

Original Research Article

Geographical distribution of the tomato borer, *Tuta absoluta* Meyrick (Lepidoptera. Gelechiidae) in Niger

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Abstract: The tomato leaf miner, *Tuta absoluta*, is a destructive insect pest of Solanaceous crops. It was reported for the first time in 2013 in Niger, a country in West Africa. Three years after its introduction, a survey was conducted in all regions of the country using pheromone traps or direct catch to track its distribution. The results of this survey showed that the pest is present in 7 of the 8 regions of Niger; only the Diffa region was not infested. But with its high reproductive rate and its great capacity for dissemination, there is a high risk that this last region becomes infested rapidly. The insect pest could also rapidly spread into neighboring countries such as Burkina Faso, Mali and Benin because of the trade links they have with Niger.

Keywords: invasive pest, tomato leaf miner, *Tuta absoluta*, geographical distribution, Niger.

INTRODUCTION

Tomatoes (*Lycopersicon esculentum* Miller) are an important commercial crop in Niger. It is only second to onion. In contrast to the latter tomatoes are grown everywhere in the country; therefore it could be considered as the most popular vegetable crop. It is grown during the dry and cool period of the year (November-February) under along the Niger River, Ader-Doutchi-Magia, the Goulbi area in Maradi, the Korama and around ponds and other water reservoirs. . In Niger the average yields, about of 20.7 t / ha [1] are still low compared to the potential of crop. This low productivity is partly due to high pressure of diseases, plant parasitic nematodes, and insect pests [2].

The occurrence of the Tomato borer, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) on tomato [3] constitutes a threat to commercial tomato production in Niger because small producers may be economically ruined.

The Tomato borer *T. absoluta* (Meyrick) (Lepidoptera: Gelechiidae) is native to South America, and was declared as a major pest in Argentina since 1964. From Argentina it invaded the rest of South America. Its worldwide dissemination went unchecked.

Now it has been reported from most of the regions of the world. In 1962 it was reported in Japan; in 2006 in Spain. Then it was reported in Morocco, Algeria and France in 2008. One year later the whole Mediterranean Basin became infested. The insect was reported in Egypt in 2011 [4]. Then it spread rapidly into Sub-Saharan Africa. In 2012 it was reported in Sudan [5] and Ethiopia in the East [6] and in the Senegal in the West [7]. Maroo and Venter [8] reported the pest in Kenya.

In Niger, the pest was found for the first time in two vegetable producing areas, Burburkabé and Talkoboye that are 15 and 70 km from the capital city, Niamey. The finding of *T. Absoluta* in Niger caused the Network of the Chambers of Agriculture to send warning messages all over the country [1, 3]. The second warning came from the agricultural extension services [9]. Three years after the report of the occurrence of *T. Absoluta* in Niger, little was known about its geographical distribution in the country and the amount of damage caused to the host crops which could include all solanaceous vegetable crops. The objective of this survey is to map the distribution of *T. Absoluta* in Niger and determine its impacts.

MATERIAL AND METHODS

The survey was conducted in the eight administrative regions of Niger (Figure 1). In each

region, the largest tomato producing sites were selected for the survey. Forty two tomato production sites were visited (Table I).



Fig 1: The eight administrative regions of the country surveyed (map from google earth)

Table 1: numbers of visited sites and producers per site

Regions	Number of sites	Number tomato producers by site
Zinder	4	252
Maradi	5	198
Tahoua	6	354
Dosso	11	346
Niamey	4	95
Tillabéri	7	268
Diffa	5	154
Total	42	1667

In each site, the tomato growers which constitute the main target groups were asked about their perception of *T. absoluta*, the main Solanaceous crops, the major insect pests and the pest management strategies used, particularly against *T. absoluta*.

After the discussions with the producers, the vegetable fields were visited. In each site, we observed the presence of small caterpillars on stems, leaves and fruits. Samples of attacked plant material were taken and kept in a tied and labeled plastic bags. These samples were then transported in the entomology laboratory and incubated until emergence of the adult of butterflies. Pheromone traps of *T. absoluta* (Russell IPM-Morocco) were also placed in the different sites and butterfly specimens caught were identified.

RESULTS

Tuta Absoluta was caught in all the regions, except the Diffa region. In the seven regions that were infested, *T. absoluta* was found in all tomato production sites covered by the survey. (Figure 2; Table 3).

But it is only in the regions of Tillabéri, Niamey and Tahoua that tomato growers have an awareness of its presence because the importance of the damages. In these three regions producers thing that the yield losses can reach up to 50%. Vegetable producers in Maradi, Zinder, Tahoua and Dosso are informed of the presence of this pest in the country. They could not however identify the insect; in addition, the damages its caused are confused with the ones caused by the cotton bollworm (*Helicoverpa armigera*) and mites. Everywhere, *T. absoluta* was only found in tomatoes except in Agadez where it was found both on tomato and potato. In this region it was encountered even in farms situated on the Mount Bagazam at 2000 m

altitude where severe attacks forced more than 90% of tomato producers to rotate to onion. In sites where *T. absoluta* is well known, the producers said they observe the presence of this pest throughout the tomato development cycle, but the attacks are more severe and

damages greater on late planted tomatoes than on early planted ones. Some argue that the infestation extends to the tomatoes grown in the rainy season and becomes severe in case of drought.

Table 2: Geographical coordinates of the study sites

Regions	Sites	Latitude	Longitude
Tahoua	Guidan Kadi	13,89151	5,49073
	Adouna	14,77374	5,57582
	Taddis	14,91721	5,25417
	AHA de Ibohamane	14,79873	5,91299
	Dogueraoua	13,94918	5,58160
	Konni	13,4853	5,1515
Maradi	Koumchi	13,65817	6,04891
	Soumarana	13,45478	7,08941
	Goumar	13,66305	3,03972
	AHA de Djirataoua	13,4075	7,1379
	Tarna	13,44306	7,10945
Zinder	Falki	13,69354	7,17905
	Kaba dan koraou	13,24231	8,9166
	Kwaya	13,19637	8,63399
	Matameye	13,44638	8,47321
Dosso	Karra	13,02139	2,93500
	Kolbou	13,34806	2,96778
	Gaya	11,87139	3,48194
	Bengou	11,98861	3,41917
	Hamdallaye	12,55417	3,53528
	Dioundiou	12,61583	3,54306
	Fadama	13,03972	3,90306
	Gazari	13,03833	3,93750
	Bado	13,45583	4,04944
	Mai kalgo	13,27333	4,05222
	Brigadier	13,3843	4,03134
Tillabéri	Tolkobeye	14,21361	2,12222
	Ayorou houssa	14,72833	0,91639
	Tillakaina	14,25000	1,43000
	Ribire boubacar	13,44056	1,92139
	Nagoual	13,27222	1,91222
	Kongou gorou banda	13,60250	2,18889
	Bourbourkabé Karma	13,38471	2,09109
Niamey	Tondibia	13,56569	2,00926
	Bourbourkabé Goudel	13,38314	2,09117
	Kahé	13,20287	2,09481
	Guériguindé	13,2833	2,0908
Agadez	Mont Bagzam	17,91333	8,75111
	Dabaga	17,53222	8,33639
	Azel	17,07306	8,10361
	Emalawlé	17,40533	8,47028
	Tassissat	17, 41046	8,44344
	Bagazane	17,43708	8,45004
Diffa	N'garwa gana	13,23420	12,4534
	Fébla	-	-
	Gagam	13,3245	12,5108
	Fiégoulori	-	-
	Dibiram	14,0598	13,1772

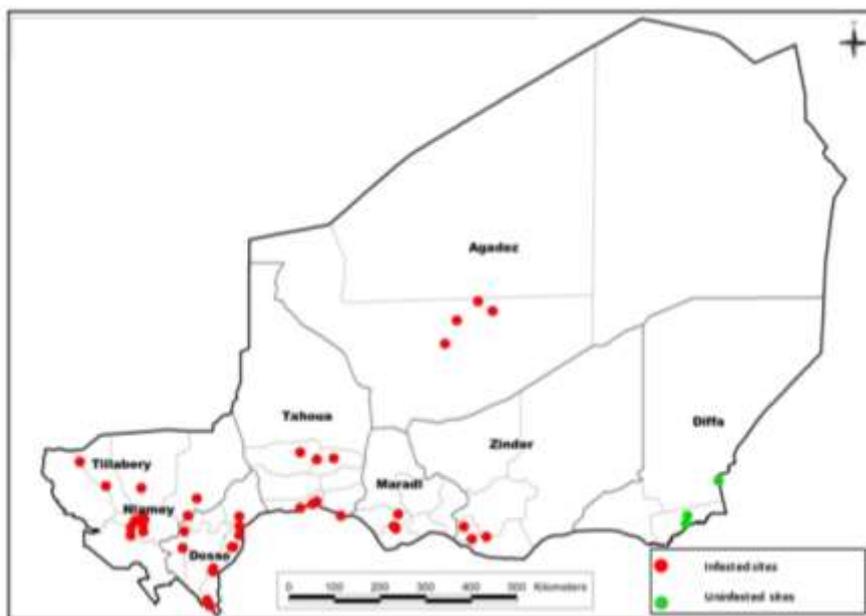


Figure 2: Geographical distribution of *Tuta absoluta* in Niger

The survey revealed that all major tomato varieties grown in Niger (*Roma*, *Xina*, *Tropimech*, *Rio Grande*, *Marmande* and *Mongal F1*) are susceptible to *Tuta absoluta* attacks at any of their developmental stage. Furthermore, the most commonly used insecticides (Lamba cyalithrine, dimethoate, cypermethrin, deltamethrin, permethrin and acetamiprid) are ineffective against the pest. Some

producers apply Abamectin that is specifically a miticide to treat their tomatoes against *T. absoluta*. The study also showed that many farmers do not perceive *T. absoluta* as important as the cotton bollworm (*H. armigera*), whiteflies (*Bemisia tabaci*), or Root-knot nematodes (*Meloidogyne* sp.) (Table IV). In general, farmers considered the last three pests as the most damaging ones to vegetable crops.

Table IV: Major pests of tomato found in all height regions of Niger

Common name	Scientific name	Crops	Attacked organs	Rank
Cotton bollworm	<i>Helicoverpa armigera</i> +++	Tomato, peppers	Flowers, fruits	+++
Caterpillars	<i>Spodoptera littoralis</i> + <i>Tricpulsia ni</i> +	Tomato, Cabbage	Leaves	+
Tomato borer	<i>Tuta absoluta</i>	Solanaceae	Leaves, fruits, stems	+++
Aphids	<i>Myzus persicae</i>	Solanacées, chou,	Leaves, buds	+
Root-knot nematodes	<i>Meloidogyne spp</i>	Solanaceae	Roots	+++
Whiteflies	<i>Bemisia tabaci</i>	Tomato	Leaves, buds	+++
Mites	<i>Tetranychus urticae</i>	Tomato, eggplant, jaxatou	Leaves, stems	+++
Birds (Parakeet)	<i>Melopsittacus</i> sp. +	Tomato	Ripe fruits	
Grasshoppers	<i>Oedalus senegalensis</i> ,	Plants in nursery	Nursery	+
	<i>Chrotogonus senegalensis</i>			+
	<i>Acrotylus spp</i>			+
Cricket	<i>Gryllus bimaculatus</i>	Tomato	Nursery	+
Mole cricket	<i>Gryllotalpa africana</i>	Potato	Nursery	+
Termites	<i>Odontotermes spp</i>	All crops	The whole plant	+

NB: the number of + sign indicates the importance of the pest: + =not important; ++= important; +++= very important

DISCUSSIONS

This survey on the geographical distribution of *Tuta absoluta* in Niger revealed that three years after

its presence was first reported, the pest has infested the whole country except the region of Diffa in the extreme south eastern part. In this region even pheromone traps

failed to catch the insect. Therefore, at the time of this study it is assumed that the region of Diffa is not infested by *T. absoluta*. In 2013, the insect was found in two regions only, Niamey and Tillaberi in the western part of the country [1]. But at that period, its presence in the region of Agadez was suspected because that region has strong trade relationships with Algeria where the insect was reported since 2008. So these results are a confirmation of the presence of *Tuta absoluta* in this region. The results also show the great capacity of this invasive pest for dissemination. The situation is similar to that observed in Algeria, where the pest was detected for the first time in the Mostaganem region during the spring of 2008 and a year later it invaded all the major tomato producing areas [10].

According Guénaoui *et al.*; [11] the rapid dissemination of this insect over large areas is due to the climate which is favorable for its development, the vast spreading of tomato cultivation in the country, the inefficiency of indigenous natural enemies which are negatively affected by the misuse of pesticides of any kind. This misuse of pesticides also causes emergence and build-up of resistant biotypes populations [12]. The explosion of the population of *Tuta absoluta* in some regions can be attributed to its rapid development in tropics. For instance at 27.1°C, it takes only 23.8 days for the insect *T. absoluta* to complete its life cycle [13]; that means one generation per month. Dissemination of *T. absoluta* can be done through the movement of infested fruits, plants and by contaminated baskets during the transport, by wind and migration of the flying adults [1]. Haougui *et al.* [14] already reported an intense commerce of tomato and pepper seedlings between Niger and Nigeria. This most likely explains how the insect was introduced in Northern Nigeria. International trade of tomatoes (fruits, seeds and seedlings) may also explain how *Tuta absoluta* has rapidly colonized the world and Africa. According to Potting *et al.* [15], between 2008 and 2009, *T. absoluta* was confined in North Africa, Algeria, Morocco Tunisia and Libya. It reached West Africa in 2012 by Senegal [7]. In 2013 it was reported in Niger [1] and in 2015 in Nigeria [16]. The presence of this invasive pest in the region of Agadez (region bordering southern Algeria) suggests that the invasion of Niger was from its northern neighbor Algeria. Because this country (Algeria) reported *T. absoluta* eight years before it was discovered in Agadez [17]. The colonization of the Western areas of Niger would come directly or indirectly from Morocco because in recent years Niger imports tomato fruits from this Mediterranean country or from countries of the sub region (Senegal particularly) that also import tomato from Morocco [18].

Although *T. absoluta* has not yet been found in Diffa, its presence is still suspected in the North West

regions of Nigeria from which it can reach this area [19]. Other areas not yet surveyed, may not be free from the attacks of *T. absoluta*, if we take into account its high capacity to spread [20]. The neighboring countries such as Burkina Faso, Mali and Benin are at high risks and should expect an invasion by this insect pest because of the trade links they have with Niger, the porous nature of the borders and hence the inefficiency of the quarantine systems.

CONCLUSION

This study showed that the tomato borer (*Tuta absoluta*) is present in almost all regions of Niger. Given the importance of the tomato yield loss it causes, each tomato development program should include the control strategies against this new pest.

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REFERENCES

1. Reça, editor. Danger : *Tuta absoluta*, un nouveau ravageur de la tomate identifié au Niger. 2013. Available from [http://www.reca-niger.org/IMG/pdf/RECA_intrants_phyto_Note5_Tuta_octobre2013 .pdf](http://www.reca-niger.org/IMG/pdf/RECA_intrants_phyto_Note5_Tuta_octobre2013.pdf).
2. Delmas P, Kimba A, Inkaye O, Haougui A, Basso A. Conseiller en maraîchage / Cas pratiques (4) Attaques sur tomates. 2015. Available from http://www.reca-niger.org/IMG/pdf/ConseilM_RECA_Niamey_Xantho_T4.pdf.
3. Muniappan R. *Tuta absoluta*: the tomato leafminer. 2013. Available from [http:// www. coraf.org/ documents /ateliers/2013-05/tuta-absoluta/Tuta-absoluta-Presentation.pdf](http://www.coraf.org/documents/ateliers/2013-05/tuta-absoluta/Tuta-absoluta-Presentation.pdf).
4. Moussa S, Sharma A, Baiomy F, El-Adl FE. The Status of Tomato leafminer, *Tuta absoluta* (Meyrick)(Lepidoptera: Gelechiidae) in Egypt and potential effective pesticides. Academic Journal of Entomology. 2013; 6(3):110-5.
5. Mohamed ES, Mohamed ME, Gamiel SA. First record of the tomato leafminer, *Tuta absoluta* (Meyrick)(Lepidoptera: Gelechiidae) in Sudan. EPPO bulletin. 2012 Aug 1; 42(2):325-7.
6. NAPPO. Surveillance Protocol for the Tomato Leaf Miner, *Tuta absoluta*, for NAPPO Member Countries. 2012. Available from [https://www.aphis.usda.gov/import_export/plants/plant_exports/downloads/ Tuta_absoluta_surveillanceprotocol_08-06-2012-e.pdf](https://www.aphis.usda.gov/import_export/plants/plant_exports/downloads/Tuta_absoluta_surveillanceprotocol_08-06-2012-e.pdf).
7. Pfeiffer DG, Muniappan R, Sall D, Diatta P, Diongue A, Dieng EO. First record of *Tuta absoluta* (Lepidoptera: Gelechiidae) in Senegal. Florida Entomologist. 2013 Jun; 96(2):661-2.

8. Maroo M and Venter JH. Pest Alert: *Tuta absoluta* (Tomato Leaf Miner). Media Advisory, Department of Agriculture and fisheries, South Africa. 2015. Available from <http://www.gov.za/speeches/agriculture-forestry-and-fisheries-issues-pest-alert-tomato-leaf-miner-4-mar-2015-0000>.
9. Ministry of Agriculture, editor. Rapport de la réunion annuelle des Cadres de l'Agriculture, Thaoua (Niger). 2013.
10. Dehliz A and Guénaoui Y. Natural Enemies of *Tuta absoluta* (Lepidoptera: Gelechiidae) in Oued Righ Region, An Arid Area of Algeria. Academic Journal of Entomology. 2015; 8 (2): 72-79.
11. Guénaoui Y, Dahliz A, Bensaad R and Ouezzani K. Five years after the first records of *Tuta absoluta* (Meyrick) in Algeria, what do we expect from its native natural enemies? IV International Symposium, Agrosym, 2013: 678-682.
12. Branco MC, França FH, Medeiros MA, Leal JG. Use of insecticides for controlling the South American Tomato Pinworm and the Diamondback Moth: a case study. Horticultura Brasileira. 2001 Mar; 19(1):60-3.
13. CABL. Crop Protection Compendium: *Tuta absoluta*. 2011. Available from <http://www.cabicompendium.org/cpc/>
14. Haougui A, Nouri MK, Basso A, Doumma A, Adam T. Plant parasitic nematode communities associated with pepper in Aguié region (Niger republic). Botany Research Int. 2013; 6(1):01-6.
15. Potting RPJ, Van der Gaag DJ, Loomans A, Van der Straten M, Anderson H, MacLeod A, Castrillón JMG and Cambra GV. *Tuta absoluta*, Tomato leaf miner moth or South American tomato moth. Ministry of Agriculture, Nature and Food Quality, Plant Protection Service of the Netherlands, 2013.
16. Rusell-IPM. The Tomato Leaf Miner Moth. 2015. Available from <http://nigeria.tutaabsoluta.net/>
17. Allache F, Bouta Y, Demnati F. Population development of the tomato moth *Tuta absoluta* (Lepidoptera: Gelechiidae) in greenhouse tomato in Biskra, Algeria. Journal of Crop Protection. 2015 Dec 1;4(4):509-17.
18. ReCA. La tomate au Niger. 2016. http://www.reca-niger.org/IMG/pdf/Tomate_Konni_Mai_2016_RECA_comp.pdf.
19. Richard-Mark M. Again, *Tuta absoluta* attacks Nigerian tomato. 2016. Available from agronigeria.com.ng/tomato-leaf-miner-disease-responsible-shortage-markets-agronigeria/.
20. Bayram Y, Güler Y, Fursov V, Kodan M, Öğreten A. First Record of *Necremnus cosmopterix* Ribeset Bernardo, 2015 (Hymenoptera: Eulophidae), as a Larval Parasitoid of the Tomato Leaf Miner, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) in Turkey. Egyptian Journal of Biological Pest Control. 2016; 26(4):853-4.