PEST MANAGEMENT

Influence of Trichomes on Attractiveness and Ovipositional Preference of *Bemisia tabaci* (Genn.) B Biotype (Hemiptera: Aleyrodidae) on Tomato Genotypes

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ABSTRACT - Brazil is one of the world's largest tomato producer, but considerable part of the production is lost due to the attack of *Bemisia tabaci* (Genn.) B biotype. Resistant germoplasm plants can be an important method for *B. tabaci* control in integrated pest management approaches. The attractiveness and ovipositional preference of *B. tabaci* for 17 tomato genotypes were evaluated in a free-choice test. Trials were set up in a randomized block design with ten replicates. Each replicate (one tomato plant per pot) was placed in a cage (80 x 50 x 50 cm) and infested with 1,000 adults during four days. Linear correlation tests were applied between the number of insects and eggs and number of trichomes in each tomato genotype. LA716, LA444-1 and PI134418 genotypes were the least attractive, while the 'Santa Clara' was the most attractive; PI134417 trapped the largest number of adults. LA716 genotype (4.1 eggs/leaflet and 2.1 cm^2/eggs per leaflet) was the least preferred for whitefly oviposition; NAV1062, 'Fanny', LA1335, 'Santa Clara' and IAC294 were the most preferred genotypes. The glandular trichomes density was negatively correlated with whitefly's attractiveness and oviposition per leaflet and per leaf, and positively with the number of trapped insects. The non-glandular trichomes density was negatively correlated with the number of trapped insects and positively with whitefly's oviposition per cm^2/leaflet and per cm^2/leaf. LA716 had high antixenosis level (ovipositional nonpreference) toward *B. tabaci* B biotype related with type IV glandular trichome.

KEY WORDS: Insecta, whitefly, *Solanum lycopersicum*, antixenosis

The whitefly *Bemisia tabaci* (Genn.) B biotype is currently one of the main pests both for industrial processing tomato and for fresh tomato. In addition to the direct damage caused by extracting large quantities of phloem sap, it also vectors plant viruses, with yield losses varying from 40% to 70% (Villas Bôas 2005). This is the main limiting factor for tomato crops in many of the producing regions, interfering in the tomato production chain, which holds great economical and social importance in Brazil (Embrapa 2006).

The improvement of plant germplasm aiming at the development of resistant genotypes to *Bemisia* spp. may be an important tool in integrated pest management of whitefly (McAuslane *et al* 1996), preventing the unnecessary use of insecticides, a method still widely used to control this pest.

Many physiological and morphological characteristics have been correlated to the resistance of tomato plants to *Bemisia* spp. The trichomes, for example, may interfere with the oviposition, fixation and feeding of insects, and their mechanical effects depend on four main characteristics: density, insertion angle, length and type.

In *Solanum lycopersicum* (= *Lycopersicon esculentum*) (Peralta *et al* 2006), eight different trichomes types occur (I to VIII) (Channarayappa *et al* 1992). The non-glandular trichomes (II, III and V) are highly similar among themselves, differing only in length (Channarayappa *et al* 1992, Simmons & Gurr 2005), and the glandular trichomes (I, IV, VI and VII) are able to release alellochemicals that interfere with the ovipositional nonpreference of *B. tabaci*. In addition, whiteflies may also be trapped in exudates liberated by glandular trichomes (Freitas *et al* 2002, Muigai *et al* 2002, Fancelli *et al* 2003).

Low or high density of one type of trichome is either correlated to the different access to the same species or to the influence of other factors such as: photoperiod (especially in type IV and type VI trichomes densities of *S. habrochaites* = *L. hirsutum*) (Snyder *et al* 1998), age of the plant and level of fertilizers used (Leite *et al* 1999), position of the leaf in the dossel (Leite *et al* 1995, Picanço *et al* 1995), or area where the plant was cultivated (in greenhouses or in the field) (Muigai *et al* 2003).

Tomato genotypes with high density of trichomes are positively correlated to the oviposition of *B. tabaci* (Heinz & Zalom 1995, Snyder *et al* 1998, Toscano *et al* 2002, Fancelli *et al* 2005), especially due to the presence of the type V non-glandular trichome. Therefore, we aimed at evaluating the influence of trichomes on 17 tomato genotypes in the attractiveness and ovipositional preference of *B. tabaci* B biotype.

Material and Methods

The experiments were carried out under controlled laboratory conditions (23 ± 2ºC, 70 ± 10% RH, and photophase of 13h) by evaluating 17 tomato genotypes: Santa Clara, Fanny (*S. lycopersicum*); LA716 (*S. pennellii* = *L. pennellii*); LA1963 (*S. chilense* = *L. chilense*); LA371, LA444-1, LA462 (*S. peruvianum* = *L. peruvianum*); IAC237, LA722, LA1335, NAV1062, PI126931, PI365928 (*S. pimpinellifolium* = *L. pimpinellifolium*); PI134417, PI134418 (*S. habrochaites* f. *glabratum* = *L. hirsutum* f. *glabratum*); IAC294 (*S. habrochaites*); IAC68F-22-2 (*S. peruvianum* x *S. lycopersicum*).

Tomato genotypes were planted on plastic trays containing agricultural substrate, and seedlings were transplanted into 500 g plastic pots (one seeding per pot) 15 days after sowing, irrigated with a nutritive solution [5 ml/l 1M KNO_3; 1 ml/l 1M KH_2PO_4; 2 ml/l 1M $MgSO_4$; 1 ml/l 1M FeEDTA; 1 ml/l 1M micronutrients (H_3BO_3, $MnCl_2{\cdot}4H_2O$, $ZnCl_2$, $CuCl_2$ and $H_2MoO_4{\cdot}H_2O$); 5 ml/l 1M $Ca(NO_3)_2$ 1M] (Sarruge 1975) and maintained in a greenhouse.

A whitefly stock colony was initiated from a population of *B. tabaci* (B biotype) obtained from Instituto Agronômico de Campinas, and reared on soybean (*Glycine max*) and *Euphorbia heterophylla* plants under greenhouse conditions.

Pots containing 30-day-old tomato plants were randomly placed in covered cages (80 x 50 x 50 cm), and nearly 1,000 whitefly adults were released/cage. The number of insects attracted and trapped by glandular trichomes per plant was verified four days later. Three fully expanded leaves of each plant were also collected to count the number of eggs laid on the abaxial surface of the apical leaflets. The leaf areas were then calculated in order to determine the number of eggs per square centimeter. The number of glandular and non-glandular trichomes on these three apical leaflets was also registered in order to correlate whitefly oviposition with trichome density. Trichome numbers were determined using the epidermal fingerprint technique (Segatto *et al* 2004), and trichome density was calculated according to McAuslane (1996).

Simple linear correlation tests between number of insects (attracted and trapped), number of eggs (apical leaflet, cm^2/apical leaflet, leaf and cm^2/leaf), and number of trichomes (glandular, non-glandular and total) in the 30-day-old tomato genotypes leaflets were carried out.

The trials were set up in a randomized block design with 10 replicates for each tomato genotype evaluated. The data obtained were tested for homocedasticity, transformed accordingly whenever necessary, submitted to ANOVA, and compared by the Tukey test ($P \leq 0.05$) whenever differences were observed.

Results and Discussion

The LA716, LA444-1, LA1963, LA371, PI134418, PI126931, LA722, PI134417 and LA462 genotypes were the least attractive to whiteflies, whereas 'Santa Clara' and NAV1062 were the most attractive ones. The greatest number of trapped insects by the glandular trichomes took place on the PI134417 genotype (3.6), as opposed to LA1963, LA722, IAC68F-22-2, PI126931, IAC237, LA1335, LA444-1, LA371, PI365928 and LA462 genotypes, in which no whiteflies were virtually trapped (ranging from zero to 0.5) (Table 1). Oviposition was lower in the LA716 genotype, while a significant larger number of eggs were laid on the 'Santa Clara', 'Fanny', NAV1062 and LA462 genotypes (Table 1). The LA716 genotype was the least preferred for oviposition by the *B. tabaci* B biotype regardless of using leaflets or leaves to estimate the number of eggs laid, while 'Santa Clara', NAV1062 and 'Fanny' were the most preferred ones (Table 1). Therefore, we can state that apical leaflets can be used instead of leaves, as they are easier to evaluate because they demand less time and are effective to discriminate the resistance of the evaluated genotypes. Our data on the effects of LA716 and 'Santa Clara' genotypes on the attractiveness and oviposition rate of *B. tabaci* have already been reported (Toscano *et al* 2002, Fancelli *et al* 2003, Baldin *et al* 2005).

The highest trichome density was recorded in LA462, LA1963, LA444-1 and LA371 genotypes, and the lowest in IAC237, 'Santa Clara', IAC294 and PI365928 genotypes. Genotypes that presented the highest number of glandular trichomes were generally the ones having the lowest number of non-glandular trichomes. The glandular trichome density was higher in PI134418, LA716 and PI134417 genotypes as compared to LA1963, LA444-1, LA462, LA722 and IAC237 genotypes. Non-glandular trichomes were most abundant in LA462, LA1963, LA444-1 and LA371 genotypes as compared to the LA716, IAC294 and PI134417 genotypes (Table 2).

The type IV glandular trichomes were exclusive on LA716 genotype (*S. pennellii*) as already reported by Toscano *et al* (2001), and the predominant trichome type on PI134417 and PI134418 genotypes (*S. habrochaites* f. *glabratum*). The last two genotypes also presented type I, VIc and VII glandular trichomes, and type V non-glandular trichomes at lower densities. The genotypes with greatest density of total trichomes, LA462, LA444-1 and LA371 (*S. peruvianum*) and LA1963 (*S. chilense*) have mainly type V non-glandular trichomes and low density of type VIa glandular trichomes.

The total trichome densities found in 30-day-old plants reported here were similar to those reported by Toscano *et al* (2002) for PI134417 and LA716 genotypes. However, a much higher number was observed for Santa Clara cultivar (19.2 mm^2/trichomes) when compared to the 4.5 mm^2/trichomes reported in here. This difference can be related to the influence of various factors, such as: photoperiod (Snyder *et al* 1998), age of the plant and level of fertilizers used (Leite *et al* 1999), position of the leaf in the dossel (Leite *et al* 1995, Picanço *et al* 1995), or the area where the plant was cultivated (in greenhouses or in the field) (Muigai *et al* 2003).

Significant correlations were observed ($P \leq 0.05$) between glandular trichomes density and the number of attracted insects (r = -0.22), number of trapped insects (r = 0.30), number of eggs per apical leaflet (r = -0.19), number of eggs per cm^2/apical leaflet (r = -0.29) and number of eggs per leaf (r = -0.23); between non-glandular trichomes density and the

Table 1 Mean (± SE) number of attracted and trapped insects per plant and number of eggs laid by *B. tabaci* B biotype on 17 tomato genotypes, in a free-choice test. Temp.: 23 ± 2ºC, RH: 70 ± 10%, photophase: 13h.

Genotypes	Number of insects per plant		Number of eggs[1]			
	Attracted[1]	Trapped[2]	Apical leaflet	cm^2/apical leaflet	Leaf	cm^2/leaf
LA716	4.7 ± 0.80 a	1.5 ± 0.48 ab	4.1 ± 2.14 a	2.1 ± 1.18 a	7.1 ± 3.58 a	11.1 ± 4.59 a
LA444-1	12.4 ± 3.92 ab	0.2 ± 0.13 a	21.1 ± 7.95 abc	18.0 ± 8.74 ab	42.6 ± 12.60 abc	27.0 ± 6.56 abc
LA1963	12.8 ± 3.72 abc	0.0 ± 0.00 a	7.4 ± 2.11 ab	11.6 ± 3.55 ab	44.6 ± 23.70 ab	33.9 ± 8.83 bc
LA371	13.4 ± 2.06 abcd	0.4 ± 0.31 a	22.6 ± 8.08 abc	13.1 ± 4.91 ab	55.2 ± 19.49 abc	36.0 ± 10.63 bc
PI134418	15.2 ± 5.34 abc	1.3 ± 0.50 ab	28.2 ± 12.34 abc	6.1 ± 2.60 ab	57.4 ± 25.94 abc	29.0 ± 11.81 abc
PI126931	18.9 ± 5.56 abcd	0.0 ± 0.00 a	25.2 ± 9.87 abc	6.5 ± 2.15 ab	66.1 ± 28.65 abc	12.9 ± 4.14 abc
LA722	19.6 ± 4.02 abcd	0.0 ± 0.00 a	24.5 ± 6.93 abc	9.6 ± 2.47 ab	47.8 ± 14.75 abc	9.3 ± 1.72 abc
PI134417	20.6 ± 4.39 abcd	3.6 ± 1.47 b	36.8 ± 16.00 abc	7.0 ± 3.01 ab	66.0 ± 27.30 abc	26.8 ± 10.02 abc
LA462	20.7 ± 6.90 abcd	0.5 ± 0.22 a	40.2 ± 12.90 abc	21.1 ± 6.08 b	91.3 ± 28.53 abc	43.4 ± 12.70 c
IAC68-F-22-2	26.7 ± 4.81 bcd	0.0 ± 0.00 a	44.2 ± 11.67 abc	13.5 ± 3.23 ab	72.4 ± 17.66 abc	15.5 ± 3.43 abc
IAC237	30.8 ± 6.71 bcd	0.1 ± 0.10 a	42.0 ± 10.68 abc	14.2 ± 2.14 ab	104.6 ± 31.36 bc	11.1 ± 2.08 abc
PI365928	32.0 ± 7.19 bcde	0.4 ± 0.22 a	40.2 ± 12.33 abc	7.9 ± 2.40 ab	111.5 ± 36.35 bc	9.5 ± 2.58 ab
LA1335	39.0 ± 10.33 bcde	0.2 ± 0.13 a	71.6 ± 25.04 bc	18.0 ± 5.59 b	163.4 ± 64.13 bc	16.0 ± 4.43 abc
IAC294	40.4 ± 16.44 bcde	1.4 ± 0.85 ab	71.6 ± 35.37 bc	17.8 ± 7.93 ab	169.6 ± 99.24 bc	8.9 ± 2.13 ab
Fanny	41.7 ± 9.69 cde	1.8 ± 0.73 ab	80.4 ± 30.68 c	14.3 ± 5.3 ab	190.6 ± 56.58 bc	19.5 ± 6.42 abc
NAV1062	43.6 ± 8.46 de	0.8 ± 0.44 ab	80.1 ± 35.90 c	26.0 ± 8.76 b	173.1 ± 76.89 bc	20.8 ± 5.16 abc
Santa Clara	67.3 ± 10.67 e	1.3 ± 0.65 ab	84.8 ± 23.15 c	10.2 ± 2.95 ab	204.6 ± 64.57 c	11.0 ± 3.45 abc
F	6.92*	4.06*	3.62*	2.39*	3.83*	3.12*
CV%	36.97	71.06	55.95	51.62	53.04	41.63

Means followed by the same letters within columns are not different by the Tukey's test (P > 0.05).
[1]Original data; transformed in $(x + 0.5)^{1/2}$ for analysis.
[2]Original data; transformed in $(x)^{1/2}$ for analysis.

number of trapped insects (r = -0.32), number of eggs per cm^2/apical leaflet (r = 0.21) and number of eggs per cm^2/leaf (r = 0.40), and between total trichomes density and number of attracted insects (r = -0.35), number of eggs per apical leaflet (r = -0.25), number of eggs per leaf (r = -0.23) and number of eggs per cm^2/leaf (r = 0.38) (Table 3). Therefore, glandular trichome negatively influenced attractiveness and oviposition by whiteflies, while being positively correlated to the trapped insects, that is, the greater the number of glandular trichomes, the less are attractiveness and oviposition, and greater the number of trapped whiteflies.

The high resistance of LA716 (*S. pennellii*) can be related to the presence of type IV glandular trichomes (Williams *et al* 1980) leading to a nonpreference for oviposition by the *B. tabaci* B biotype, as observed by others (Fancelli & Vendramim 2002, Toscano *et al* 2002, Fancelli *et al* 2003, Muigai *et al* 2003, Baldin *et al* 2005). These assumptions are supported by other studies in which the trichome exudates were removed, leading to an increase in the number of eggs of *B. tabaci* B biotype (Fancelli *et al* 2005).

The allelochemicals found in the trichomes (acylsugar, 2-tridecanone, 2-undecanone and zingiberene) may present a repelling, fumigant, or toxic effect to the whitefly (Aragão *et al* 2000). The 2-tridecanone induces low levels of repellence and toxicity; the 2-undecanone, high levels of repellence and fumigant activity; and the zingiberene, high toxicity and repellence to whitefly (Muigai *et al* 2002). Nevertheless, the resistance of LA716 is related to acylsugar found in type IV trichome, since the ovipositional nonpreference of *B. tabaci* B biotype was induced by applying synthesized acylsugar on the susceptible 'Santa Clara' genotype (Silva *et al* 2008). However, such allelochemical did not affect the development of whitefly nymphs (Liedl *et al* 1995). Resistance in *S. pennellii* (LA716) has also been related to antixenosis for oviposition, mediated by acylsugars present in type IV glandular trichomes exudates (Barten *et al* 1994, Nombela *et al* 2000, Muigai *et al* 2003, Fancelli *et al* 2005).

In addition to causing ovipositional nonpreference, whiteflies may be trapped by exudates released by glandular trichomes (Toscano *et al* 2001, Freitas *et al* 2002, Muigai *et al* 2002, Fancelli *et al* 2003, 2008). The greatest number of trapped whiteflies was found in PI134417 genotype (3.6), followed by 'Fanny' (1.8) and LA716 (1.5) (Table 1), and showed significant and positive correlation to glandular trichomes (Table 3). In this experiment, however, the number

Table 2 Mean (± SE) mm²/number of trichomes on abaxial surface of 17 tomato genotypes.

Genotypes	mm²/number of trichomes		
	Glandular[1]	Non-glandular[1]	Total[2]
PI134418	11.3 ± 1.36 a	2.8 ± 0.85 cde	14.0 ± 2.18 bcd
LA716	9.8 ± 1.08 a	0.0 ± 0.00 f	9.8 ± 1.08 def
PI134417	9.4 ± 1.63 a	1.6 ± 0.53 ef	11.0 ± 2.05 cde
IAC294	3.3 ± 0.41 b	1.4 ± 0.37 de	4.7 ± 0.31 fg
PI365928	2.4 ± 0.47 bc	2.3 ± 0.27 cde	4.7 ± 0.34 fg
PI126931	1.8 ± 0.16 bcd	5.7 ± 0.39 bc	7.5 ± 0.49 defg
NAV1062	1.7 ± 0.37 bcd	8.5 ± 0.90 b	10.2 ± 0.95 def
LA1335	1.5 ± 0.08 bcd	3.4 ± 0.85 cde	4.8 ± 0.87 fg
Fanny	1.2 ± 0.22 cd	4.3 ± 0.58 bcd	5.5 ± 0.63 efg
Santa Clara	0.9 ± 0.17 cd	3.6 ± 0.84 cde	4.5 ± 0.84 g
LA371	0.9 ± 0.15 cd	17.4 ± 2.16 a	18.3 ± 2.18 abc
IAC68F-22-2	0.9 ± 0.12 cd	6.0 ± 0.85 bc	6.8 ± 0.86 efg
IAC237	0.8 ± 0.33 d	3.2 ± 0.66 cde	4.0 ± 0.87 g
LA722	0.7 ± 0.16 d	4.5 ± 0.70 bcd	5.1 ± 0.70 efg
LA462	0.6 ± 0.19 d	24.0 ± 1.83 a	24.5 ± 1.90 a
LA444-1	0.6 ± 0.14 d	19.2 ± 3.11 a	19.7 ± 3.23 ab
LA1963	0.5 ± 0.07 d	21.8 ± 3.08 a	22.4 ± 3.07 b
F	45.89*	44.50*	23.13*
CV%	24.47	25.09	21.62

Means followed by the same letters within columns are not different by the Tukey's test (P > 0.05).
[1]Original data; transformed in $(x + 0.5)^{1/2}$ for analysis.
[2]Original data; transformed in $(x)^{1/2}$ for analysis.

Table 3 Correlation (r) between the number of insects and number of eggs laid by *B. tabaci* B biotype and the density of trichomes on 17 tomato genotypes, in a free-choice test. Temp.: 23 ± 2ºC, RH: 70 ± 10%, photophase: 13h.

Evaluated parameters	mm²/number of trichomes		
	Glandular[1]	Non-glandular[1]	Total[2]
Number of insects			
Attracted[1]	-0.22*	-0.11[NS]	-0.35*
Trapped[2]	0.30*	-0.32*	-0.10[NS]
Number of eggs[1]			
Apical leaflet	-0.19*	-0.03[NS]	-0.25*
cm²/apical leaflet	-0.29*	0.21*	-0.02[NS]
Leaf	-0.23*	-0.01[NS]	-0.23*
cm²/leaf	-0.06[NS]	0.40*	0.38*

*Significative by t-test (P ≤ 0.05).
[1]Data transformed in $(x + 0.5)^{1/2}$ for analysis.
[2]Data transformed in $(x)^{1/2}$ for analysis.

of trapped insects on LA716 was not too large, which might be related to the high ovipositional nonpreference of whiteflies for this genotype. On the other hand, 66% of the released whiteflies were trapped by glandular trichomes in a no-choice test with this genotype (Oriani *et al*, unpublished data).

The negative influence of the number of trichomes on the number of eggs per leaflet (r = -0.25), per leaf (r = -0.23) and the attractiveness (r = -0.35) of *B. tabaci* B biotype (Table 3), is not supported by others in the literature, which have reported that the high density of trichomes in tomato cultivars (especially when type V non-glandular trichomes are the majority) correlates positively with the oviposition of *B. tabaci* B biotype (Heinz & Zalom 1995, Snyder *et al* 1998, Toscano *et al* 2002). Yet, trichome density was shown to have no effect at all in the oviposition of whitefly in wild tomato genotypes (*S. chilense*, *S. chmielewskii*, *S. habrochaites*, *S. pennellii*, *S. peruvianum*, *S. pimpinellifollium* and *S. neorickii*) (Heinz & Zalom 1995), and the total trichome density has been indicated to be an unreliable criterion in the selection of features related to the resistance to *B. tabaci* B biotype (Muigai *et al* 2003).

The analysis of the data related to LA1963 genotype (*S.*

chilense) shows low oviposition (7.4 eggs per apical leaflet) (Table 1) and high density of total trichomes (22.4 mm^2/trichomes) (Table 2); the opposite is true for Santa Clara and Fanny cultivars, with high level of oviposition (84.8 and 80.4 eggs per apical leaflet, respectively) (Table 1) and low density of total trichomes (4.5 and 5.5 mm^2/trichomes, respectively) (Table 2). However, when the number of eggs per square centimeter was calculated, Fanny and Santa Clara cultivars (14.3 and 10.2 eggs per cm^2/apical leaflet, respectively) did not differ significantly from LA1963 genotype (11.6) (Table 1). This is due to the fact that the latter genotype has a small leaf area whereas Santa Clara and Fanny cultivars have large leaf areas. This fact may have contributed for the mismatch between total trichomes and the number of eggs per cm^2/apical leaflet ($r = -0.02$) and a positive correlation of this parameter with the number of eggs per cm^2/leaf ($r = 0.38$) (Table 3). In order to avoid any disparity in the interpretation of the data, both evaluations must be carried out, either using number of eggs per leaflets or number of eggs per cm^2/leaflets, what can make easier for discriminating the resistance of the evaluated genotypes.

Our data on non-glandular trichomes (Table 2) basically refer to type V trichomes, since a few type II and type III non-glandular trichomes were found in the genotypes evaluated, and no type VIII non-glandular trichome was found. The density of non-glandular trichomes showed a negative correlation to the number of trapped insects ($r = -0.32$), while being positively correlated to the number of eggs per cm^2/apical leaflet ($r = 0.21$) and the number of eggs per cm^2/leaf ($r = 0.21$) (Table 3). Therefore, the larger the number of type V non-glandular trichomes, the lower the number of trapped insects, and the larger the number of eggs per square centimeter. The opposite was observed with glandular trichomes (especially types IV and VI), for which the larger the density, the larger the number of trapped insects and the lower the number of eggs. Consequently, it can be inferred that the ovipositional preference of *B. tabaci* B biotype for tomato genotypes is directly related to the type of trichome found in the genotypes, and not to the total trichome density.

The negative correlations between whitefly egg densities and nymphal densities have been correlated to the presence of type IV trichomes (Muigai *et al* 2003), which were also the trichomes commonly found in the tested genotypes that most affected oviposition of whiteflies (PI134418, PI134417 and LA716 – Table 2). Consequently, the ovipositional nonpreference resistance of *B. tabaci* B biotype presented by LA716 genotype (*S. pennellii*) is related to the presence of type IV glandular trichomes, since acylsugar has a repelling reaction to whiteflies. In addition, exudates present in the trichomes also trapped adults.

Finally, we suggest that future research for improvement in resistance of tomato cultivars to whiteflies should be made especially using genotypes that have type IV glandular trichomes, which are abundantly found in *S. pennellii*, *S. habrochaites* and *S. habrochaites* f. *glabratum*. In addition to the decrease in the attractiveness to whiteflies and the contribute to the ovipositional nonpreference resistance made by this trichome type, the presence of type IV trichomes can also aid to decrease the problems related to the transmission of viruses by *B. tabaci* B biotype.

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