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Resistance of potato genotypes (*Solanum* spp.) to *Bemisia tabaci* biotype B

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ABSTRACT

The resistance of 24 potato genotypes to *B. tabaci* (Genn.) biotype B (Hemiptera: Aleyrodidae) was evaluated in five greenhouse experiments. The first experiment we evaluated the attractiveness and preference for oviposition in a free-choice test (randomized blocks, 24 treatments, and eight replications). In two other experiments we evaluated no-choice preference for oviposition (randomized blocks, six treatments, and ten replications). The whitefly egg-adult cycle was monitored using a statistical design in randomized blocks with five replications. Trichome density was evaluated in an experiment with 24 treatments and six replications, in a completely randomized design. In the free-choice test, potato genotypes NYL 235-4 and IAC-1966 were the most attractive to adults, while cultivars Achat, Aracy Ruiva, and Monte Bonito presented the lowest number of adults. Also in this assay, cultivars Achat, Ibituaçu, Panda, IAC-1966, and Agata presented the lowest number of eggs, while in the no-choice test, only cultivar Achat and IAC-1966 remained resistant. Consequently, for these two genotypes non-preference is the oviposition resistance mechanism. The egg-adult cycle varied from 21 days (cultivar Panda) to 22.5 days (clones IAC-1966 and NYL 235-4). The adult emergence varied from 91.2% (clone IAC-1966) to 99.3% (cultivar Ibituaçu). Clone NYL 235-4 had the greatest number of simple (ST) and glandular (GT) trichomes; while clone IAC-1966 had the lowest number of ST and, clone IAC-6290, of GT. There were significant correlations between adult attractiveness and oviposition preference; between oviposition preference and ST density; and between oviposition preference and GT density. Considering all characteristics, cultivar Achat was the most resistant to *B. tabaci* biotype B among all potato genotypes studied, while clone NYL 235-4 proved (past tense) to be susceptible.

Keywords: Insecta, Aleyrodidae, silverleaf whitefly, host plant resistance.

RESUMO

Resistência de genótipos de batata (*Solanum* spp.) a *Bemisia tabaci* biótipo B

No presente trabalho avaliou-se a resistência de 24 genótipos de batata a *B. tabaci* (Genn.) biótipo B (Hemiptera: Aleyrodidae), em casa-de-vegetação, por meio de cinco experimentos. No primeiro, foram avaliadas a atratividade e a preferência para oviposição em teste com chance de escolha (blocos ao acaso, 24 tratamentos, oito repetições). Para avaliação da preferência para oviposição sem chance de escolha, foram conduzidos dois experimentos (blocos ao acaso, seis tratamentos, dez repetições). Para acompanhamento do ciclo ovo-adulto também foram utilizados blocos ao acaso, com seis tratamentos e cinco repetições. As avaliações de tricomas foram realizadas em experimento inteiramente casualizado, com os 24 tratamentos, repetidos seis vezes. Na avaliação de atratividade, os genótipos NYL 235-4 e IAC-1966 apresentaram o maior número de adultos e, as cultivares Achat, Aracy Ruiva e Monte Bonito, o menor. Com relação à oviposição, em teste com chance de escolha, as cultivares Achat, Ibituaçu, Panda e Ágata e o clone IAC-1966 foram os genótipos menos ovipositados. Porém, em teste sem chance de escolha, permaneceram como resistentes apenas a cultivar Achat e o clone IAC-1966, caracterizando-se como portadores de não-preferência para oviposição. O ciclo ovo-adulto variou de 21,4 (cultivar Panda) a 22,5 dias (clones IAC-1966 e NYL 235-4). A emergência de adultos oscilou de 91,2% (clone IAC-1966) a 99,3% (cultivar Ibituaçu). Com base nos dados de densidade de tricomas, verificou-se que o clone NYL 235-4 possui alta densidade de tricomas simples (TS) e glandulares (TG). Já os genótipos com menor pilosidade foram IAC-1966 (TS) e IAC-6290 (TG). Foram verificadas correlações significativas e positivas entre atratividade para adultos e preferência para oviposição (PO), PO e TS e entre PO e TG. Considerando-se todas as características, a cultivar Achat é o genótipo mais resistente a *B. tabaci* biótipo B.

Palavras-chave: Insecta, Aleyrodidae, mosca-branca, resistência de plantas a insetos.

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Possibly, *B. tabaci* biotype B was introduced in Brazil in the beginning of the 1990's via importation of plant material. Large populations were observed in São Paulo State, in Campinas region, in 1991 and 1992. Severe infestations were observed in ornamentals and in broccoli, eggplant, tomato, and pumpkin crops, causing irregular fruit ripening and leaf silvering in the latter two, respectively (Lourenção & Nagai, 1994). Recent whitefly infestation surveys in potato were conducted by Souza-Dias *et al*. (2005) in the Southwest region of São Paulo. These authors observed that producers conduct frequent field inspections to control the initial *B. tabaci* points of attack.

B. tabaci biotype B management in several crops has become a challenge to growers, because the damages caused by this whitefly have increased in various geographic regions, including Brazil. Takahashi (2008) described that agricultural practices based on monoculture, together with high reproductive potential of the pest, are among the most important causes of its emergence as a major phytosanitary control target.

Among control methods, the breeding and use of resistant cultivars is very important, and it is considered the ideal method, for the following reasons: it can prevent or reduce insecticide applications; its effects are cumulative with time; it can improve the efficiency of natural enemies by decreasing the vigor and causing changes in the physiological condition of pests; it does not pollute; its technology comes enclosed in the seed itself; it does not interfere with other agricultural practices, and it usually fits harmoniously into integrated management programs (Smith, 1989; Lara, 1991).

Therefore, the present study was carried out to evaluate resistance of 24 potato genotypes (*Solanum* spp.) with respect to *B. tabaci* biotype B infestation.

MATERIAL AND METHODS

***B. tabaci* biotype B stock rearing -** A small greenhouse (3 × 5 m) was used to rear the whitefly, constructed with a masonry base (1m height), anti-aphid screen sides, and a glass roof, with benches. Soybean, tomato, tobacco, and collards plants were used. Senescent plants were replaced every fifteen days to provide suitable conditions for the insect.

Selection of genotypes - Twenty-four genotypes (most of which are cultivars) from different breeding programs were selected from Instituto Agronômico's (IAC) Potato Germplasm Active Bank, maintained at *APTA Regional do Sudoeste Paulista*, in Itararé, São Paulo State (Table 1). In this process, we sought to select cultivars and clones resistant to different plant pathogens, comprising fungi, viruses, and bacteria, as well as insects (Silva, 2007), aiming at assembling germplasm with high genetic variability.

Adult attractiveness and oviposition preference of *Bemisia tabaci* biotype B in a free-choice test - Plants from the 24 evaluated genotypes (Table 1) were grown in greenhouse, using 3-L plastic pots, filled with a soil-organic compost mix and fertilized with 4-14-8 rate (8.08 g plant^{-1}), according to the recommendation for the crop (Raij *et al*., 1997). Thinning was performed when the plants reached 20 cm in size, leaving one plant per pot.

Artificial infestation was carried out when plants showed the first pair of full developed leaves, by introducing pots with highly infested soybean, containing on average 300 whitefly adults per plant. Infestation spots were equidistantly sorted among the potato pots, placing one spot for each four potato pots. This procedure was adapted from the technique adopted by Valle & Lourenção (2002) to evaluate adult attractiveness and oviposition preference of *B. tabaci* biotype B in soybean genotypes. After infestation periods of 24, 48, and 72 hours, adults present on the abaxial surface of the first two leaflets of the first pair of full expanded leaves of each plant were counted.

After one week of exposure to adults, two upper leaflets per plant were collected for counting the number of eggs present. To preserve their quality, leaflets were wrapped in baking paper, placed in plastic bags, and then kept under cold storage for later handling. To assess the number of eggs, leaflet abaxial surfaces were examined under the stereoscopic microscope at 40X magnification. Upon egg counting, leaflet area was measured in a leaf area measuring device (LI-COR LI 3100A) to allow estimating number of adults and number of eggs per cm^2.

The experiment was arranged as random blocks, with 24 treatments and eight replications. Each plot consisted of two leaflets, summing up 16 leaflets per genotype.

Oviposition preference in a no-choice test – 1st run - The oviposition preference of *B. tabaci* biotype B in a no-choice test was carried out under greenhouse conditions using five of the least preferred genotypes in the previous assay (cultivars Achat, Ibituaçu, Panda, and Agata, and clone IAC-1966), together with a susceptible genotype (clone NYL 235-4). Which presented high number of adults and eggs in a face-choice test. Six-liter plastic pots were used with one plant each. An iron frame (35 cm upper diameter × 70 cm height) covered with voile was placed over each pot. The experiment was planted and carried out using the same procedures as in the previous assays.

Artificial infestation was performed when plants developed the first pair of full expanded leaves, by introducing about 200 *B. tabaci* biotype B adults of unknown age into each pot protected by the voile-covered iron frame. The number of adults used in our test was based on similar studies (no-choice tests with *B. tabaci* biotype B) conducted by Valle & Lourenção (2002) and Alves *et al*. (2006). The experiment finished six days after infestation, when two upper leaflets were collected from each plot for counting the number of eggs on the abaxial surface. Therefore, only the upper canopy of the plants was used for evaluation. The number of eggs cm^{-2} was estimated in the same way as in the previous experiment. A random block experimental design was adopted, consisting of six treatments replicated ten times, summing up 60 plots.

Oviposition preference in a no–choice test – 2nd run - The no-choice test was conducted a second time, using the same procedures as before. The only difference was in the evaluation sampling, in which two pairs of leaflets were collected to obtain egg counts (1st and 2nd pairs of fully developed leaflets), in order to determine whitefly oviposition on the lower canopy of the plants.

Egg-adult development of *B. tabaci* biotype B - In this experiment, a small insect rearing facility was used (2.0 m width × 1.7 m height) with sides protected by anti-aphid screen, a glass roof, and a masonry base. The five genotypes with the least oviposition (cultivars Achat, Ibituaçu, Panda and Ágata, and clone IAC-1966) and the genotype with the highest mean number of eggs (NYL 235-4) were evaluated. The procedures adopted to conduct the plants were the same as in the previous experiments. When the plants showed the first pair of full developed leaves, the pots were transferred to the *B. tabaci* biotype B rearing facility for a period of four hours. The pots were then taken out of the facility and all whiteflies were removed from the plants to prevent further oviposition and to ensure that all eggs had approximately the same age. Plants were taken to the laboratory and areas containing 15 eggs were delimited under the stereoscopic microscope (40X magnification) using a red, 1-mm-tip overhead projector marker. Two leaflets were used per plant, adding up 30 eggs per plot, in a total of 150 eggs evaluated per genotype. Plants were then placed in the insect rearing facility to prevent infestation by other insects.

The delimited areas of each plant were inspected daily during a 34-day period, and the number of viable eggs, nymphs, and empty puparia (an indication of adult emergence) were recorded. Based on these data, we determined the number of days required for complete development from egg-adult and adult emergence percentages for all selected genotypes. A random block experimental design was adopted, consisting of six treatments replicated five times, numbering 30 plots.

Trichome density - The number of simple and glandular trichomes was counted on the abaxial surface of leaflets

Table 1. *B. tabaci* biotype B adult attractiveness averages (adults cm^{-2}) in three evaluations (24, 48, and 72 hours) and oviposition means (eggs cm^{-2}), on the abaxial surface of leaflets of 24 potato genotypes, evaluated in a free-choice test in the greenhouse (Atratividade para adultos (adultos cm^{-2}) em três avaliações (24, 48 e 72 horas) e de oviposição (ovos cm^{-2}) de *B. tabaci* biótipo B, na face abaxial de folíolos de 24 genótipos de batata, avaliados em teste com chance de escolha, em casa-de-vegetação). Campinas, IAC- APTA, 2006.

Genotype	Genealogy	Adults cm^{-2} (24 h)*;**	Adults cm^{-2} (48 h) *;**	Adults cm^{-2} (72 h) *;**	Eggs cm^{-2}*;**
Achat	Fina × Rheinhort	1.0 a	1.7 a	1.8 c	20.4 b
Ibituaçu	JACI × G5264 (1)	1.0 a	1.6 a	2.6 bc	25.0 b
Panda	UP 0.0351/17 × W 6858/8	1.1 a	2.6 a	2.8 abc	28.1 b
IAC-1966	Solanum chacoense	3.1 a	5.6 a	7.5 ab	30.1 b
Agata	Bohm × Sirco	1.3 a	2.5 a	2.8 abc	32.7 b
Asterix	Cardina × SVP Ve 70.9V	1.9 a	3.6 a	4.3 abc	36.1 ab
IAC-6063	Aracy × Abnaki	2.0 a	4.1 a	5.2 abc	37.7 ab
Atlantic	Wauseon × Lenape (B5141-6)	2.2 a	3.0 a	3.0 abc	38.9 ab
Apuã	Leo × IAC 5566	1.3 a	2.7 a	3.5 abc	45.1 ab
Aracy	Katahdin × Profijt	1.9 a	3.8 a	4.7 abc	46.6 ab
Abaeté	622 × LORI	1.3 a	2.8 a	3.8 abc	46.7 ab
Monte Bonito	A-726-2-70 × Hydra	0.7 a	2.2 a	2.2 c	48.0 ab
Itaiquara	IAC 3052 × Konsul	1.7 a	2.9 a	3.9 abc	49.2 ab
Aracy Ruiva	Mutant from Aracy	0.9 a	1.6 a	2.1 c	49.6 ab
Monalisa	Bierna A1-287 × Colmo	1.3 a	2.4 a	2.9 abc	51.7 ab
Serrana INTA	MPI 59703/21 × B 2.63	1.8 a	3.4 a	4.0 abc	53.6 ab
IAC-6290	Delta × G-37.47 (6)	2.1 a	3.9 a	5.3 abc	55.0 ab
Bintje	Munstersen × Fransen	1.1 a	2.6 a	3.5 abc	56.7 ab
Catucha	CRI-1149-1-78 × C-999-263-70	2.5 a	4.5 a	6.0 abc	58.6 ab
Itararé	Leo × IAC 5566	2.4 a	4.4 a	5.9 abc	61.2 ab
IAC-6093	JACY × G-56.70 (1)	2.0 a	4.1 a	5.2 abc	61.9 ab
Krantz	MN 366.65-3 × C 6743-5	1.7 a	2.7 a	4.1 abc	83.6 ab
Baronesa	Open pollination from Loman	2.3 a	4.9 a	6.0 abc	83.6 ab
NYL 235-4	S. tuberosum × S. berthaultii	2.9 a	4.9 a	8.0 a	100.4 a
C.V. (%)		47.06	39.73	35.18	37.58

*Means followed by the same letter in the column do not differ significantly from each other by Tukey test, p≤0.05 (médias seguidas de mesma letra na coluna não diferem significativamente entre si, pelo teste de Tukey (p≤0,05)); **Original data. For statistical analysis, data were transformed to log (x) (dados originais. Para análise estatística, os dados foram transformados em log (x)).

from the 24 genotypes studied, aiming at correlating their density with the other resistance parameters evaluated. The experiment was carried out using the same practices adopted for the free-choice assay. Leaflets were collected when plants showed the first pair of full developed leaves and were preserved in a refrigerator. The number of trichomes was counted using a stereoscopic microscope at 40X magnification.

A completely randomized design was used, with 24 treatments and six replicates. Each plot corresponded to one-plant pot. Two leaflets were taken from each plant and two areas (ad and abaxial) were marked per leaf, measuring 28 mm^2 each, represented by a circle. Each plot consisted of four areas, with 24 areas per genotype, summing up 576 areas in all plots.

Statistical analyses - An analysis of variance was run for all the evaluated characteristics, and means were compared by the Tukey test (p≤0.05), using the SAS statistical software.

RESULTS AND DISCUSSION

***B. tabaci* biotype B adult attractiveness -** Since no new artificial infestations were made at the experiment's site during the three days of evaluation, the insects had a chance to move from one genotype to another, according to the best host suitability. In the first evaluation (24 h), there were no attractiveness differences among the 24 genotypes (Table 1), which may indicate insufficient time for the whitefly to recognize and accept a genotype. This fact was again observed in the second evaluation (48 h). There were differences between genotypes in the last evaluation, and the most and least attractive genotypes to the whitefly could be identified. Low attractiveness to *B. tabaci* biotype B adults was demonstrated for cultivars Achat (1.8 adults), Aracy Ruiva (2.1), and Monte Bonito (2.2). These differed from the most attractive genotypes, namely, IAC-1966 (7.5 adults) and NYL 235-4 (8.0 adults). The other genotypes ranked at intermediate positions.

The occurrence of different attractiveness levels to *B. tabaci* biotype B adults depending on genotype evaluated is known for other plant species of economic expression. The lowest attractiveness to adults was observed in soybean (Valle & Lourenção, 2002), squashes (Alves *et al.*, 2005), tomato (Fancelli *et al.*, 2003), and cotton (Boiça Jr. *et al.*, 2007).

Oviposition preference in a free-choice test - In this evaluation, cultivars Achat (20.4 eggs), Ibituaçu (25.0), Panda (28.1), and Agata (32.7), and

Table 2. *B. tabaci* biotype B oviposition (eggs cm^{-2}) on the abaxial surface of leaflets of six potato genotypes, evaluated in two no-choice test runs in the greenhouse (oviposição (ovos cm^{-2}) de *B. tabaci* biótipo B, na face abaxial de folíolos de seis genótipos de batata, avaliados em duas conduções de teste sem chance de escolha, em casa-de-vegetação). Campinas, IAC- APTA, 2006/2007.

Genotype	Eggs cm^{-2}			mean
	1st run*;**	2nd run*;***		
	1st pair of leaves	1st pair of leaves	2nd pair of leaves	
Achat	16.0 c	18.9 b	29.3 ab	24.1 b
IAC-1966	26.3 bc	34.5 ab	16.1 b	25.3 b
Panda	34.0 ab	36.4 a	48.0 ab	42.2 ab
NYL 235-4	17.7 bc	24.8 ab	67.8 a	46.3 a
Ibituaçu	29.8 ab	37.7 a	60.9 a	49.3 a
Agata	47.4 a	44.4 a	55.6 ab	50.0 a
C.V.	13.27	13.72	40.74	14.24

*Means followed by the same letter in the column do not differ significantly from each other by the Tukey test, p≤0.05 (médias seguidas pela mesma letra na coluna não diferem significativamente entre si, pelo teste de Tukey, p≤0,05); **Original data. For statistical analysis, data were transformed to log (x) (dados originais. Para análise estatística, os dados foram transformados em log (x)); ***Original data. For statistical analysis, data were transformed to square root of (x+k), with k=0 (Dados originais. Para análise estatística, os dados foram transformados em raiz de (x+k), sendo k=0).

clone IAC-1966 (30.1) presented the lowest averages for egg per leaf area (Table 1), suggesting they have the non-preference-for-oviposition type of resistance. Even having been one of the most attractive genotypes to whitefly adults, clone IAC-1966 presented a low number of eggs, which can be explained by the various stimuli from the plant that affect insect behavior, from their arrival at the plant to locomotion movements, induction of feeding, oviposition, and departure from the plant (Lara, 1991).

The non-preference-for-oviposition type of resistance in *B. tabaci* biotype B also occurs in free-choice tests with other crops, such as soybean (Valle & Lourenção, 2002), squashes (Alves *et al*., 2005), tomato (Fancelli *et al*., 2003), and cotton (Boiça Jr. *et al*., 2007). In this work, the clone NYL 235-4 (100.4) presented the highest egg average, suggesting it is susceptible to oviposition by this whitefly. The other genotypes were at an intermediate position relative to clone NYL 325-4 and the five least-oviposited ones.

Oviposition preference in a no–choice test – 1st run - In this first run, cultivar Achat (16.0 eggs) stood out for showing the least oviposition, followed by genotypes NYL 235-4 (17.7) and IAC-1966 (26.3), which did not differ from each other (Table 2). Cultivar Agata was the genotype with the highest average, demonstrating that the lowest oviposition observed in the free-choice test was not stable. However, clone NYL 235-4, which was the most susceptible genotype in the free-choice test, showed a low number of eggs in the canopy layer sampled (upper), which motivated us to replicate the experiment, evaluating both upper and lower plant canopy layers.

S. berthaultii accessions (species to which one of the clone NYL 235-4 parents belongs) have been evaluated for resistance to insects, including no-choice oviposition preference tests. Thus, Lopes *et al*. (2000) evaluated PIs 473331 and 473334 and verified that both accessions bore resistance of the non-preference-for-oviposition type to the lepidopteran *P. operculella*, demonstrating that this test is essential to confirm resistance observed in free-choice tests.

Oviposition preference in a no–choice test – 2nd run - In this second run, both plant canopy layers were taken into consideration; assessments were made in the first and second pairs of completely developed leaves. The oviposition values in the six genotypes found for the first pair of leaves followed the same tendency observed in the first run. Cultivar Achat, with 18.9 eggs, was again the least oviposited, differing from cultivars Panda (36.4), Ibituaçu (37.7), and Agata (44.4), with the highest oviposition values, but not differing from clones NYL 235-4 (24.8) and IAC-1966 (34.5) (Table 2).

By evaluating the second pair of leaves, the highest oviposition was shown to occur in clone NYL 235-4 and cultivar Ibituaçu, in contrast with clone IAC-1966, the least preferred by the insect. The more comprehensive sampling of the plant, expressed by the average of both canopy layers, demonstrated that clone NYL 235-4 does not show resistance of the non-preference-for-oviposition type as the no-choice test might have suggested. The high value obtained in the second pair of leaves (67.8 eggs), as well as the average for both layers indicate that some plant factor determines that the insect will remain in the lower canopy, where it oviposits, on average, in greater numbers than in genotypes Achat and IAC-1966. It is known that *B. tabaci* lays its eggs preferentially in the upper part of plants where younger leaves occur, whereas older nymphs and pupae are found in older leaves (Lenteren & Noldus, 1990). However, the present study indicates that potato samplings intended to obtain egg counts should be more comprehensive to detect *B. tabaci* biotype B oviposition preference.

Based on oviposition on both plant canopy layers, it can be considered that cultivar Achat and clone IAC-1966 are the two genotypes least oviposited by *B. tabaci* biotype B, being characterized as possessing resistance of the non-preference-for-oviposition type. It also becomes evident that the lower oviposition observed in cultivars Panda, Agata, and Ibituaçu in the free-choice assay is not stable, which reinforces the importance of the mandatory test to obtain reliable inferences.

Egg-adult *B. tabaci* biotype B development - The required period for *B. tabaci* biotype B to complete development from egg to adult varied from 21.4 days in cultivar Panda to 22.5 days in clones IAC-1966 and NYL 235-4. This period reached 21.6 days in cultivar Agata, 21.9 days in cultivar Ibituaçu, and 22.3 days in cultivar Achat. Although the difference between the extremes (cultivar Panda and clone IAC-1966) was greater than one day, no differences were detected between treatments. Extension of an insect's life cycle may characterize the presence of the antibiosis type of resistance (Lara, 1991), but in the present case such event was not demonstrated.

The detection of significant development time differences in *B. tabaci* on different genotypes of a crop may occur only in wild genotypes, such as tomato (Baldin *et al*., 2005) or even among cultivated germplasm, such as squashes (Alves *et al*., 2005). However, in other crops, like cotton (Torres, 2007) and soybean (Lourenção, 1980), no differences were observed in the egg-adult cycle for this insect, as in the present study. It is possible that, by evaluating clones of wild *Solanum* species, results might be obtained indicating antibiotic effects of some genotype.

With respect to adult emergence, the genotypes were not different from one another, with percentages varying from 91.2% (clone IAC-1966) to 99.3% (cultivar Ibituaçu). In the other genotypes, averages were 94.0% (cultivar Achat), 94.5% (clone NYL 235-4), 94.7% (cultivar Agata), and 97.3% (cultivar Panda). Decreased adult emergence is considered an indication of the presence of antibiosis (Lara, 1991), but in our investigation this factor could not be demonstrated.

Trichome density evaluation - The lowest glandular trichome density averages were observed in cultivars Itararé (22.8 trichomes 28mm^{-2}) and Serrana INTA (21.3), and clones IAC-1966 (20.5) and IAC-6290 (6.0), which were different from genotypes NYL 235-4, which showed the highest glandular trichome density (135.8 trichomes 28mm^{-2}), followed by cultivar Krantz, clone IAC-6063, and cultivars Aracy and Asterix, with 76.8, 66.9, 66.9, and 63.5, respectively (Table 3). As to simple trichome averages, the smallest value observed was for clone IAC-1966, with 14.3 trichomes 28mm^{-2}. It should be pointed out that this genotype has simple trichomes on its veins only; they are absent from the leaf blade. The clone NYL 235-4 also had the highest simple trichome average (309.5 trichomes 28mm^{-2}), and did not differ from 40% of all evaluated genotypes.

In the conduction of the various experiments of the present work, it was observed that glandular trichomes were not an important adverse factor to the whitefly, since the adults managed to move between the trichomes and avoid their exudates, feeding and ovipositing

Table 3. Trichome density (number of trichomes 28mm^{-2}) on the abaxial surface of leaflets of 24 potato genotypes, evaluated on the upper canopy (1st pair of completely developed leaves), in the greenhouse (densidade de tricomas (número de tricomas 28mm^{-2}) da superfície abaxial de folíolos de 24 genótipos de batata, avaliados no estrato superior (1º par de folhas completamente desenvolvidas), em casa-de-vegetação). Campinas, IAC- APTA, 2006.

Genotype	Mean number of trichomes 28 mm-2*;**	
	Glandular trichome	Simple trichome
NYL 235-4	135.8 a	309.5 a
Krantz	76.8 b	285.5 ab
IAC-6063	66.9 bc	264.7 abc
Aracy	66.9 bc	146.6 defg
Asterix	63.5 bcd	262.3 abc
Apuã	58.3 bcde	161.0 cdefg
Ibituaçu	54.5 bcde	88.1 gh
Monte Bonito	53.8 bcde	242.4 abcde
IAC-6093	52.5 bcde	170.0 cdefg
Baronesa	49.1 bcde	197.3 bcdefg
Aracy Ruiva	47.3 bcde	202.2 abcdef
Abaeté	44.3 bcdef	206.8 abcde
Bintje	43.5 bcdef	250.8 abcd
Itaiquara	42.7 bcdef	186.8 bcdefg
Atlantic	40.6 bcdef	197.9 abcdefg
Ágata	32.9 cdef	163.4 cdefg
Panda	29.5 cdef	198.9 abcdefg
Catucha	28.1 def	145.5 defg
Achat	27.1 def	90.7 fgh
Monalisa	27.0 def	162.6 cdefg
Itararé	22.8 ef	133.7 efg
Serrana INTA	21.3 ef	189.1 bcdefg
IAC-1966	20.5 ef	14.3 h
IAC-6290	6.0 f	173.0 cdefg
C.V. (%)	38.6	28.1

*Means followed by the same letter in the column do not differ significantly from each other by the Tukey test, p≤0.05 (médias seguidas pela mesma letra na coluna não diferem significativamente entre si, pelo teste de Tukey, p≤0,05); **Original data (dados originais).

normally (Table 1). The nymphs were able to complete their development, with high emergence of adults (94.5%) even on genotype NYL 235-4, which showed the highest glandular trichome density.

It is important to highlight that *S. berthaultii* introductions and hybrids with high functional type B trichome density inhibited egg-laying in the moth *P. operculella* (Mumesci *et al*., 1997). Nevertheless, Lopes *et al*. (2000) reported that such oviposition-repellent effect was not due exclusively to type B trichomes, since PI 473334, which only has type A trichomes, also showed high non-preference for oviposition. In genotypes NYL 235-4 and N 140-201, however, this type of resistance did not occur, probably due to the presence of type B non-functional trichomes.

In the present work, genotype NYL 235-4 did not show the non-preference-for-oviposition type of resistance, which might also be attributed to the fact that type B glandular trichomes are not functional. It must also be taken into consideration that densely hairy genotypes can provide a more adequate microclimate for oviposition by *B. tabaci* females (Butter & Vir, 1989). In addition, highly pubescent leaves may hinder parasitism by the whitefly natural enemies (De Ponti *et al*., 1990). Therefore, this morphological factor should be taken into consideration in potato breeding programs aimed at incorporating whitefly resistance.

Medeiros & Tingey (2006) evaluated the effect of glandular trichomes in *S. berthaultii* and its hybrids with *S.*

tuberosum on nymph emergence, development, and survival of the leafhopper *E. fabae*, another pest in this crop. Evaluations were made with or without removal of glandular trichomes. It was seen that, regardless of trichome removal, no nymphs completed development on PI 473331 and only a small percentage of the nymphs reached the adult stage on clone NYL 123 and on PI 473334. Resistance in these genotypes was caused not only by the influence of glandular trichomes, but also by *S. berthaultii* chemical makeup.

Correlation analyses - Coefficient values demonstrate a significant and positive correlation between number of *B. tabaci* biotype B eggs and adults (r=0.59; pd"0.01). Valle & Lourenção (2002) also found a significant positive correlation for number of eggs and number of *B. tabaci* biotype B adults on soybean, which indicates higher oviposition associated with greater presence of adults. As to the average number of eggs and simple trichomes, a significant and positive correlation was observed as well (r=0.54; p≤0.01). It must be taken into consideration that simple trichomes do not constitute physical barriers for whitefly oviposition, but can enhance this behavior, according to observations on positive correlations between whitefly oviposition and trichome density (Peña *et al*., 1993; Oriani & Lara, 2000).

A significant correlation (r=0.51; p≤0.01) was found between the average number of eggs and glandular trichomes. It was also seen that a positive relationship exists between both characteristics. It is therefore considered that glandular trichomes in potato did not represent morphological influences on resistance to oviposition by *B. tabaci* biotype B, although in other insects like *Myzus persicae* and *E. fabae* it is a resistance factor (Tingey & Laubengayer, 1981).

Considering all characteristics evaluated among the germplasm under study, cultivar Achat was the most resistant genotype to *B. tabaci* biotype B. Because cultivar Achat is completely sterile, its parents, cultivars Fina and Rheinhort, as well as products from that cross, should be evaluated in breeding programs as a source of resistance to *B. tabaci* biotype B. Considering that cultivar Achat is no longer a commercial genotype and, because of this, it would not be appropriate to recommend it for immediate planting in whitefly ridden locations.

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