# Toxicity of Two Extracted Destruxin Against *Palpita unionalis* (Lepidoptera: Crambidae) under Laboratory and Field Conditions

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ABSTRACT

Olive trees are subjected to attack by many insect pest species that affect yield quality and quantity. Among the most common olive pest species surveyed in Egypt is *Palpita unionalis*. The fungus, *Metarhizium anisopliae* (Metschnikoff) Sorokin produces some cyclic peptide toxins, destruxins, Destruxin which may play a role in its pathogenicity in insect pests and decreases the infestations of many harmful pests. The present study aimed to evaluate the efficacy of this two solated Destruxin (Destruxin A-760 and Destruxin A- 724) against *P. unionalis* under laboratory and field conditions. The results obtained showed that the $LC_{50}$ of Destruxin A-760 on the third larval instars was 151 ppm. However, when Destruxin A- 724 was applied on the target pest, the $LC_{50}$ reached to 185 ppm. Under field conditions, both isolated Destruxin declined the rate of infestation by *P. unionalis* with the least infestation in case of treatment with Destruxin A- 724 compared to untreated olive trees. The yield of harvested olive fruits increased due to treatment with isolated Destruxin the highest yield in case of trees treated with Destruxin A-760.

***Keywords:*** *P. unionalis, Destruxin A- 724, Destruxin A-760 Toxicity.*
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## 1. INTRODUCTION

*Palpita unionalis* , is one of the most important pests of olive nurseries and olive orchards. Ti is also very important in modern olive plantations in Egypt and also in the other Mediterrean country Basin generally. In Olive has become one of the important economical crops in Egypt (Esmat *et al*., 2012). Their cultivated areas have been expanded largely in the last decade, particularly in new reclaimed arid areas (Western side of the Nile) reaching 49000 hectares in 2010 with productivity of 6327 Kg/ hectare. Olive trees are subjected to attack by many insect pests that affect yield quality and quantity (Esmat *et al*., 2012).

*Metarhizium* spp. produce a wide array of small molecules including destruxins (DTXs), cyclic and plant pathogens. The effects of DTXs on insects include: tetanic paralysis, inhibition of DNA and RNA synthesis in insect cell lines, inhibition of Malpighian tubule fluid secretion, blocking $H^+$ ATPase activity (James *et al*., 1993) and Muroi *et al*. (1994) and suppression of insect defense responses. DTXs also have antifeedant and repellent properties. The insecticidal potential of these toxins has been confirmed in numerous reports of acute toxicity . The fungus, *Metarhizium anisopliae* (Metschnikoff) Sorokin produces some cyclic peptide toxins, destruxins, which may play a role in its pathogenicity of insects and causes a paralysis, and eventually death. Destruxin is widely used for controlling agricultural insect pests; it can be applied by injection of soil and trees, applied on plant surface, foliar broadcasting, ground application as a granular or liquid formulation, or as a pesticide-coated seed treatment. Additionally, it is applied to foundations to prevent termite damage, to control pest gardens, to treat domestic pets for flea control, and to protect trees from boring insects (James *et al*., 1993; Muroi *et al*., 1994).

Nanotechnology is a promising field of interdisciplinary research. It opens up a wide array of opportunities in various fields like insecticides, pharmaceuticals, electronics and agriculture. The potential uses and benefits of nanotechnology are enormous. These include management of insect pests through the formulations of nanomaterials-based insecticides. Traditional strategies like integrated pest management used in agriculture are insufficient, and application of chemical pesticides have adverse effects on animals and human beings apart from the decline in soil fertility (Sparks *et al*., 2012). Therefore, nanotechnology would provide green and efficient alternatives for the management of insect pests in agriculture without harming the nature.

Therefore, the present study aimed to evaluate the efficacy of Destruxin against *Palpita unionalis* under laboratory and field conditions.

## 2. MATERIALS AND METHODS

### 2.1. Biological Material

Olive leaf moth larvae were obtained from infested olive orchards in (El-Esraa farm ) Nobaryia regions during 2015 and 2016 season. Egypt. They were reared for about 10 generations on olive leaves, Oleae europaea (Yılmaz and Genç, 2012) at 24 ± 1 °C, 65% RH and 16:8 h L:D in the growth chamber. The adults were fed a 10% honey solution. The eggs were collected daily and placed in a sealed petri dish for 3-4 days before hatching. Neonates from these eggs were used throughout this study

Destruxin was prepared according to Guan *et al*. (2008). Six aqueous concentrations of Destruxin were prepared: 2.000, 1.500, 0.750, 1.000, 0.500, 0.250, 0.125 ppm. Olive leaves were dipped in each concentration for 10 seconds and left to dry at room temperature. Treated leaves were offered to third larval instars (20 flies /concentration). A parallel control of non-treated insects fed on olive leaves dipped in distilled water was run. Each treatment was replicated five times. The percentage of mortality was recorded after seven days of treatment and corrected against that of the control according to Abbott's formula (Abbott, 1925). Corrected mortality was

subjected to probit analysis (Finney, 1971) to estimate the $LC_{50}$ value. All experiments were run under laboratory conditions mentioned above.

### 2.2. Field Experiments

Field experiments were carried out at El Esraa farm (Nobaria )during two successive seasons 2015,2016 starting from the first of July to end of August. Three random patches of olive trees were selected; each consisted of 12 trees for Destruxin A- 724 application, 12 trees for Destruxin A-760 application and 12 trees for control. Both two isolated -Destruxin (Destruxin A-760 and Destruxin A- 724 ) were applied at the rate of 2.00 and 0.12 ppm, respectively. Three applications were made at one week interval at the commencement of the experiment. Treatments were performed at sunset using a ten liter sprayer. Percentage of infestation/sample was calculated after 20, 50, 90 and 120 days of application. Each treatment was replicated four times. Four plots were treated with water and used as control. Random samples of olive leaves and fruits were weekly collected from each treatment and transferred to laboratory for examination. The infestation percentage of *P. unionalis* was estimated in each case. After harvesting olive fruits, the yield of each treatment was weighed and expressed as Kg/Feddan.

### 2.3. Statistical Analysis

Data were statistically analyzed by *F*-test; LSD value was estimated, using SPSS statistical program software.

## 3. RESULTS AND DISCUSSION

Table 1 show that Destruxin A-760 toxic by 1.2 than Destruxin A- 724aginst the 3rd larval nstar of *P. unionalis* the LC50 recorded 185 and 151 ppm for both tested Destruxin , respectively., the sam finding recorded by Sabbour (2013;2015a;2015b). The $LC_{50}$ of Destruxin tested against the olive pests, *Ceratitis capitata* and *Pryas oleae*, were 221 and 200 mg/L, respectively (Sabbour, 2015a).

Field studies revealed that the rate of infestation of olive trees by *P. unionalis* was significantly ($P < 0.05$) declined due to treatment with Destruxin A-760 and Destruxin A- 724 compared to control insects with the least infestation in case of treatment with extracted nano-Destruxin at (El-Esraa farm ) Nobaryia regions during 2015 and 2016 season (Table 2). The least infestation was attained after 20 and 120 days of treatment with Destruxin A-760 and Destruxin A- 724, respectively. Interestingly, the infestation decreased with the increase in time after treatment with Destruxin A-760 . Similarly, Sabbour (2015a) reported that Destruxin and nano-Destruxin reduced the rate of infestation by *C. capitata* and *P. oleae* in olive trees. Again, Sabbour (2015b) recorded decreased infestation rate by potato tuber moth, *Phthorimaea operculella*, in plants treated with nano-fungi *Isaria fumosorosea* and *Metarhizium flavoviride*. Similar findings were also attained by Sabbour (2013) against *B. oleae*, *C. capitata* and *P. oleae* in olive trees treated with spinosad. Sabbour and Nayera (2017) controlled the *Bactrocera oleae* by Beauvaricin under laboratory and field conditions.

The weight of harvested olive fruits was significantly ($P < 0.05$) enhanced after treatment olive trees with Destruxin A-760 and Destruxin A- 724 at (El-Esraa farm ) Nobaryia regions during 2015 and 2016 season. compared to control trees (Table 3). Destruxin A-760 and Destruxin A- 724 increased the crop yield by about 1.9 and 1.8 fold relative to control, respectively (El-Esraa farm ) Nobaryia regions during 2015 . Also the corresponding treatments increased by 2.1 and 2 to control during 2016 season such increase was in case of treatment with Destruxin A-760 and Destruxin A- 724, respectively. These results are in consistence with those obtained by Sabbour (2015a) for olive trees treated with Destruxin and nano-Destruxin and infested by *C. capitata* and *P. oleae*. Also, treatment of potato plants, infested by *P. operculella*, with nano-fungi *I. fumosorosea* and *M.*

*flavoviride* increased the yield (Sabbour, 2015b). Similar results were obtained by Sabbour (2013) for spinosad-treated olive trees that were infested by *B. oleae*, *C. capitata* and *P. oleae*. Sabbour (2017) found that the olive weight increased after bioinscticid applications.

In conclusion, isolated two Destruxin tested (Destruxin A-760 and Destruxin A- 724 ) causing a protection to olive trees against *P. unionalis* under laboratory and field conditions.

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**Table-1.** Susceptibility of *P. unionalis* third larval instars to Destruxin and Destruxin A- 724 under laboratory conditions

| Treatment | $LC_{50}$ ppm | 95% Confidence limit | Slope |
|---|---|---|---|
| Destruxin A-760 | 151.0 | 77.0 - 123.0 | 0.01 |
| Destruxin A- 724 | 185.0 | 55.0 - 101.0 | 0.02 |

**Table-2.** Infestation of olive trees by *P. unionalis* after treatment with Destruxin A-760 and Destruxin A-724under field conditions at (El-Esraa farm ) Nobaryia regions during 2015 and 2016 season.

| % of infested plants | | | |
|---|---|---|---|
| **Treatment** | Days after treatment | 2015 | 2016 |
| Control | 20 | 10 | 11 |
| | 50 | 21 | 29 |
| | 90 | 67 | 78 |
| | 120 | 99 | 99 |
| Destruxin A-760 | 20 | 2 | 3 |
| | 50 | 10 | 11 |
| | 90 | 12 | 13 |
| | 120 | 12 | 13 |
| Destruxin A- 724 | 20 | 4 | 8 |
| | 50 | 10 | 10 |
| | 90 | 33 | 39 |
| | 120 | 38 | 40 |
| *F*-test | | 33 | 30 |
| **LSD 5%** | | 79.0 | 78.0 |

**Table-3.** Weight of harvested olive fruits treated with Destruxin A-760 and Destruxin A- 724 and infested by *P. unionalis* at (El-Esraa farm ) Nobaryia regions during 2015 and 2016 season.

| Weight of yield (Kg/Feddan) | | |
|---|---|---|
| Treatment | 2015 | 2016 |
| Control | 2120.0 ± 90.72[b] | 2009.0 ± 81.50[b] |
| Destruxin A-760 | 4116.0 ± 50.11[a] | 4394.0 ± 31.14[a] |
| Destruxin A- 724 | 4001.0 ± 70.10[a] | 4190.0 ± 31.10[a] |
| *F*-test | 40.1 | 39.4 |
| **LSD (P = 0.05)** | 89 | 87 |