Scientia Agraria
ISSN 1519-1125 (printed) and 1983-2443 (on-line)

SOURCES OF RESISTANCE TO TOMATO LEAFMINER IN CHERRY TOMATO

FONTES DE RESISTÊNCIA A TRAÇA DO TOMATEIRO EM TOMATE CEREJA

Fábio Moreira SOBREIRA[1]
Fabricio Moreira SOBREIRA[2]
Gilberto Santos ANDRADE[3]
Gustavo Dias de ALMEIDA[4]
Frederico de Pina MATTA[5]

ABSTRACT

The tomato plant has narrow genetic base due to intensive breeding and domestication of wild varieties. On the other hand, accessions are a potential source of germplasm against insect pests for tomato crop. The aim of this study was to evaluate the injury caused by *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) in the leaves and plant of *Lycopersicon esculentum* var. *cerasiforme*. The phenotypic and qualitative variability among 15 accessions, injury in leaves and plant after 20 days were evaluated. The injury in leaves and plant were carried out by the scale notes. In general, the accession CCAUFES 40 was the most resistant to *T. absoluta*, what indicate that one have potential as a source of germplasm for plants breeding of tomato against *T. absoluta.*

Key-words: *Tuta absoluta*; germplasm; varietal resistance; breeding.

RESUMO

O tomateiro possui estreita base genética, devido ao intensivo melhoramento e domesticação de espécies selvagens. Por outro lado, acessos são fontes potenciais de germoplasma contra insetos-praga dessa cultura. O objetivo deste estudo foi avaliar os danos causados por *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) em folhas e nas plantas de *Lycopersicon esculentum* var. *cerasiforme*. A variabilidade fenotípica e qualitativa entre 15 acessos, os danos nas folhas e plantas após 20 dias foram avaliados. O dano nas folhas e plantas foi avaliado por escala de notas. De maneira geral, o acesso CCAUFES 40 foi a mais resistente a *T. absoluta*, o que indica que o mesmo possui potencial como fonte de germoplasma para o melhoramento de plantas de tomate contra *T. absoluta*.

Palavras-chave: *Tuta absoluta*; germoplasma; resistência varietal; melhoramento.

[1] D.Sc. Student, Department of General Biology, Federal University of Viçosa, Viçosa, MG, Brazil. E-mail: fabiomsobreira@yahoo.com.br. Author for correspondence. CEP.: 36570-000.
[2] M.Sc. Student, Department of Agriculture, Federal University of Lavras, Lavras, MG, Brazil. E-mail: sobreirafm@bol.com.br
[3] D.Sc. Student. Department of Animal Biology, Federal University of Viçosa, Viçosa, MG, Brazil. E-mail: gilbertoandrade1@yahoo.com.br
[4] D.Sc. Student, Department of General Biology, Federal University of Viçosa, Viçosa, MG, Brazil. E-mail: gdalmeida.ufv@hotmail.com
[5] D.Sc. Department of Vegetal Production, Federal University of Espírito Santo, Alegre, ES, Brazil. E-mail: fpmatta@bol.com.br.

INTRODUCTION

Tuta absoluta (Meyrick) (Lepidoptera: Gelechiidae) is the major pest of tomato plant in Brazil and other countries such as Argentina, Uruguay, Bolivia, Chile, Peru, Ecuador, Colombia and Venezuela (Maluf et al., 1997). This insect induces injury buds, terminal buds, flowers, branches insertion, fruits and specially the leaves of tomato (Souza & Reis, 1992).

Insecticides are used to reduce the injury caused by this insect, which can cause development of resistant pest populations (França, 1993; Siqueira et al., 2000; Lietti et al., 2005). On the other hand, factors of resistance in *Lycopersicon* spp. may be an alternative to control by plant breeding (Hartman & St. Clair, 1998; Labory et al., 1999).

The tomato germplasm was severely reduced since its domestication. The one has narrow genetic base, with risks to its adaptation to climate change, diseases and more severe pest biotypes in this yield. This indicates that plant breeding is the most feasible method to maintain high yield and ensure the population food security (Tanksley & Mccouch, 1997). Thus, genetic resources in wild germplasm, cultivars and old varieties are important sources of diversity to modern cultivars (Saavedra et al., 2001), which can be an important against insect pests (Freitas et al., 2002; Alba et al., 2009). Nevertheless, this potential is not so much exploited in *Lycopersicon esculentum* var. *cerasiforme* (Sánchez-Peña, 2006).

Host plant resistance may be due to antixenosis, mechanism employed to deter or prevent herbivore insect colonization; antibiosis, plants induce a deleterious effects on survival and development of insect, and tolerance, the plant capacity of keeping its production under attack for herbivore insect (Painter, 1951; Lara, 1991).

The aim of this study was to evaluate the resistance of *L. esculentum* var. *cerasiforme* by the injury caused by *T. absoluta* in the leaves and plants.

MATERIAL AND METHODS

The experiment was conducted in two stages. Firstly, it was evaluated the genetic diversity among the accessions and subsequently, its resistance to *T. absoluta*. Both stages were conducted in a greenhouse at the Centro de Ciências Agrárias da Universidade Federal do Espírito Santo (CCA-UFES) in the municipality of Alegre - ES, Brazil (20º 45' S and 41º 29' W), at 270 m. The average temperature during the study was 26 ± 3 °C and relative humidity of 75 ± 10%.

Fifteen *L. esculentum* var. *cerasiforme* accessions were used from collections of genetic material of the Departamento de Produção Vegetal the CCA-UFES. The experiment was carried out in *a randomized block design*. Thirty days after sowing, the seedlings were transplanted to pots of 12 dm^3, filled in the proportion of 2:1:1 of soil, sand and cattle manure, respectively.

The accessions were characterized according standards descriptors by the International Plant Genetic Resources Institute (IPGRI, 1996). The descriptors used were: pedicel length (PEL, in mm), pedicel length to the knee (PLK, in mm), fruit mean weight (FMW, in g), fruit mean length (FML, in cm), fruit mean diameter (FMD, in cm), pedicel scar diameter (PSD, in mm), mesocarp thickness (MET, in mm), soluble solids content (SSC, in °Brix), pH, growth speed (GRS in cm / day), number of flowers per inflorescence (NFI), internode length (INL, in cm), days to fruit ripening (DFR) leaves below the first inflorescence (LBI) and days to flowering (DAF).

Leaves from the mid portion of each tomato plant were selected to evaluate the resistance of *L. esculentum* var. *cerasiforme* accessions to *T. absoluta*. Five first instar *T. absoluta* caterpillars were uniformly distributed on the abaxial surface of leaflets. The insects used were from the mass rearing in the laboratory (Giustolin et al., 2002). The treatments were obtained by variables: leaves injured (LED), and injured on plant (DPL). The LED was evaluated twenty days after the initial infestation considering only the marked leaves, where there was distribution of *T. absoluta* caterpillars. The plant general state was evaluated for DPL variable twenty days after the initial infestation.

Assessments of injury in leaf and plant were carried out by the scale notes, where 0 and 5 are to the absence and maximum injury, respectively. Leaves injury were attributed note 0 = no lesion, 1 = few and small lesions, 2 = medium-sized lesions, few, often located in the edges of the leaflets, 3 = medium and large lesions, numerous and coalescent, deformed edges of the leaflets, 4 = large coalescing lesions, deformed leaves completely, 5 = lesions throughout the leaflet. To quantify the injury in plant (DPL) was used the notes 0 = 0% of injury in the plant, 1 = small lesions, not coalescing, 0.1 to 5% injury, 2 = small lesions, not coalescing, 5.1 to 20% injury, 3 = medium and large lesions, from 20.1 to 50% of injury, 4 = numerous lesions, large and coalescent, from 50.1 to 80% of injury, 5 = plant completely deformed, more than 80.1 % of injury (Labory et al., 1999; Pereira et al., 2008).

Analysis of variances to variability among accessions was performed. The Tukey test at 5% probability was used to identify the resistance to *T. absoluta*. The estimates of simple correlations between variables LED and DPL were also obtained. The statistical analysis was performed by the Genes program (Cruz, 2001).

RESULTS AND DISCUSSION

The *L. esculentum* var. *cerasiforme* accessions shown significant genetic variability due to high phenotypic diversity among them (Table 1). The phenotypic characteristics can indicate the agronomic potential among accessions, although a more complete analysis with molecular markers is ideal for indicating the probable genetic divergence

(Gonçalves et al., 2008). The diversity of accessions may display inappropriate morphophysiological characteristics to adults of *T. absoluta* and/or restrict the larvae feeding. Some genotypes of tomato plant also have potential to cause adverse effects on the larvae biology of insect pest (Suinaga et al., 2004; Bertan et al., 2007; Bento et al., 2007). Such features can be used in plant breeding programs aimed at resistance to pests.

TABLE 1 – Sumary of analysis of variance for 15 cherry tomato accessions, considering the variables: pedicel length (PEL, in mm), pedicel length to the knee (PLK, in mm), fruit mean weight (FMW, in g), fruit mean length (FML, in cm), fruit mean diameter (FMD, in cm), pedicel scar diameter (PSD, in mm), mesocarp thickness (MET, in mm), soluble solids content (SSC, in °Brix), pH, growth speed (GRS, in cm / day), number of flowers per inflorescence (NFI), internode length (INL, in cm), days to fruit ripening (DFR) leaves below the first inflorescence (LBI) and days to flowering (DAF).

Variable	Q.M.	Mean	C.V. (%)	Descr.	Q.M.	Mean	C.V. (%)
PEL	17.84**	16.25	13.81	pH	0.074*	4.30	3.78
PLK	5.00**	8.44	17.91	GRS	0.16**	2.31	7.40
FMW	293.28**	14.96	20.52	NFI	109.37**	11.38	44.65
FML	2.34**	3.10	19.37	INL	1.82**	5.32	14.22
FMD	1.48**	2.73	8.77	DFR	106.21**	105.02	4.87
PSD	6.00**	3.63	17.42	LBI	4.43**	10.33	11.19
MET	4.22**	3.36	12.78	DAF	21.02**	54.64	4.04
SSC	4.62**	3.32	21.37				

** Significant by F test at 1% probability, ns not significant

Tuta absoluta caused less injury in leaves of accessions CCAUFES 50, 79 and 40 than on CCAUFES 78. On other hand, the CCAUFES 79 e 50 accessions were similar to CCAUFES 78, 16 and 71 after 20 days with more injury in plant. This may suggests that these accessions have lower potential for photosynthetic compensation even with lower initial injury in leaves due to *T. absoluta* larvae injury (Table 2).

TABLE 2 - Leaves injured (LED), and injured in plant (DPL), caused by Tuta absoluta larvae (Meyrick) (Lepidoptera: Gelechiidae) on Lycopersicon esculentum var. cerasiforme accessions.

Accessions	LED[1]	Accessions	DPL[1]
CCAUFES 78	3.66 a	CCAUFES 78	3.66 a
CCAUFES 16	3.08 ab	CCAUFES 71	3.66 a
CCAUFES 71	3.08 ab	CCAUFES 16	3.66 a
CCAUFES 11	2.75 ab	CCAUFES 11	3.33 ab
CCAUFES 81	2.58 ab	CCAUFES 81	3.00 ab
CCAUFES 77	2.50 ab	CCAUFES 77	3.00 ab
CCAUFES 64	2.50 ab	CCAUFES 51	3.00 ab
CCAUFES 51	2.50 ab	CCAUFES 05	3.00 ab
CCAUFES 25	2.25 ab	CCAUFES 64	2.66 ab
CCAUFES 05	2.16 ab	CCAUFES 50	2.66 ab
CCAUFES 82	2.08 ab	CCAUFES 82	2.00 ab
CCAUFES 80	2.00 ab	CCAUFES 25	2.00 ab
CCAUFES 50	1.83 b	CCAUFES 79	1.66 ab
CCAUFES 79	1.75 b	CCAUFES 80	1.33 ab
CCAUFES 40	1.33 b	CCAUFES 40	1.00 b

Means followed by the same letter in a column do not differ significantly by the Tukey test (5%).

[1] Scale notes from 0 (no injury) to 5 (maximum injury)

The CCAUFES 80, CAUFES 82, CCAUFES 05, CCAUFES 25, CCAUFES 51, CCAUFES 64, CCAUFES 77, CCAUFES 81, CCAUFES 11, CCAUFES 71 and CCAUFES 16 accessions showed intermediate resistance in injury in leaves of *L. esculentum* var. *cerasiforme* compared to other ones, with similar results to the less or more resistant accessions. The accession CCAUFES 40 showed minor injury to the plant compared to CCAUFES 78, CCAUFES 71 and CCAUFES 16. Differences against *T. absoluta* can be associated to acylsugars levels among tomato plants (Azevedo et al., 2003; Resende et al., 2006; Pereira et al., 2008), what suggest that CCAUFES 40 can be source of resistance against *T. absoluta* in plant breeding programs aim to control *T. absoluta.*

CONCLUSIONS

The accession CCAUFES 40 had minor injury to leaves and plant. Accession CCAUFES 78 was less resistant to attack by *T. absoluta*. Thus, genetic diversity among the *L. esculentum* var. *cerasiforme* accessions shows resistance to *T. absoluta* what demonstrate that the ones have potential as source of germplasm for plants breeding program.

REFERENCES

1. ALBA, J. M.; MONTSERRAT, M.; FERNÁNDEZ-MUÑOZ, R. Resistance to the two-spotted spider mite (*Tetranychus urticae*) by acylsucroses of wild tomato (*Solanum pimpinellifolium*) trichomes studied in a recombinant inbred line population. **Experimental and Applied Acarology**, v. 47, n. 1, p. 35-47, 2009.
2. AZEVEDO, S. M. de. et al. Zingiberene-mediated resistance to the South American tomato pinworm derived from *Lycopersicon hirsutum* var. *hirsutum*. **Euphytica**, v. 134, n. 3, p. 374-375, 2003.
3. BENTO, C. S. et al. Descritores qualitativos e multicategóricos na estimativa da variabilidade fenotípica entre acessos de pimentas. **Scientia Agraria**, v. 8, n. 2, p. 149-156, 2007.
4. BERTAN, I. et al. Variabilidade genética em trigo aferida por meio da distância genealógica e morfológica. **Scientia Agraria**, v. 8, n. 1, p. 67-74, 2007.
5. CRUZ, C. D. **Programa GENES – Versão Windows**: aplicativo computacional em genética e estatística. Viçosa: UFV, 2001. 648 p.
6. FRANÇA, F. H. Por quanto tempo conseguiremos conviver com a traça do tomateiro? **Horticultura Brasileira**, v. 11, n. 2, p. 176-178, 1993.
7. FREITAS, J. A. et al. Inheritance of foliar zingiberene contents and their relationship to trichome densities and whitefly resistance in tomatoes. **Euphytica**, v. 127, n. 2, p. 275-287, 2002.
8. GIUSTOLIN, T. A.; VENDRAMIM, J. D.; PARRA, J. R. P. Número de ínstares larvais de *Tuta absoluta* (Meyrick) em genótipos de tomateiro. **Scientia Agricola**, v. 59, n. 2, p. 393-396, 2002.
9. GONÇALVES, G. M. et al. Correlações fenotípicas e genético-aditivas em maracujá-amarelo pelo Delineamento I. **Ciência e Agrotecnologia**, v. 32, n. 5, p. 1413-1418, 2008.
10. HARTMAN, J. B.; ST. CLAIR, D. A. Variation for insect resistance and horticultural traits in tomato inbred backcross populations derived from *Lycopersicon penellii*. **Crop Science**, v. 38, n. 6, p. 1501-1508, 1998.
11. INTERNATIONAL PLANT GENETIC RESOURCES INSTITUTE (IPGRI). **Descriptors for tomato (*Lycopersicon* spp.)**. Roma, 1996. 47 p.
12. LABORY, C. R. G. et al. Seleção indireta para teores de 2-tridecanona em tomateiros segregantes e sua relação com a resistência à traça do tomateiro. **Pesquisa Agropecuária Brasileira**, v. 34, n. 5, p. 733-740, 1999.
13. LARA, F. M. **Princípios de resistência de plantas a insetos**. 2. ed. São Paulo: Ícone, 1991. 336 p.
14. LIETTI, M. M. M.; BOTTO, E.; ALZOGARAY, R. A. Insecticide resistance in Argentine populations of *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae). **Neotropical Entomology**, v. 34, n. 1, p. 113-119, 2005.
15. MALUF, W. R.; BARBOSA, L. V.; COSTA SANTA-CECILIA, L. V. 2-tridecanone mediated mechanism of resistance to the South American tomato pinworm *Scrobipalpuloides absoluta* Meyrick (Lepidoptera-Gelechiidae) in *Lycopersicon* spp. **Euphytica**, v. 93, n. 2, p. 189-194, 1997.
16. PAINTER, R. H. **Insect resistance in crop plants**. New York: Macmillan, 1951. 520 p.
17. PEREIRA, G. V. N. et al. Seleção para alto teor de acilaçúcares em genótipos de tomateiro e sua relação com a resistência ao ácaro vermelho (*Tetranychus evansi*) e à traça (*Tuta absoluta*). **Ciência e Agrotecnologia**, v. 32, n. 3, p. 996-1004, 2008.
18. RESENDE, J. T. V. et al. Acylsugars in tomato leaflets confer resistance to the South American tomato pinworm, *Tuta absoluta* Meyr. **Scientia Agricola**, v. 63, n. 1, p. 20-25, 2006.
19. SAAVEDRA, G.; SPOOR, W.; HARRIER, L. Molecular markers and genetic base broadening in *Lycopersicon* spp. **Acta Horticulturae**, n. 546, p. 503-507, 2001
20. SÁNCHEZ-PEÑA, P. et al. Sources of resistance to whitefly (*Bemisia* spp.) in wild populations of *Solanum lycopersicon var. Cerasiforme* (Dunal) spooner G.J. Anderson et R.K. Jansen in Northwestern Mexico. **Genetic Resources and Crop Evolution**, v. 53, n. 4, p. 711–719, 2006.
21. SIQUEIRA, H. A. A.; GUEDES, R. N. C.; PICANÇO, M. C. Insecticide resistance in populations of *Tuta absoluta* (Lepidoptera: Gelechiidae). **Agricultural and Forest Entomology**, v. 2, n. 2, p. 147-153, 2000.
22. SOUZA, J. C. de; REIS, P. R. **Traça-do-tomateiro**: histórico, reconhecimento, biologia, prejuízos e controle. Belo Horizonte: EPAMIG, 1992. 20 p. (Boletim Técnico, 38).
23. SUINAGA, F. A. et al. Resistência por antibiose de *Lycopersicon peruvianum* à traça do tomateiro. **Horticultura Brasileira**, v. 22, n. 2, p. 281-285, 2004.
24. TANSKLEY, S. D.; MCCOUCH, S. R. Seed Banks and Molecular Maps: Unlocking Genetic Potential from the Wild. **Science**, v. 277, n. 5329, p. 1063-1066, 1997.

Recebido em 20/02/2009
Aceito em 17/07/2009