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Fumigant potential of essential oils from *Laurus nobilis* (Lauraceae) against the date moth *Ectomyelois ceratoniae* (Pyralidae) †

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Abstract: This work aims to search new management alternatives to manage the date moth *Ectomyelois ceratoniae*. Thus, fumigant potential of the extracted essential oils of *Laurus nobilis* leaves was tested against fifth instar larvae for various storage periods. Moreover, a reference treatment using Phosphorus hydride (Phosphine®) was accomplished. The impact of essential oils on the physical, biochemical and organoleptic properties were determined on dates treated and stored for three storage periods (7, 15 and 30 days). Results showed that laurel essential oils exhibited an interesting fumigant larvicidal activity. Respective LC_{50} and TL_{50} values were 750.4 µL liter−1 air and 33.8 days.

Keywords: Ectomyelois ceratoniae; Laurus nobilis; essential oil; dates

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1. Introduction

Laurel, *Laurus nobilis L.*, is an evergreen tree or shrub which belong to Lauraceae family, from the south parts of Europe specially the Mediterranean area. Moreover *Laurus nobilis L.* is widely cultivated in several countries. Taking the example of Tunisia, it grows near rivers, on mountains and on damp cliffs. It also presente in the humid and sub-humid bioclimatic areas, especially in the region of Ain Draham, Tabarka and Cap-Bon [1]. Essential oils extracted from the leaves of *Laurus nobilis* is important for many reasons; taken the exemple of its medicinal uses to treat neurological diseases [2,3]. Several studies reported that essential oils of *Laurus nobilis* leaves has many biological activities [8] such as antimicrobial and antioxidant activity [4, 5, 6] antifungal [4] anticancer [9] and insecticidal activities [10,11]. It can also be used in the soap and perfume industries [7]. Further studies have make inquiries about the insecticidal toxicity of *L. nobilis* essential oil against several insect pests including *Lasioderma serricorne* [10], *Tribolium castaneum* [11] and *Rhyzopertha dominica* [12]. Salehi et al [13] reported the repulsive effect of *L. nobilis* essential oil towards the adult stage of *Ephestia kuehniella* Zeller. On the other hand, Ectomyelois ceratoniae (Pyralidae), is the most important phytosanitary problem which has dangerous consequences on Tunisian production and industry. This is reflected by the infestation of the harvestable crop which can attend 20% annually [**14**]. Post-harvest control is mainly done through the use of synthetic fumigants [15,16]. However, problems related to residual toxicity, adverse effects on non-target organisms as well as human health prevent successful pest control. As well insect resistance problems pose a major problem. [15, 17]. To this reasons, the research on effective alternative methods is necessary . Nowadays, many researchers turn to the use of plant extracts such as essential oils as alternatives to the use of pesticides [18]. To this end this paper aims to: investigate the insecticidal potential of

Laurus nobilis leaves essential oils collected from Rafraf (Bizerte, North Tunisia) against fifth instar larvae of *Ectomyelois ceratoniae* (Pyralidae)

2. Materials and methods

2.1. Plant material collected

Leaves of cultivated *Laurus nobilis* plants were collected from the North of Tunisia: Rafraf (Bizerte). The harvest was made during the two months of October 2020 and November 2020. Leaves have been dried away from sun and rain for about two weeks.

2.2. Methode used to obtained essential oils

The extraction of essential oils were carried out using a modified Clevenger-type apparatus for 3h to 4h (100 g of dried leaves in ½ L of distilled water). Essential oils were kept in the refrigerator away from light in glass tubes. Yields were calculated according to the dry weight of the leaves over three repititions.

2.3. Collection of infested dates

In order to collect *E. ceratoniae* fifth instar larvae (L5), infested dates were collected from different regions of southern Tunisia such as Sagdoud (Gafsa), Dhafria (Tozeur), Mrah Lahwar, Nefta (Tozeur) and Om somaa (Kebili).

2.4. Fumigant bioassays

2.4.1. Larval mortality rate

Evaluation of fumigant toxicity of extracted essential oils from *Laurus nobilis* leaves was carried out as follows, whatman filter papers were impregnated with different oil concentrations: 60, 120, 180, 240 µL. The already soaked filter paper was then tied to the screw caps of a 1 L glas bottle. Each bottle containing 20 unsexed larvae were closed immediately (each date contains a larva L5). In order to ensure credibility of experiences, treatments and controls was repeated three times. Fifth instar mortality rate was observed after 1week , twoo weeks and one month. The corrected death rate was calculated using Abbott's formula [19].

2.4.2. Lethal median concentration (LC_{50})

To determine (LC_{50}) for the fifth instar larvae, we assess the mortality rate by direct observation after two weeks of exposure using different concentrations (60, 120,180 and 240 µL /L air). Data were analyzed using Probit analysis method [20].

2.4.3. Median Lethal time

The median lethal effective times (LT50 values) that provoke 50% mortality of tested insects at the differents concentrations(60, 120,180 and 240 µL /L air) were analyzed using Finney's method [20].

3. Results

3.1. Essential oils yields

Results showed that the EO yield was 0.5% ± 0.01%.

3.2. Fumigant toxicity

3.2.1. Larval mortality

Results related to larval mortality assessment were designed in Figure 1. Results revealed that larvicidal toxicity varied according to the oil concentration (60, 120,180 and 240 µL /L air) and exposure time(one week, two weeks and one month). Essential oils were showed an important toxicity against *Ectomyelois ceratoniae* fifth-instar larvae. Starting with the lowest concentration (60 µL liter−1 air), larval mortality was 14.3%, 21.4% and 37% after 7, 15 and 30 days of exposure. Furthermore, the highest concentration (240 µL liter−1 air) essential oils of *Laurus nobilis* induced 17.9%, 28.6%, and 44.4% after 7, 15

and 30 days of exposure respectively. In all cases results showed that, *Laurus nobilis (Lauraceae)* essential oil extracted from leaves exhibited very interesting insecticidal fumigant activity against *E. ceratoniae* larvae. In addition, Probit analysis revealed that the respective LC_{50} and LC_{95} values after 15 days of exposure were 750.370 µL liter−1 air and 2210,297 µL liter−1 air . LT_{50} and LT_{95} values confirmed that *Laurus nobilis (Lauraceae)* essential oil is toxic; the values were represented in table 1.

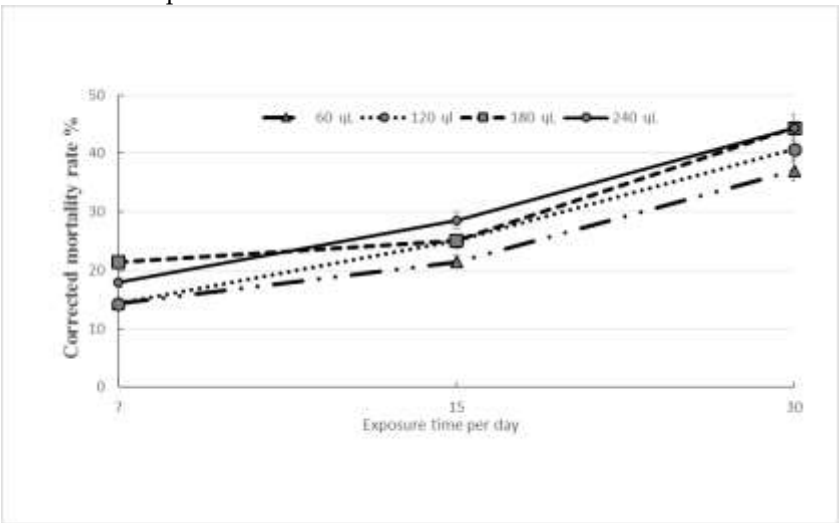

Figure 1. Mortality rate (%) of *Ectomyelois ceratoniae* fifth-instar larvae exposed for various periods of time (7 days, 15 days and 30 days) to different concentrations of the essential oils from *Laurus nobilis* (60, 120,180. and 240 µL /L air)

Table 1. LT_{50} calculated for *Ectomyelois ceratoniae* fifth-instar larvae exposed to *Laurus Nobilis* essential oils from Bizerte (Rafraf).

Concentration (uL/L air)	TL_{50} (days)	TL_{95} (days)	Slope±SEM	degree of freedoom	χ^2
60	40.306 (31.898-64.43)	92.09 (66.77- 170.107)	0.32±0.008	1	0.012
120	36.195 (29.481-52.622)	83.473 (62.55-140.452)	0.035±0.008	1	0.348
180	35.430 (28.12-56.199)	91.014 (65.454-173.668)	0.030±0.008	1	0.414
240	33.763 (27.43-49.345)	83.75 (62.186-144.712)	0.033±0.008	1	0.241

3. Discussion

This study presents an inquiry on insecticidal activity of extracted essential oils from *Laurus nobilis* leaves. Previous reseraches revealed that *Laurus nobilis* essential oil had a very important insecticidal potential against several family pf insectes and that this bioactivity is depend on the chemical composition [10, 11]. In this regards, several works are devoted to the study of the insecticidal propriety of essential oils of various plant material against the deferent stages of development of *Ectomyelois ceratoniae*. Indeed, Amri et al [21], prove that *Thymus capitatus* and *Rosmarinus officinalis* essential oils can inhibit the hatching of eggs with a rate of 100% after 24 hours of treatment. Amri et al [21] showed the toxicity of *R. officinalis* essential oil against the deferent stages of development of *E. ceratoniae*. Moreover, Mahmoudvand et al [22] demonstrated that *Plodia interpunctella* lar-

vae were sensitive to this oil. Besides, Batish et al [18] showed that the bioactivity of several essential oil can depends on the nature, type and different concentrations levels of its constituents.

.4.Conclusion

This investigation revealed that Tunisian *Laurus nobilis* essential oils could be used as plant based insecticides alternative to improve dates safety during storage. However, studies are needed to reveal impact of the use of such alternative treatment on the stored date in particular on physical, biochemical and organoleptic properties.

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