0.67(1.49±0.24)	33.33±2.33(5.85 ±0.20)	99.00±4.62(10.00±0.23)	11.17±0.00	2.33±0.00	9.00±0.00
IHR 3926	15.67±0.67(4.08±0.08)	1.00±0.00(1.41±0.00)	5.00±0.00(2.45 ±0.00)	9.33±0.33(3.21±0.05)	19.20±0.20	6.79±0.02	7.00±0.00
IHR 1732	38.00±1.53(6.24±0.12)	59.67±1.20(7.79±0.08)	52.67±3.84(7.32 ±0.27)	205.00±2.08(14.35±0.07)	15.87±0.00	7.62±0.02	12.67±0.33
IHR 3438	14.00±1.53(3.86±0.20)	7.00±1.53(2.80±0.26)	0.33±0.33(1.14 ±0.14)	3.67±0.33(2.16±0.08)	13.17±0.00	3.69±0.03	13.00±0.00
IHR 4431	12.33±1.76(3.64±0.25)	6.67±1.76(2.73±0.32)	0.00±0.00(1.00 ±0.00)	0.67±0.33(1.28±0.14)	12.10±0.28	3.39±0.02	9.00±0.00
IHR 3453	16.00±0.58(4.12±0.07)	32.67±2.60(5.79±0.23)	22.67±2.73(4.85 ±0.28)	92.33±0.88(9.66±0.05)	10.41±0.27	2.45±0.02	9.00±0.00
IHR 3580	10.67±1.20(3.41±0.17)	10.33±1.45(3.35±0.22)	6.00±0.58(2.64 ±0.11)	0.33±0.33(1.14±0.14)	10.07±0.27	2.07±0.05	9.33±0.33
IHR 3581	10.00±0.58(3.31±0.09)	4.67±0.88(2.37±0.19)	10.00±0.00(3.32 ±0.00)	1.00±0.00(1.41±0.00)	10.12±0.02	1.81±0.07	8.67±0.67
IHR 4418	5.67±0.67(2.58±0.13)	11.33±0.67(3.51±0.10)	69.00±4.93(8.36 ±0.30)	194.33±2.91(13.98±0.10)	15.86±0.25	3.54±0.03	10.00±0.00
IHR 4518	22.33±1.45(4.83±0.15)	27.67±1.76(5.35±0.16)	22.33±0.67(4.83 ±0.07)	60.33±1.76(7.83±0.11)	13.66±0.07	3.78±0.10	13.00±0.00
IHR 4507	14.67±0.33(3.96±0.04)	1.33±0.33(1.52±0.11)	33.67±0.88(5.89 ±0.08)	171.33±20.88 (13.08±0.78)	10.21±0.90	3.12±0.03	13.00±0.00
IHR 4608	7.00±0.00(2.83±0.00)	10.67±0.67(3.41±0.10)	0.00±0.00(1.00 ±0.00)	0.00±0.00(1.00±0.00)	12.13±0.19	2.90±0.06	14.00±0.00
IHR 3849	14.33±0.33(3.92±0.04)	40.33±2.40(6.42±0.19)	2.67±0.88(1.88 ±0.24)	0.67±0.33(1.28±0.14)	8.17±0.04	1.37±0.02	9.33±0.33
IHR 4657	23.33±1.45(4.93±0.15)	6.67±1.20(2.75±0.21)	9.33±0.88(3.21 ±0.14)	22.33±1.76(4.82±0.19)	10.78±0.00	2.65±0.00	9.00±0.00
IHR 4517	16.00±0.58(4.12±0.07)	1.33±0.33(1.52±0.11)	17.67±2.40(4.30 ±0.29)	51.00±7.23(7.18±0.50)	10.92±0.47	2.51±0.02	9.00±0.00
IHR 2050	10.00±1.00(3.31±0.15)	0.00±0.00(1.00±0.00)	2.00±0.00(1.73 ±0.00)	9.33±1.45(3.20±0.23)	22.25±0.24	4.24±0.03	8.00±0.00
IHR 3443	17.67±1.20(4.32±0.14)	6.33±1.86(2.67±0.33)	0.00±0.00(1.00 ±0.00)	0.33±0.33(1.14±0.14)	13.46±0.00	4.09±0.00	14.00±0.00
IHR 3011	1.00±0.00(1.41±0.00)	0.00±0.00(1.00±0.00)	9.67±0.88(3.26 ±0.14)	5.33±0.33(2.52±0.07)	20.30±0.60	8.99±0.52	13.67±0.33
IHR 1485	10.00±1.16(3.31±0.18)	29.33±2.03(5.50±0.18)	3.00±0.58(1.99 ±0.15)	6.00±1.00(2.63±0.20)	15.89±0.62	4.62±0.04	12.00±0.00
IHR 2451	60.33±2.33(7.83±0.15)	110.67±2.96(10.57±0.14)	40.33±1.20(6.43 ±0.09)	82.00±7.23(9.09±0.40)	15.03±0.25	5.47±0.00	14.00±0.00
IHR 2452	6.67±0.33(2.77±0.06)	10.00±1.00(3.31±0.15)	23.33±1.45(4.93 ±0.15)	53.00±5.20(7.33±0.36)	15.31±0.11	5.34±0.24	9.00±0.00
IHR 3014	9.67±0.33(3.27±0.05)	1.00±0.00(1.41±0.00)	8.67±0.88(3.10 ±0.14)	42.67±0.88(6.61±0.07)	11.65±0.11	2.50±0.10	9.00±0.00
IHR 3291	27.00±2.65(5.28±0.25)	2.00±0.58(1.72±0.17)	8.67±0.67(3.11 ±0.11)	34.33±3.76(5.93±0.32)	13.52±0.28	3.86±0.18	10.00±0.00
IHR 500	19.67±1.33(4.54±0.15)	64.67±1.76(8.10±0.11)	19.33±0.33(4.51 ±0.04)	56.00±2.08(7.55±0.14)	16.09±0.00	3.10±0.08	9.00±0.00
C.D.	3.03 (0.34)	3.37 (0.39)	6.47 (0.74)	27.36 (1.37)	1.10	0.83	0.89
P-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
SE	1.09 (0.12)	1.21 (0.14)	2.32 (0.26)	9.82 (0.49)	0.39	0.30	0.32
C.V.	9.93 (5.09)	9.47 (5.84)	24.86 (12.34)	31.02 (13.45)	3.94	8.84	4.98

Total flavonoids

Significant differences were found for total flavonoids among the genotypes ($F = 70.063$; $P < 0.0001$). The total flavonoids (mg/g) ranged from 0.98 to 16.84 with an average total of 1.73 ± 2.96 . The lowest content of total flavonoids were estimated in the genotypes IHR 4580, IHR 4631, IHR 4631-1, IHR 4652, IHR 4587-1, IHR 4588-2, IHR 4590, IHR 4590-1, IHR 4503 and IHR 3849, whereas, the highest content of total flavonoids were estimated in the genotypes IHR 4283, IHR 4329, IHR 4355, IHR 3991, IHR 4315, IHR 4290, IHR 4330, IHR 3240, IHR 3241 and IHR 3024.

Plant produces many toxic biochemical compounds that may deter whiteflies and expresses some physical barriers to prevent whitefly feeding (van Emden, 2002) [12]. In free choice evaluation many genotypes were not preferred by whiteflies, while others preferred and supported large numbers of whiteflies indicating existence of antixenosis against whiteflies in some genotypes. There were large differences with respect to whitefly population numbers between preferred and non-preferred genotypes in choice test. The preference of host can be changed by leaf trichomes, leaf architecture and leaf colour, cuticle thickness and plant metabolites that act as either attractant or repellent (Sippell *et al.*, 1987; Channarayappa *et al.*, 1992; Mcauslane, 1996; Chermenskaya *et al.*, 2009) [13, 14, 15, 16]. Whitefly preferred the most suitable genotype for feeding and oviposition so they can complete their life cycle (Nomikou *et al.*, 2003) [17]. Similar result was obtained in this study, where adult survivability significantly correlated with nymphal density. In choice test many genotypes showed different levels of resistance to whitefly. This difference may be due to those genotypes having some physical barriers or repellent resulting avoidance. Other aspect may be due to more attraction of whitefly towards other genotypes.

Correlation and PCA analysis

Correlation analysis of the total variables showed significant correlation [$P = 0.01$ to 0.05] among the variables tested (Table 1). The total number of whiteflies settled on the plant was positively correlated with LSN (0.74), ESN (0.78), total

nymphs (0.81), adaxial NGT (0.30) and total NGT (0.20). The late stage nymphs (LSN) were positively correlated with ESN (0.76), total nymphs (0.94) and adaxial NGT (0.26). The early stage nymphs (ESN) were positively correlated with total nymphs (0.93) adaxial NGT (0.28), total NGT (0.20). Total nymphs were positively correlated with adaxial NGT (0.28). The number of glandular trichomes on the adaxial surface is positively correlated with the abaxial glandular trichome (0.45), total glandular trichome (0.77) and total trichomes (0.41). Abaxial glandular trichome is positively correlated with total glandular trichome (0.92) and total trichomes (0.39) while negatively correlated with total flavonoids (0.21). Total glandular trichomes were highly positively correlated with total trichomes (0.47). Adaxial NGT was highly correlated with abaxial NGT (0.70), total non-glandular trichomes (0.80) and total trichomes (0.75). Abaxial non glandular trichomes total NGT (0.99) and total trichomes (0.89). Total NGT was highly positively correlated with total trichomes (0.91). Total phenols were highly correlated with total flavonoids (0.78).

The analyzed results for different variables by PCA revealed that the first two PCs (PC1 and PC2) accounted together for 53.51% of total variance (30.50 for PC1; 23.013% for PC2) (Table 2). PC1 was highly represented with the traits *viz.*, total non-glandular trichomes, total trichomes, upper non-glandular trichomes, lower non-glandular trichomes, total nymphs, ESN, total number whiteflies and LSN (positive relationship). However, the PC2 showed positive relationship with total glandular trichomes, total trichomes, upper glandular trichomes and lower glandular trichomes while showed negative relationship with total nymphs, LSN, ESN and total whiteflies. PC3 and PC4 accounted for 16.69% & 11.63% of the total variance respectively (eigenvalue > 1.0).

In this study the high positive correlation observed between whitefly population and non-glandular trichome as well as total trichome density. Similar correlations are also reported in chilli (Firdaus *et al.*, 2011) [5] and tomato (Toscano *et al.*, 2002) [18]. Whiteflies prefer to oviposit on plant leaves with trichomes than without trichomes and non-glandular trichomes were more suitable for oviposition than glandular trichomes (Butter and Vir, 1989; Javed *et al.*, 2016) [19, 20]. In

this study also glandular trichomes were negatively correlated with whitefly population and nymphal population vis-à-vis oviposition. In cotton whitefly adult population exhibited negative correlation with gossypol glands on leaf lamina, midrib and vein while adult whitefly and nymphal population positively correlated with hair density on leaf lamina, vein and length of hair on leaf midrib (Khalil *et al.*, 2017) [21]. The leaf colour has not shown any correlation with resistance to

whitefly in the tested genotypes. Total phenolic and flavonoid contents did not exhibit any significant relationship with variables under study. A direct genetic correlation between biochemical based resistance characteristics and reduced whitefly population was reported in wild tomato species *Solanum pennellii* (van den Oever-van den Elsen *et al.*, 2016) [12].

Table 1: Correlation between of different variables used for whitefly screening (morphological, biochemical and insect observations)

Variables	3 DAD	6 DAD	9 DAD	Total WF	ESN	LSN	Total Nymphs	Adaxial GT	Abaxial GT	Total GT	Adaxial NGT	Abaxial NGT	Total NGT	Total T	TP mg/g	TF mg/g	Leaf Colour
3DAD	1																
6DAD	0.920**	1															
9DAD	0.844**	0.953**	1														
Total WF	0.946**	0.990**	0.967**	1													
ESN	0.665**	0.724**	0.736**	0.734**	1												
LSN	0.746**	0.761**	0.759**	0.780**	0.758**	1											
Total Nymphs	0.751**	0.791**	0.797**	0.806**	0.941**	0.934**	1										
Adaxial GT	-0.147	-0.147	-0.131	-0.146	-0.120	-0.029	-0.081	1									
Abaxial GT	-0.062	0.020	0.074	0.015	-0.061	-0.026	-0.047	0.450**	1								
Total GT	-0.110	-0.052	-0.006	-0.055	-0.097	-0.032	-0.070	0.772**	0.915**	1							
Adaxial NGT	0.273**	0.290**	0.295**	0.296**	0.255**	0.276**	0.283**	0.043	0.124	0.108	1						
Abaxial NGT	0.208*	0.131	0.120	0.155	0.092	0.167	0.137	0.110	-0.011	0.042	0.701**	1					
Total NGT	0.233**	0.172	0.163	0.193*	0.131	0.199*	0.175	0.101	0.017	0.058	0.800**	0.989**	1				
Total T	0.161	0.131	0.142	0.148	0.076	0.163	0.126	0.409**	0.394**	0.465**	0.754**	0.894**	0.911**	1			
TP mg/g	0.103	-0.023	-0.049	0.005	0.004	0.075	0.041	0.035	-0.156	-0.095	0.052	0.141	0.129	0.075	1		
TF mg/g	0.028	-0.096	-0.158	-0.084	-0.033	-0.038	-0.038	0.006	-0.207*	-0.145	-0.025	0.113	0.090	0.020	0.781**	1	
Leaf Colour	0.024	0.009	0.007	0.013	0.034	0.000	0.018	0.078	-0.059	-0.006	-0.039	-0.094	-0.087	-0.080	-0.046	0.059	1

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).
r=125

*WF- Whiteflies, DAD- Days after dusting, ESN-Early stage nymphs, LSN-Late stage nymphs, GT-Glandular trichomes, NGT-Non-glandular trichomes, T-Trichomes, TP- Total phenols, TF-Total flavonoids

Table 2: Loading values of the major variables contributing towards particular principal components (PC)

Variables/PCs	PC1	PC2	PC3	PC4
3DAD	0.357	-0.090	-0.011	0.071
3DAD	0.368	-0.108	0.078	0.009
9DAD	0.363	-0.098	0.115	-0.011
Total WF	0.375	-0.102	0.067	-0.021
ESN	0.328	-0.121	0.038	0.047
LSN	0.345	-0.076	0.045	0.092
Total Nymphs	0.359	-0.105	0.044	0.073
Adaxial GT	-0.037	0.285	0.314	0.316
Abaxial GT	0.005	0.252	0.474	0.145
Total GT	-0.013	0.308	0.479	0.246
Adaxial NGT	0.196	0.336	-0.152	-0.181
Abaxial NGT	0.147	0.403	-0.279	-0.149
Total NGT	0.165	0.410	-0.267	-0.164
Total T	0.141	0.491	-0.039	-0.043
TP mg/g	0.019	0.044	-0.336	0.598
TF mg/g	-0.020	0.025	-0.361	0.587
Leaf Colour	-0.003	-0.052	0.036	0.102
Eigenvalue	6.323	3.570	2.425	1.638
Cumulative Per cent	37.194	58.193	72.460	82.094

Conclusion

We have identified chilli genotype that varies in their susceptibility to whiteflies and identified the traits that are responsible for their inherent resistance and susceptibility. Glandular and non-glandular trichomes of leaves were associated with the whitefly non-preference and preference respectively. The chilli genotypes viz., IHR 4283, IHR 4329, IHR 4300, IHR 4321 and IHR 4338 are found to be most promising lines with whitefly resistance. Choice assays revealed significantly less number of whitefly settlers and low nymphal density in these lines indicating the possibility of

non-preference and antibiosis mechanisms against whiteflies. This difference in the evaluated genotypes offers opportunities for developing whitefly resistant chilli varieties/hybrids.

Acknowledgment

Authors are highly thankful to the Director, ICAR-Indian Institute of Horticultural research for providing facilities and University Grant Commission, Government of India, New Delhi for providing financial support to Mr. Rajeev Kumar Yadav.

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