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Evaluation of the Insecticidal Effect of the Essential Oil of *Cinnamomum zeylanicum* Against *Tuta absoluta* (Meyrick)

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ABSTRACT: The objectives of this study were to propose alternative solutions based on the use of natural products "bio-insecticide" to fight the tomato leafminer, *Tuta absoluta* (Meyrick). To achieve this objective, we evaluated the toxicity of essential oil of *Cinnamomum zeylanicum* against larvae of *Tuta absoluta*.

Bioassays were performed in the laboratory in Petri dishes of 90 mm diameter, at an average temperature of 26 ± 2 ° C, and a relative humidity of 60 to 70%. According to the method of Finney, the doses of 0.054µl/cm² of the essential oil of *Cinnamomum zeyanicum* were able to induce 100% of Larvae mortality within four hours of exposure. Moreover, the dose of 0,023µl/cm² is the LD50 of the essential oil that was able to induce 50% mortality of insects within four hours of exposure. 96.25% of repellency of larvae was induced by 0.0785µl/Cm² of the essential oil, whereas the dose of 0,0098µl / cm² induces only 52.50% of repellency of *Tuta absoluta* larvae, with an average of 73.12%.

This study shows a potential repellent and insecticidal effect of essential oil of *Cinnamomum zeylanicum* against *Tuta asoluta* larvae on filter paper.

KEYWORDS: *Cinnamomum zeylanicum*, *Tuta absoluta*, repellent effect, insecticidal activity.

I.INTRODUCTION

Tomato, *Lycopersicon esculentum* Mill is a vegetable crop of a large importance throughout the world. Its annual production accounts for 107 million tons in which fresh market tomato represents 72 % of the whole [1].

The tomato leafminer *Tuta absoluta* (Meyrick) (*Lepidoptera: Gelechiidae*) is a devastating pest of tomato which originates from South America. After its early detection in eastern Spain in 2006, it rapidly invaded various other European countries and spread throughout the Mediterranean basin (Fig.1). If no control measures are taken, then the pest can cause up to 80–100% of yield losses in tomato crops as in recently invaded areas and may pose a threat to both greenhouse and open-field tomato production [2].

Although *Tuta absoluta* prefers tomato, it can also feed, develop and reproduce on other cultivated Solanaceae such as eggplant (*Solanum melongena L.*), potato (*S. tuberosumL.*), sweet pepper (*S. muricatum L.*) and tobacco (*Nicotiana tabacum L.*) [3];[4].

The management of Tuta absoluta is largely based on prophylactic measures in its early detection by the sex pheromone traps, and the use of insecticides are techniques often used [5]. Due to the negative aspects of insecticide use, many researchers have been considering alternative ways to control this pest and, since 1991, significant progress has been made in controlling this pest biologically [6].

The objectives of this study were to propose alternative solutions based on the use of natural products "bio-insecticide" to fight the tomato leafminer, *Tuta absoluta (Meyrick)*. To achieve this objective, we evaluated the toxicity of essential oil of *Cinnamomum zeylanicum* against larvae of *Tuta absoluta*.

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(a) (b)

Fig.1: The fresh leaves of tomatoes (a) after 12 hours of exposure to the larvae of *Tuta absoluta* (b) in laboratory.

II.MATERIALS AND METHODS

1. Essential oil extraction

100 g of *Cinnamomum zeylanicum* were subjected to hydro-distillation using a Clevenger apparatus over 4 h. The obtained oils were separated from water by decantation, dried over anhydrous sodium sulphate (Na2SO4) and yield percentage was calculated as volume of essential oil per 100 g of plant dry matter weight. The extracted oils were stored at 4 °C in the dark until their analyses.

2. preparation of solutions

Several preliminary tests were carried out to select the dose to be used. Thus, different doses of the essential oil of *Cinnamomum zeylanicum* were prepared by diluting 2 ml of acetone in the essential oil of 10µl volume and then a ½-based cascade dilution was performed in vials, each containing 1 ml of acetone to obtain a range of doses between 5µl and 0,625µl.

3. Insects

In order to obtain a uniform and a sufficient population of *Tuta absoluta* larvae for various biological tests, mass breeding was done with larvae collected from the plots affected by the pest *Tuta absoluta* in the area M'nasra in the region of "Gharb-Chrarda-Beni Hsen".

The breeding was carried out in the laboratory on fresh tomato leaves at a temperature of 26 ± 2 ° C, with relative humidity ranging from 60 to 70% and a photoperiod of 16/8.

4. Bioassays

Bioassays were performed in the laboratory in 90 mm diameter of Petri dishes at an average temperature of 26 ± 2 ° C and a relative humidity of 60 to 70%.

4.1. Contact toxicity on filter paper

A Whatman filter paper n° 1 (9cm dia.) was placed in a glass Petri dish. 1 ml of various concentrations was prepared beforehand in acetone and was applied to the paper discs filter. The acetone was allowed to evaporate for 10 min prior to the introduction of 20 larvae of *Tuta absoluta* separately into each dish. Each treatment was replicated 4 times. Insect mortalities were recorded after 4 h [7]. Insects were presumed dead if they remained immobile after 10 minute of recovery period. The insect mortality percentage was calculated using the Abbott correction formula for natural mortality in untreated controls [8].

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The method of **Finney in 1971** [9] based on the regression of probit mortality as a function of the logarithms of the doses of essential oil allows the determination of the LD50. Statistical analysis was performed via a BioStat Pro 5.9.8 software.

4.2. Repellency bioassay

The area preference test described by **Mc.Donald and al. (1970)** [10] was used to evaluate the repellent action of essential oil tested against the larvae of *Tuta absoluta*. Test areas are consisted of Whatman filter papers n° 1 (9 cm) cut in half. 0,5ml of each of various concentrations prepared beforehand in acetone was applied to a half filter paper disc as uniformly as possible with a pipette. The other filter paper halves were treated with acetone alone. The treated chemical and the controlled half discs were air-dried to evaporate the solvent completely. Full discs were then remade by attaching treated halves to untreated halves of the same dimensions with sellotape. Each filter paper was placed in a Petri dish and 20 larvae of *Tuta absoluta* were released separately at the centre of each filter paper disc and then covered. Each treatment was replicated 4 times. The number of insects presented in the treated (NT) and control (No) areas were recorded after 4 hours of exposure.

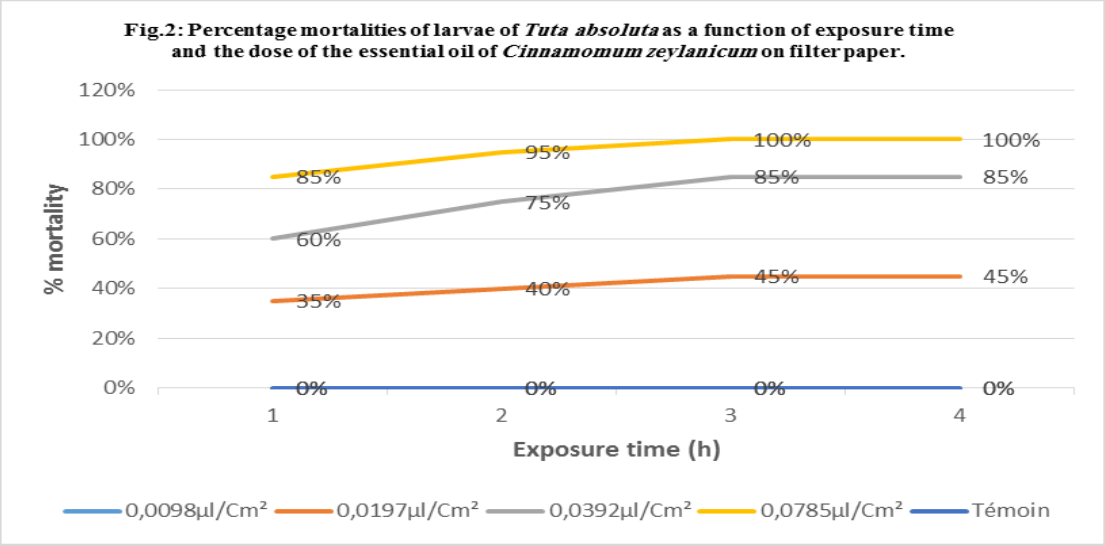
The repellency percentage % (PR) values were calculated as follows:

$$PR = \frac{Nc-Nt}{Nc+Nt} \times 100$$

The effect of concentration on repellency was represented graphically. The repellency values average were assigned to repellency classes from O to V, where O<0.1; class 1 = 0.1-20; class II = 20.1-40; class II = 40.1-60; class IV = 60.1-80; class V = 80.1-100 % repellency [11];[12].

III. RESULTS AND DISCUSSION

The mortalities' percentage of *Tuta absoluta* larvae after 4 hours of exposure to increasing dosages of essential oils from *Cinnamomum zeylanicum* on filter paper discs are shown in Fig. 2.



Mortality of *Tuta absoluta* was nil at low concentrations of the essential oil of *Cinnamomum zeylanicum* (0.0098µl/Cm²) during the first four hours after treatment.

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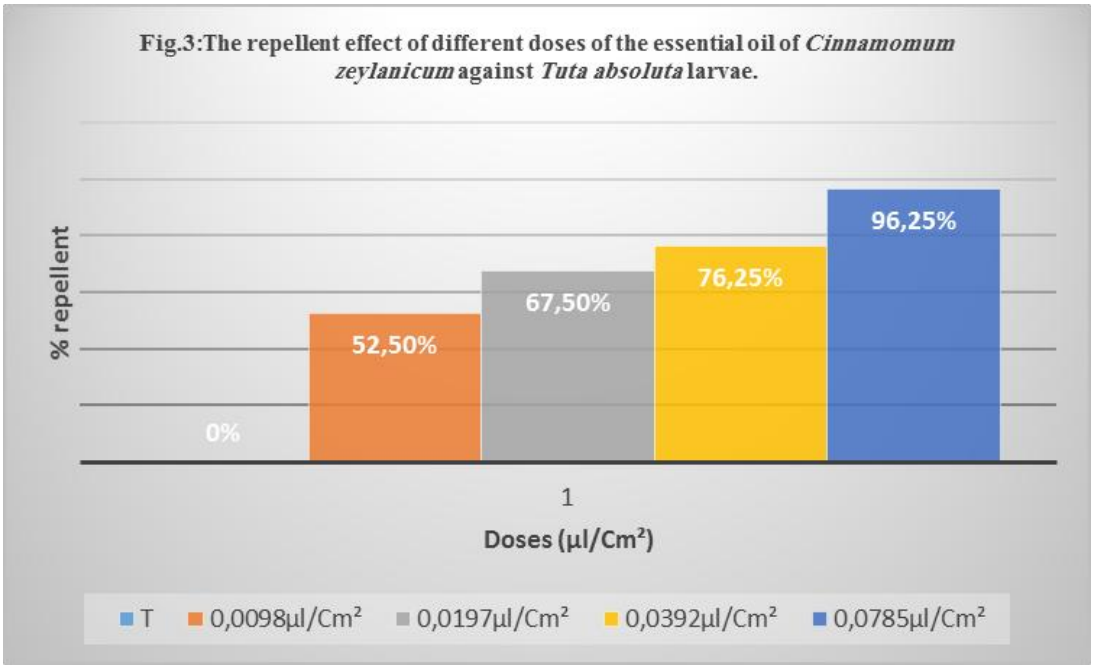
According to the method of Finney, the doses of 0.054µl/cm² of the essential oil of *Cinnamomum zeyanicum* were able to induce 100% mortality of larvae within four hours of exposure. However, the dose of 0,023µl/cm² is the LD_{50} of the essential oil that was able to induce 50% of mortality of insects within four hours of exposure.

Fig.3 gives the repellency average values for each dose of the essential oil of *Cinnamomum zeylanicum* against *Tuta absoluta* larvae. The reported repellency values in Fig.3 are the results of average of the values obtained in the four repetitions.

There was a considerable variation in the repellent effects in view of the different doses of the essential oil of *Cinnamomum zeylanicum* against *Tuta absoluta* larvae. 96.25% of repellency of larvae was induced by 0.0785µl/Cm² of the essential oil whereas the dose of 0.0098µl / cm² induced only 52.50% of repellency of *Tuta absoluta* larvae, with an average rate of 73.12%. According to the classification of Mc.Donalds et al. (1970), the essential oil of *Cinnamomum zeylanicum* against *Tuta absoluta* larvae is classified in class IV.

This shows a potential repellent effect of essential oil of *Cinnamomum zeylanicum* against *Tuta asoluta* larvae on filter paper.



The volatile nature of the constituents of essential oils leads us to believe that the active ingredient would probably be one volatile component contained in the essential oil. Insecticidal and repellent effects of this essential oil may depend on its chemical composition and level of insect sensitivity [13].

Studies have shown that the essential oil of *Cinnamomum zeylanicum* is mainly composed of cinnamaldehyde [14]. Some American companies have recently taken advantage of this situation and have been able to bring essential oil based on cinnamon pesticides to market, with cinnamaldehyde as the active ingredient [15]. However, it would be difficult to think that the insecticidal activity of this oil is limited only to some of its major constituents; it could also be due to certain minor constituents or to a synergistic effect of several components [16].

A further detailed study of the active ingredients responsible for the insecticidal activity from Cinnamon essential oil may create opportunities for the development of an environmentally safe botanical insecticide for the control of *Tuta absoluta* larvae at different stages of their life cycle.

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IV.CONCLUSION

In conclusion, this study reveals that the essential oil of *Cinnamomum zeylanicum* has potential insecticidal and repellent properties against *Tuta absoluta* larvae in laboratory. This is why further evaluations of the efficacy of Cinnamon essential oil on wild populations of *Tuta absoluta* larvae in field trials must be performed.

REFERENCES

1. FAO, "Production year book", FAO. Italy, Vol. 54, 2000
2. Desneux N., Wajnberg E., Wyckhuys K. A. G., Burgio G., Arpaia S. C. A., Narváez-Vasquez, González-Cabrera J., Ruescas D. C., Tabone E., Frandon J., Pizzol J., Poncet C., "Biological invasion of European tomato crops by Tuta absoluta : ecology, geographic expansion and prospects for biological control", Journal of Pest Science.August, Vol.83, Issue 3, pp: 197-215, 2010
3. Hector vargas C., "Observaciones sobre la biología y enemigos naturales de la polilla del tomate, Gnorimoschema absoluta. (Meyrick). (Lep. Gelechiidae)", Idesia Depto. Agricultura, Universidad del Norte-Arica. Agosto, N° 1, 1970
4. Roberto Campos G., "Control químico del "minador de hojas y tallos de la papa" (Scrobipalpula absoluta Meyrick) en el valle de cañete "., Revista Peruana de Entomología. Vol. 19, n° 1, 1976
5. Marcelo Dante Collavino; Rosana Alejandra Giménez., "Efecto del imidacloprid en el control de la polilla del tomate (Tuta absoluta Meyrick) efficacy of imidacloprid to control the tomato borer (Tuta absoluta Meyrick) ". IDESIA (Chile) Enero - Abril , Vol.26, n°1, pp.65-72, 2008
6. Marchiori, C. H., Silva, C. G. and Lobo, A. P., "Parasitoids of *Tuta absoluta* (Meyrick, 1917) (Lepidoptera: gelechiidae) collected ontomato plants in lavras, state of minas gerais", Brazil. Braz. J. Biol., 64(3A), pp.551-552, 2004
7. Tapondjou L.A., Alder C., Fontem D.A., Bouda H. & Reichmuth C., "Bioactivities of cymol and essential oils of Cupressus sempervirens and Eucalyptus saligna against Sitophilus zeamais Motschulsky and Tribolium confusum du Val". Journal of Stored Products Research, Vol.41, pp.91-102, 2005
8. Abbott W.S., "A method of computing the effectiveness of an insecticide". Journal of Economic Entomology, Vol.18, pp.265-267, 1925
9. Finney D.J., "Statistical Methods in Biological Assay", 2nd edition. London: Griffin, pp.333, 1971
10. McDonald L.L., Guy R.H. & Speirs R.D., "Preliminary evaluation of new candidate materials as toxicants, repellents and attractants againts stored product insects". Marketing Res. Rep. n° 882. Washington: Agric. Res. Service, US. Dept of Agric., pp.183, 1970
11. Obeng-Ofori D., Reichmuth C.H., Bekele J. & Hassanali A., "Biological activity of 1,8-cineole, a major component of essential oil of Ocimum kenyense (Ayobangira) against stored product beetles". Journal of Applied Entomology, Vol.121, pp.237-243, 1997
12. Ojimelukwe P.C. and Adler C.,"Potential of Zimtaldehyde, 4-Allyl-anisol, Linalool, Terpineol and other Phytochemicals for the Control of the Confused Flour Beetle (Tribolium confusum J. d. V.) (Col., Tenebrionidae)", J. Pest Science, Vol.72, pp.81-86, 1999
13. Casida J.H., "Pesticide mode of action, evidence for implications of a finite number of biochemical targets". In: Casida J.E. (ed.). Pesticides and alternatives. Innovative chemical and Biological Approaches to Pest Control. Amsterdam: Elsevier, pp. 11-22, 1990
14. Yehouenou Boniface, Sessou Philippe, Houinsou Rose de Lima1, Noudogbessi Jean Pierre1, Alitonou Guy Alain1, Toukourou Fatiou, Sohounhloue Dominique, "Chemical composition and Antimicrobial activities of *Cinnamomum zeylanicum* Blume dry Leaves essential oil against Food-borne Pathogens and Adulterated Microorganisms", International Research Journal of Biological Sciences. Vol. 1, n°.6, pp.18-25, 2012
15. Arun K. Tripathi, Shikha Upadhyay, Mantu Bhuiyan and P. R. Bhattacharya, "A review on prospects of essential oils as biopesticide in insect-pest management", Journal of Pharmacognosy and Phytotherapy Vol.1, n°.5, pp. 052-063, 2009
16. Agnès F. N., Tapondjou1 A.L., Tendonkeng F., Tchouanguep F. M., " Evaluation des propriétés insecticides des feuilles de Callistemon viminalis (Myrtaceae) contre les adultes d'Acanthoscelides obtectus (Say) (Coleoptera; Bruchidae) ", TROPICULTURA, Vol.27, n°.3, pp.137-143, 2009