

Survey report on the recognition and management of the tomato leaf miner *Phthorimaea absoluta* by producers in the Mostaganem region (Algeria).

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ABSTRACT

The tomato (*Solanum lycopersicum L.*) is the second most cultivated and consumed vegetable in Algeria. However, it attacked by many pests, including *Phthorimaea absoluta* a leaf miner that reduces yields, attacking the entire aerial part of the crop at all phenological stages. On average, producers in the Mostaganem region estimate that this leaf miner causes them to suffer yield losses of between 25 and 50% and the use of synthetic chemical insecticides remains the means favored by producers despite numerous treatment failures recorded in several cases.

1.Introduction

Tomato (*Solanum lycopersicum L.*) represents one of the most cultivated horticultural crops worldwide, with over 5 million hectares of cultivated area and more than 182 million tons of tomato produced globally (Singh *et al.*, 2018 ; Blanchard-Gros *et al.*, 2021; Panno *et al.*, 2021; Caruso *et al.*, 2022).

At the continental level, Asia represents almost 62% of the share of world production, followed by America (13.2%), Europe (12.6%) and Africa (12%). The two leading world-producing countries are China with 62.8 million tons followed by India with 19 million tons. The United States of America ranks third in the world with more than 12.8 million tons of tomatoes produced; Turkey is next with 10.9 million tones and Egypt with 6.8 million tons (FAOSTAT, 2021).

In Algeria, more than one thousand hectares devoted annually to tomato cultivation. It is one of the most important vegetable crops grown in open fields and in greenhouses with a highly variable annual yield (Bradea *et al.*, 2015). The production of industrial tomatoes amounted to more than 23 million qx in 2021, registering a growth of more than 17% compared to the previous financial year. On the other hand, the national production of fresh tomatoes yielded 13.72 million qx during the 2020-2021 campaign (MADR, 2022).

Among the main tomato-producing regions, the Wilaya of Mostaganem recorded a production of 1.33 million qx over an area of 2,438.5ha (DSA Mostaganem, 2022). During its vegetative cycle, this crop continually threatened by various bio-aggressors, including *Phthorimaea absoluta*, the main pest that affects both the quality and the quantity of production in this region (Krache *et al.*, 2021).

Given the importance of the tomato in the Mostaganem region, the

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potential harm of this pest and the many complaints from producers, we were interested in assessing the phytosanitary situation by interviewing tomato producers in greenhouses and open fields.

2. Presentation of the wilaya of Mostaganem

Geographical location :

The Mostaganem region covers an area of 2269 km², from 0°8' West to 0°46' East and from 36°29' to 35°37' North. Located in the northwest of Algeria, it is bordered to the north and northwest by the Mediterranean Sea, with a coastline of around 120 km, to the east by the wilaya of Chlef, south by the wilayas of Mascara and Relizane, and to the west by that of Oran (Fig. 01) (Caïd et al., 2019).

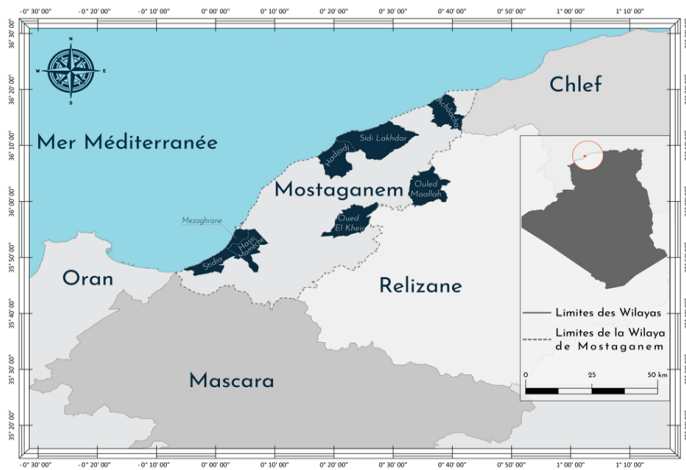


Fig. 1. Geographical location of Mostaganem.

3. Methodology

To assess the phytosanitary impact caused by the invasion of *P. absoluta* on tomato crops in Mostaganem, we conducted a survey of 45 producers from the main producing municipalities in the region (Achâacha, Sidi Lakhdar, Stidia, Hadjadj, Mazagran, Hassi Mamèche, Ouled Maallah and Oued El Kheir). The interviews with the producers took place during the period from 2019 to 2020.

The sites selected for the survey were determined in collaboration with the managers of the phytosanitary product companies, which are in close contact with farmers and tomato producers.

A questionnaire developed to characterize tomato farms, to assess the level of knowledge of producers of the pest, to estimate the damage caused and to list the phytosanitary practices for controlling this insect.

4. Results and discussion

4-1. Identification of farmers

4-1-1. Age: All market gardeners interviewed during this study were men. Indeed, they mainly made up of a population aged between 30 and 39 years with 51.11%. While, 42.22% of producers were between 40 and 49 years old and only 4.45% were between 25 and 29 years old. On the other hand, market gardeners who are over 49 years old

were largely in the minority with 2.22% of the workforce.

The age of growers considered one of the most important points affecting agricultural production in general, especially tomato cultivation which spreads more effort and requires younger growers.

4-1-2. Educational level of farmers: The survey tells us that 2.22% at a primary level, 15.56% at an average level and 66.67% at a secondary level. Whereas, 4.44% of market gardeners have had agricultural training. Only 11.11% of farmers have non-agricultural higher education. This last category could be the nucleus or the engine of development in the area. A good level of education will allow the market gardener to be able to read and correctly follow the instructions described in the field of crop protection.

4-1-3. Experience in tomato production: In terms of experience in tomato production, 55.56% of producers have less than 10 years' experience and 42.22% have between 10 and 20 years' experience. Only 2.22% have a seniority of more than 20 years in market gardening production.

4-2. Characterization of tomato farms:

4-2-1. Area reserved for tomato production: The area reserved for tomato production in greenhouses and in the open field by producers varies between 0.5 and 05 hectares. Indeed, 42.22% of the farmers cultivated the tomato on an area of ½ ha and 46.67% cultivated it on one and 05 hectares. Only 11.11% of market gardeners produce it on 5 hectares.

4-2-2. Mode of acquisition of agricultural land: The survey indicates that 55.56% of farmers are owners and 44.44% of farmers are tenants. Most producers (53.33%) preferred to produce tomatoes in greenhouses; some market gardeners (15.56%) install the field tomato as a late season crop. On the other hand, 31.11% of farmers produced the tomato by both modes.

4-2-3. Irrigation method: All market gardeners surveyed use the drip system as a very efficient and economically compatible mode of irrigation.

4-2-4. Cultivated varieties: Several varieties of tomatoes grown in the Mostaganem region; thanks to their adaptations to climates and their resistance to diseases and pests. After all, fruits differ in size, appearance, taste, pedoclimatic needs. Indeed, the main varieties used are Kawa (32.14%), Tomastar (21.42%), Nada (14.3%), Suzana (14.3%), Panekra (10.07%) and Belfast (7.14%). Farmers because of their good yield generally prefer them; their fruits characterized by tolerance to pests and keep well during transport.

4-2-5. Production system (Monoculture / Association culture): In our sample, 22.22% of the farms apply the intercropping system system (tomato, pepper, pepper, bean, garlic...etc.) and 77.78% of the farms apply the simple system (monoculture) for tomato production.

4-2-6. Fertilization: Fertilization generally considered one of the most important basic restoration materials for growing tomatoes. All tomato producers in the study area use organic and chemical fertilizers. The use of organic manure will swing between poultry manure and cattle manure and this varies according to soil quality (clay, sand) and water clarity and salinity. Manure with all of its sources aids seedling start and growth. However, poultry manure accelerates the start of the seedling and causes the roots to absorb mineral salts, while long-term cattle manure often shows effectiveness in winter.

NPKs used in the soil to supplement the materials necessary for the growth of the plant in all its cycles and correct the lack of organic matter.

- The association of cultures (11.11%);
- Installation of mulch (44.44%);
- The installation of the insect-proof (6.67%).

All farmers apply weeding, uprooting and destruction of infested organs/plants. Indeed, the fight against weeds done manually with the hoe, this practice could have the additional advantage of also allowing the earth to stir up and bringing the chrysalises buried in the ground to the surface and exposing them to the sun's rays.

For the rotations, the speculations used are cabbage, cauliflower, potato, cucumber, broad bean, pea, melon, watermelon, durum bean and soft wheat.

4-6-2. Pesticides used by growers: All of the producers met know the names of the products they use. For chemical products, the producers cited 08 active molecules used against *P. absoluta* during this survey: lambda-cyhalothrin (32.60% of the products used), spinozad (22.83%), abamectin (15.21%), emamectin benzoate (9.78 %), proact (6.52%), chlorantraniliprole (6.52%), cypermethrin (4.34%), deltamethrin (2.17%).

Some producers even claim that they mix up to five different products to carry out the treatments against this pest. Several producers have told us that some of their treatments have proven ineffective to the point of having to abandon their fields because of uncontrollable *P. absoluta* contamination.

4-6-3. Period of use of chemical pesticides: Among the rules of good practice for the use of plant protection products, there is the application of chemicals only when strictly necessary. All the producers met declared that they systematically treated their crops with chemicals. No farmer only sprays his crops when pests attack or symptoms appear.

All the farmers said they had tried all the insecticides available to them to control *P. absoluta*. Indeed, several sprays carried out during the tomato production cycle. Thus 22.22% of producers perform between 10 to 15 treatments, 33.33% apply 20 to 25 phytosanitary treatments and 33.33% perform between 30 and 35 sprays. Only 11.12% of market gardeners treat their tomato crops 40 times.

This repeated use of pesticides explains their current relative ineffectiveness. This would result in a lack of knowledge of the appropriate pesticide to use depending on the pest, but also in the acquisition of resistance by bio-aggressors to pesticides.

Indeed, this invasive pest is not easy to fight, given its high reproductive capacity, its food strategy and its proven resistance to several molecules. Thus, several cases of abandonment of production plots following attacks by *P. absoluta*.

We find that most producers cannot respect recommended doses (62.22%), pre-harvest times (82.22%). This situation leads to disastrous consequences including treatment failures, the development of resistant populations, human and animal poisoning, and environmental pollution.

4-7. Investigation challenges

The realization of this study was not as simple as one imagined. We found several difficulties but they did not influence our desire to

4-3. State of knowledge of producers on *P. absoluta*:

Given the extent of its damage caused in the field and in greenhouses, all the producers surveyed know how to identify *P. absoluta* and are able to describe the symptoms it causes on the different organs of the plant.

4-4. Damage caused by *P. absoluta*:

Damage caused by *P. absoluta* encountered during all stages of crop development. However, the damage observed on all the aerial part of the plants, namely: the leaves, the stems and the fruits. The majority of these producers not trained in the recognition of pests, in particular insects. They recognize them by habit or knowledge transmitted from generation to generation.

4-5. Damage estimate:

The damage caused by *P. absoluta* on tomato crops is significant in production areas where 53.33% of producers estimate that between 25 and 50% of the vegetation in their field destroyed by this pest from the first tomato harvest. A degree of severity lower than 25% reached for 26.67% of the farmers. While 15.56% of market gardeners claim production losses between 50 and 75%, and 4.44% of growers claim that, the larvae of this insect can cause damage between 75 and 100%.

This disparity in severity estimated by farmers could be explain by the climatic conditions of the production areas as well as the effectiveness of the main molecules used. On the other hand, the alternation of pesticides with different modes of action and the use of good phytosanitary practices by producers.

During our study, 57.78% of the producers affirm that they could not sell the tomato fruits attacked by *P. absoluta*, on the other hand 42.22% of the farmers report their sale of the infected fruits but with low prices intended for tomato processing factories. .

4-6. Phytosanitary protection measures:

All-farmers surveyed have never received training in crop protection. Indeed, the main sources of information for farmers regarding phytosanitary protection measures are:

- Their personal experience, enhanced by that of their elders, their neighbor, other farmers, this being for 48.89% of the farmers surveyed;
- Engineers from agricultural input companies who contribute to informing farmers up to 46.67%;
- Agriculture services (INPV) also corresponding to 4.44%.

4-6-1. Phytosanitary practices to control *P. absoluta*: To counter the action of pests, different methods are used by producers, whether cultural practices or the use of pesticides. The results of our survey reveal that the cultural practices adopted by the market gardeners of Mostaganem are:

- Crop rotation with other speculations (37.78%);

carry out this work. Among these, we cite:

- Farmers do not count their productions. In general, the farmer calculates the overall sales per greenhouse and does not count the production and the quantity produced;
- Their statements regarding the purchase prices of raw materials are not supported by invoices or other documents;
- The difficulty of obtaining information on costs and communicating with farmers on some sensitive aspects (profitability, selling price, etc.);
- The unavailability of farmers in some cases at the level of their farms.

4. Conclusion

The tomato occupies a very important place in the market gardening sector in Mostaganem. Good practices make it possible to grow a healthy crop as well as to obtain a sufficiently constant yield.

P. absoluta is a microlepidopteran that attacks tomato crops. Thanks to the survey carried out with 45 producers in different municipalities of Mostaganem, we have assessed the impact of this pest on tomato cultivation.

This pest attacks tomato crops during all their stages of development and causes various damage to different parts of the plant. In addition, peppers and eggplants are the two crops most attacked after tomatoes by this insect and its damage noted by the majority of producers.

Most growers produce tomatoes on areas between one to 5ha. All have demonstrated knowledge of *P. absoluta* and can describe its symptoms. On average, producers estimate that this miner causes them to suffer yield losses of between 25 and 50%.

To fight against pests in their crops, all market gardeners encountered use plant protection products. In total, 08 insecticide cited by market gardeners, including lambda-cyhalothrin, spinosad, abamectin, emamectin benzoate, proact, chlorantraniliprole, cypermethrin, deltamethrin.

The agroecological methods practiced by the market gardeners encountered are limited to crop rotation, crop association and the collection of attacked fruits or organs. The resistance of the populations is such that many producers abandon plots because of uncontrollable infestations. Alternative methods are sometimes used: destruction of infested plants, crop rotation, weeding, crop association, installation of mulch and installation of insect-proof.

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