Applied Biological Research 17(3): 297-301; (2015) **SHORT COMMUNICATION**
DOI: 10.5958/0974-4517.2015.00042.7

EFFICACY OF VARIOUS INSECTICIDES AGAINST TOMATO LEAF MINER, *Tuta absoluta,* IN EGYPT

Samir A.M. Abdelgaleil, Ahmed S. El-bakary, Mohamed S. Shawir and Gomaa R.M. Ramadan

Department of Pesticide Chemistry, Faculty of Agriculture, 21545 El-Shatby, Alexandria University, Alexandria (Egypt)
*e-mail: *gomaa.r.mohamed@gmail.com*

(Received 22 July, 2015; accepted 30 September, 2015)

ABSTRACT

***Tuta absoluta* has recently become one of the most devastating pests of tomato in Egypt. In this study, field experiments were conducted during two summer seasons (2012 and 2013) to determine the effectiveness of four insecticides, abamectin 152.4 g L^{-1} + thiamethoxam 33.2 g L^{-1} (Agriflex 18.6% SC), chlorpyrifos (Lirifos 48% EC), spinosad (Tracer 24% SC) and imidacloprid (Admire 20% SC), in controlling *T. absoluta* in tomato. These insecticides were found effective in reducing *T. absoluta* infestation in both the seasons. Spinosad proved most promising and caused 98.6% reduction in *T. absoluta* infestation in comparison of 62.8 and 54.8% by abamectin + thiamethoxam and chlorpyrifos, respectively. Imidacloprid was least effective with infestation reductions of 9.3%.**

Key words: Field evaluation, insecticides, pest management, tomato, *Tuta absoluta*

INTRODUCTION

Tomato (*Solanum lycopersicum*) crop in Mediterranean basin and Europe has recently been affected by an exotic pest *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) which has posed serious threat to the crop owing to its high reproduction rate and development of resistance to insecticides (Lietti *et al.*, 2005). The tomato leaf-miner (*T. absoluta)* is a native micro-lepidopteron of South America (Torres *et al.*, 2001) and assumed the status of major tomato pest since its detection in Mediterranean basin (Guenaoui, 2008). It was first recorded from Eastern Spain in late 2006 and then from Morocco, Algeria, France, Greece, Malta, Egypt and other countries (Roditakis *et al.*, 2010; Mohammed, 2010). The severe infestation of this insect causes severe loss to the extent of 80-100% in tomato, both in protected and open field cultivation (Korycinska and Moran, 2009). In early 2010, *T. absoluta* was detected in Marsa Matrouh governorate, the Western Egyptian border side to Libya (Mousa *et al.* (2013). In mid-2010, Ministry of Agriculture in Egypt reported its presence in other parts of the Delta valley (*http://www. apc.gov.eg*) and the insect spread rapidly in upper and lower regions of Egypt (Mousa *et al.*, 2013).

In general, at least 12 classes of insecticides, including synthetic insecticides, are currently in use to control *T. absoluta* (IRAC, 2009). Organophosphates and pyrethroids have been in use since 1970's while new its products (abamectin, spinosad, tebufonzide and chlorfenpyr) have been introduced in 1990s (Lietti *et al.*, 2005). However, frequent failures to control the pest with organo-phosphates and pyrethroids in South America (Lietti *et al.*, 2005), has lead to the assessment of new

safer insecticides for effective pest control (IRAC, 2009). Insecticides used to control tomato pinworm (*Keiferia lycopersicella)* that occupies the ecological niche of *T. absoluta* have been recommended to control this insect in the United States (Olson *et al.*, 2009). Indoxacarb, spinosad, imidacloprid, deltamethrin and *Bacillus thuringiensis* var. *kurstaki* have successfully been used to control of larval infestations in Spain (Russell, 2009). Chlorpyrifos and pyrethrins are frequently used in Italy (Garzia *et al.*, 2009). Abamectin, indoxacarb, spinosad, imidacloprid, thiacloprid, lufenuron and *B. thuringiensis* (*Bt*) have been recommended in Malta (Mallia, 2009). In Egypt, however, some new insecticides are still under registration for the control of *T. absoluta*. In addition, a few studies have described the efficacy of these insecticides for its control under laboratory open field conditions (Shalaby *et al.*, 2012; Hanafy and El-Sayed, 2013). Hence, it is imperative to device effective chemical control program to control *T. absoluta* in Egypt. The present study was aimed to evaluate the efficiency of four new insecticide formulations in controlling the tomato leafminer (*T. absoluta)* under open field conditions.

MATERIALS AND METHODS

Four insecticide formulations *viz.*, Agriflex 18.6% SC (abamectin 152.4 g L^{-1} + thiamethoxam 33.2 g L^{-1} @ 570 mL ha^{-1} (Syngenta AG, Switzerland), Lirifos 48% EC (chlorpyrifos @ 2.38 L ha^{-1} (Plaaskem (Pty) Ltd./South Africa), Tracer 24% SC (spinosad @ 30 mL 100 L^{-1} water (Dow Agro Sciences, England) and Admire 20% SC (Imidacloprid @ 50 mL 100 L^{-1} water (Bayer, Germany) were evaluated. These insecticides were supplied by the Ministry of Agriculture, Egypt.

The field experiments were conducted to evaluate the comparative efficacy of 4 insecticides at recommended rate for the management of *T. absoluta* in tomato crop in flood irrigated field at Banger El-soker region, El Amreya, Alexandria, Egypt in two seasons (2012 and 2013). Tomato cv. 'Elbasha 1077' seedlings, raised in a greenhouse, were transplanted to field on 15 May in 2012 and 2013. Two foliar sprays were conducted for each insecticide with 1st spray done soon after the appearance of *T. absoluta* infestation and 2nd spray 10 days later. The insecticides were sprayed by using knapsack sprayer. The water sprayed plots served as control. The experiments were conducted in a randomized complete block design in plots of 42 m^2 for each treatment and each treatment replicated thrice. Standard agronomic practices were followed to raise a good crop. Ten plants were randomly examined from each plot for *T. absoluta* infestation. The infestation percentages were determined before insecticide treatments and 3, 5, 10 days after treatments. The reduction in *T. absoluta* infestations were calculated as per Henderson and Tilton (1955) using the equation:

$$\text{Reduction (\%)} = 1 - \frac{T_a \times C_b}{T_b \times C_a} \times 100$$

Where, T_a and T_b are the numbers of infested plants in treatments after and before insecticide use; C_a and C_b are the numbers of infested plants in control after and before insecticide use. The data was subjected to one-way analysis of variance, followed by student-Newman-Keuls test (Cohort Software Inc., 1985) to determine significant difference between treatments at $P \leq 0.05$.

RESULTS AND DISCUSSION

The tested insecticides [spinosad, abamectin + thiamethoxam, chlorpyrifos & imidacloprid] were effective in reducing the *Tuta absoluta* infestation in tomato cv. Elbasha 1077 under field conditions during 2012 and 2013 (Fig. 1). The insecticide efficiency varied with time intervals of insecticide treatments. In season 2012, abamectin + thiamethoxam was the most effective for

reducing the infestation, followed by spinosad and chlorpyrifos. Infestation reductions were 88.2, 87.6 and 54.1% for abamectin + thiamethoxam, spinosad and chlorpyrifos, respectively, 3 days after 1st spray. Ten days later, infestation reduction of chlorpyrifos and abamectin + thiamethoxam decreased to 40.0 and 28.3%, respectively, while spinosad was the most effective insecticide in reducing *T. absoluta* infestation with 100% infestation reduction. In the case of the second spray, 3 days after application, spinosad exhibited high efficiency in reducing infestation of *T. absoluta* after all time intervals with infestation reduction of 100%. In addition, infestation reduction of abamectin + thiamethoxam and chlorpyrifos were 80.6 and 71.4% after 3 days and dropped to 40.5 and 28.0%, respectively, after 10 days following the application. Similar results were obtained in the second season 2013, there was a significant reduction in infestation of *T. absoluta*, particularly in plots that received the insecticides spinosad, (abamectin+ thiamethoxam), and chlorpyrifos with infestation reduction of 96.6, 83.3, and 87.5%, respectively, after 3 days of 1st application and 100, 90.0, and 84.3%, respectively, after 3 days following the second spray. After 10 days following the spraying, spinosad exhibited the highest infestation reduction of *T. absoluta* after all the time intervals elapsed after 1st and 2nd spray with infestation reduction of 100%. The infestation reduction percentage of (abamectin + thiamethoxam) and chlorpyrifos declined to 50.5 and 21.4%, respectively, after 1st spray, and 27.9 and 18.2%, respectively, after 2nd spray. In contrast, imidacloprid was the least effective insecticide or not active against *T. absoluta* after all time intervals of 1st and 2nd sprays in both seasons (2012 and 2013).

The average reduction percentages of *T. absoluta* infestation in tomato after different time intervals of insecticide treatments during two sprays in both the seasons of 2012 and 2013 revealed that spinosad was most promising in reducing *T. absoluta* infestation (97.3%) as compared to 61.7 and 54.8% in abamectin + thiamethoxam and chlorpyrifos, respectively, after 1st spray (Table 1).

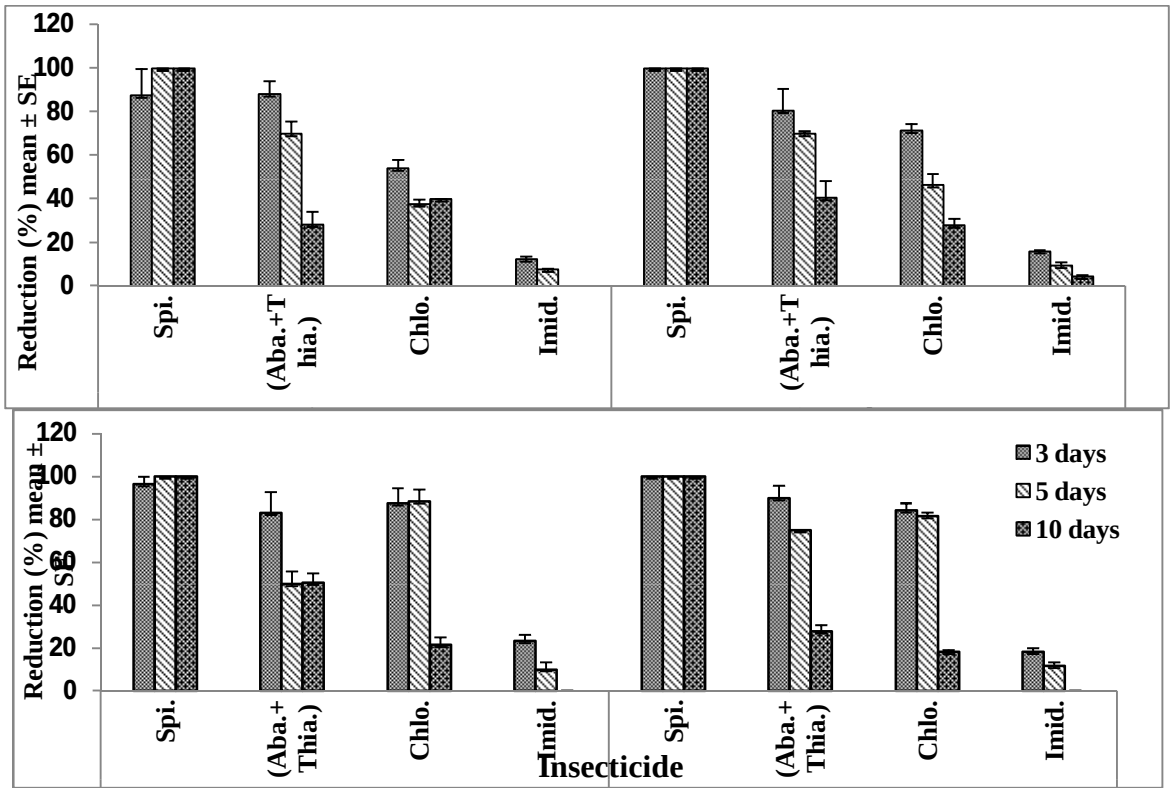

Fig. 1: Reduction in *T. absoluta* infestation (%) on tomato cv. Elbasha 1077 after insecticide treatments at various time intervals in seasons 2012 (upper) and 2013 (lower)

Table 1: Reduction percentages of *T. absoluta* infestation on Elbasha 1077 tomato variety after different time intervals of insecticide treatments (average of 2012 and 2013)

Insecticides	% Reduction (mean ± SE)								General mean
	1st spray				2nd spray				
	3d*	5d	10d	Mean	3d	5d	10d	Mean	
Spinosad	92.1±8.5^{a}	100.0±0.0^{a}	100.0±0.0^{a}	97.3^{a}	100.0±0.0^{a}	100.0±0.0^{a}	100.0±0.0^{a}	100.0^{a}	98.6^{a}
Abamectin + Thiamethoxam	85.6±7.3^{ab}	60.0±8.1^{b}	39.4±8.3^{b}	61.7^{b}	85.3±7.9^{b}	72.5±1.7^{b}	34.2±6.5^{b}	64.0^{b}	62.8^{b}
Chlorpyrifos	70.8±11.7^{b}	63.1±16.4^{b}	30.7±6.3^{b}	54.8^{b}	77.8±4.9^{b}	64.0±11.5^{b}	23.1±3.6^{b}	54.9^{b}	54.8^{b}
Imidacloprid	17.8±3.6^{b}	8.8±0.8^{c}	0.0±0.0^{c}	8.8^{c}	17.1±0.9^{c}	10.4±0.9^{c}	2.1±1.7^{c}	9.8^{c}	9.3^{c}

*****Periods after spray (days)

Same trend was observed after 2nd spray. spinosad, abamectin + thiamethoxam and chlorpyrifos showing infestation reductions of 100, 64.0, and 54.9%, respectively. Based on the general mean of 1st and 2nd spray during both seasons, the highest reduction of *T. absoluta* infestation (98.6%) was achieved by spinosad, followed by abamectin + thiamethoxam (62.8%) and chlorpyrifos (54.8%). In contrast, imidacloprid exhibited the lowest *T. absoluta* infestation reduction after all time intervals of 1st and 2nd sprays with infestation reduction of 9.3%. Our results are in agreement with Maraus *et al.* (2008) who reported spinosad as a standard product for controlling *T. absoluta* in Brazil. Nannini *et al.* (2008) reported spinosad highly effective against tomato borer larvae. In addition, among seven insecticides, spinetoram and spinosad were most effective in controlling *T. absoluta* (Hanafy and El-Sayed, 2013). Abamectin was effective against the leafminer fly (*Melanogromyza phaseoli*) on bean plants (*Phaseolus vulgaris*) (El-Bessomy, 2005). Moreover, Chlorfenapyr (100, 200 g a.i. ha^{-1}) and abamectin (8.1 g a.i. ha^{-1}) were effective against neonate larvae of potato moth (*Phthorimaea operculella* (Zeller) on tomatoes and larvae in mines (Kay, 2006). Granero and Carlos (2002) reported that chlorpyrifos had a better control efficiency for *T. absoluta*. Ramesh and Ukey (2007) and Kay (2006) found that imidacloprid weak and ineffective insecticide against tomato leafminer and potato moth *Phthorimaea operculella* on tomatoes.

Conclusion: The study revealed that Spinosad was most effective insecticide in controlling *T. absoluta*, followed by (Abamectin + Thiamethoxam) and Chlorpyrifos. These findings suggest the feasibility of Spinosad as chemical control agent for *T. absoluta* under the field conditions, alone or in a combination with other agents in the IPM program for *T. absoluta* on tomato.

REFERENCES

Cohort Software Inc. 1985. *Costat User's Manual.*Version 3. Cohort. Tucson, Arizona, USA.

El-Bessomy, M.A.E. 2005. Efficiency of abamectin alone and its combination with natural and KZ oils against the leafminer fly (*Melanogromyza phaseoli*) on bean plants. *Mansoura Journal of Agricultural Science,* **30**:1117–1121.

Garzia, G.T., Siscaro, G., Colombo, A. and Campo, G. 2009. Reappearance of *Tuta absoluta* in Sicily. Rinvenuta in Sicilia *Tuta absoluta. [Abstract]. L'Informatore Agrario, **65**:71*

Granero, O. and Carlos, A. 2002. Comparison of the control of tomato moth (*Tuta absoluta* Meyrick), with organic products and traditional chemical products in tomato (*Lycopersicon licopersicum* L.) under greenhouse. (*http://agris.fao.or*g).

Guenaoui, Y. 2008. New pest of tomato in Algeria, First observation of *Tuta absoluta*, tomato leafminer invasive in the region of Mostaganem, in spring 2008. *Phytoma-La Défense des Végétaux,* **617**:1–19.

Hanafy, H.E.M. and El-Sayed, W. 2013. Efficacy of bio-and chemical insecticides in the control of *Tuta absoluta* (Meyrick) and *Helicoverpa armigera* (Hubner) infesting tomato plants. *Australian Journal of Basic and Applied Sciences,* **7**: 943-948.

Henderson, C.F. and Tilton, E.W. 1955. Tests with acaricides against the brown wheat mite. *Journal of Economic Entomology,* **48**: 157-161.

IRAC. 2009. *Tuta absoluta* on the move. IRAC (Insecticide Resistance Action Committee) Newsletter, *Accessed January 4, 2010. http://www.irac-online.org/ documents /eConnection_ issue20a.pdf.*

Kay, I.R. 2006. Testing insecticides against *Phthorimaea operculella* (Zeller) (Lepidoptera: Gelechiidae) using a tomato plant bioassay. *Plant Protection Quarterly,* **21**: 20-24.

Korycinska, A. and Moran, H. 2009. Plant Pest Notice: South American tomato moth, *Tuta absoluta* (No. 56). pp. 1-4. Department of Environment, Food and Rural Affairs, Food and Environment Research Agency. ***56****: 1-4. www.defra.gov.uk/fera/plants/plantHealth.*

Lietti, M.M.M., Botto, E. and Alzogaray, R.A. 2005. Insecticide resistance in Argentine populations of *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae). *Neotropical Entomology,* **34**: 113-119.

Mallia, D. 2009. Guidelines for the Control and Eradication of Tuta absoluta. Ministry for Resources and Rural Affairs, Plant Health Department, Malta. *Accessed November 4, 2009. http://www.agric.gov.mt/plant-health-deptprofile.*

Maraus, P.F., Catapan, V., De Faria, D.S., Torres, J.U., Filho, B., Santos, H.S and Da hora, R.C. 2008. Efficiency of insecticides to control the leaf miner *Tuta absoluta* in the culture of tomatoes. *Horticultura Brasileira,* **26**: 2929-2933.

Mohammed, A.S. 2010. New record for leafminer, *Tuta absoluta* (Lepidoptera: Gelechiidae) infested tomato plantations in Kafer El-Sheikh region. *Journal of Agricultural Research, Kafrelsheikh University,* **36**: 238-239.

Mousa, S., Sharma, A., Baiomy, F. and Eid El-Adl, F., 2013. The Status of tomato leafminer; *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) in Egypt and Potential effective pesticides. *Academic Journal of Entomology,* **6**: 110-115.

Nannini, M., Foddi, F., Murgia, G., Pisci, R. and Sanna, F. 2008. Insecticides efficacy trials for management of the tomato borer *Tuta absoluta,* a new tomato pest in Sardinia, Italy. ISHS Acta Horticulturae 917, XXVIII International Horticultural Congress on Science and Horticulture for People (IHC2010): *International Symposium on Plant Protection*.

Olson, S. M., Stall, W. M., Vallad, G. E., Webb, S. E., Taylor, T. G., Smith, S. A., Simonne, E. H., McAvoy, E. and. Santos, B. M. 2009. Chapter 23: Tomato Production in Florida. In: S. M. Olson, ed. *The Vegetable Production Handbook for Florida. University of Florida IFAS Extension, USA.*

Ramesh, R. and Ukey, S.P. 2007. Bio-efficacy of botanicals, microbials and newer insecticides in the management of tomato leafminer, *Liriomyza trifolii* burgess. *International Journal of Agricultural Sciences,* **3**: 154-156.

Roditakis, E., Papachristos, D. and Roditakis, N.E. 2010. Current status of the tomato leafminer *Tuta absoluta* in Greece. *EPPO Bulletin,* **40**: 163-166.

Russell IPM. 2009. *Tuta absoluta*- Insect Profile. Russell IPM Ltd., *Accessed January 4, 2010. http://www.tutaabsoluta.com/ insectprofile.php?lang=en).*

Shalaby, E. M., Soliman M. M. and Abd Ei-Mageed, E. M., 2012. Evaluation of some insecticides against tomato leaf minor (*Tuta absoluta*) and determination of their residues in tomato fruits. *Applied Biological Research,* **14**: 113-119.

Torres, J.B., Faria, C.A., Evangelista, W.S. and Pratissoli, D. 2001. Within plant distribution of leaf miner *Tuta absoluta* (Meyrick) immatures in processing tomatoes, with notes on plant phenology. *International Journal of Pest Management,* **47**: 173-178.