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Research Article

Test of biological control against datemoth *Ectomyelois ceratoniae* Zeller.(Lepidoptera, Pyralidae) by Spinosad

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Abstract

Currently, chemical control is the only means used to control populations ofthe date moth (*Ectomyeloisceratoniae*) which is the most important and dangerous pest to palm groves in Algeria, conventional insecticides act faster, but their main drawback is it can't be destroyed or degraded.In this context we conducted our work to explore the insecticidal activity of Spinosad which is a bio-pesticide on the larval stages of *Ectomyeloisceratoniae*. The study of the effect of Spinosad on the mortality of different larval stages revealed that the doses used were significantly and positively correlated with mortality adjusted for different durations of exposure of larvae bio- pesticide. Lowest corrected mortality was observed in a short time and lethal in older larvae treated with the lowest concentration. While the higher mortality was observed in a longer duration of exposure in younger instars treated with the highest concentration.

Keywords: Datepalm, Ectomyeloisceratoniae, Spinosad, Biological control, toxicology.

Introduction

In Algeria, the date palm is the mainstay of the oasis ecosystem in Saharan and pre-Saharan regions. It provides, through marketing nationally and internationally for its fruit a regular income for farmers. It plays a screen role in protecting oasis against the desert influences and creates a microclimate favoring development of underlying crops and stabilization of local populations in these ecologically fragile areas (Majourhat et al., 2002).

The date production has declined over the years by the attacks of different pests and diseases such as: Bayoud, Rot inflorescences, mites, mealy bugs and the date moth *Ectomyelois ceratonia* Zeller, this latter is a polyphagous pest whose larvae identified as economically damaging pest, it can cause considerable damage that can reach 20 to 30% of the date production (Mehaoua et al., 2013). Annually several tons of pesticides and herbicides are produced in the world,only1% of this quantity reaches the bodies mentioned and the rest resulted in organisms in the ecosystem which are not subject when it may cause serious damage to human and animal health and it can disrupt the ecosystem. Due to the catastrophic consequences of the massive application of pesticides and herbicides, scientists have been finding less harmful methods.

In this context we conducted our work to explore the toxicological activity of Spinosad on the in star larvae of *Ectomyelois ceratoniae*, which is the most important and dangerous pest of date palm in the world and particularly in Algeria.

Materials and Methods

Mass-Rearing of date moth

Our breeding was conducted with a strain of *Ectomyelois ceratoniae* from the palm grove of Biskra of the year (2013).We have put infested dates

in the breeding cage in a controlled growth chamber at temperature of 30 ± 1 °C, relative humidity (RH) of 70 ± 5% and a photoperiod of 16:8 (L:D) (Al-izzi*et al*., 1987;Mediouni and Dhouibi, 2007). At the emergence, the adults of *Ectomyelois ceratoniae* are captured using a test tube, then they are put inside the coupling jars. After mating, females will lay eggs inside the jars,eggs are discharged through a fine mesh tulle in the feeding location (flour dates, wheat bran and distilled water) in plastic boxes. After some days, the eggs hatch and we get larvae's of first stage for bio pesticide treatment. (Dridi*et al*., 2009).

Study of the toxicity of Spinosad on larvae

In Petridish containing the feeding, we applied a treatment of four doses of the Spinosad, (30 ppm, 60 ppm, 120 ppm, 240 ppm) with a witness doses; the all with three repetitions, then we've filed 20 larvae's of the first stage per box. The observations were made every 24 h for counting dead larvae.

Study of the effect of Spinosad on female fertility and eggs

Larvae that have escaped the toxic effect of biopesticide are placed in a breeding location to reach the adult stage. At adult emergence, we placed 30 couples issue from larvae's treated with Spinosad (6 couples used for each dose) and 6 couples control; each couple in a petri dish or counting eggs laid. Then there are eggs hatches after incubation.

Statistical Analysis

In the case of Spinosad measured variable corresponds to the rate of larval mortality. The mortality rate is corrected by Abbot's formula (1925). Different rates of mortality undergo an angular transformation according to the tables established by Bliss (Fisher & Yates, 1975). The transformed data are subject of analysis variance (ANOVA) with a single classification criterion. The calculation of the least significant difference (LSD) allows the classification of different concentrations used.

In order to characterize the power of insecticidal molecules used, we determined the 50% lethal dose (LD 50).The rates corrected mortality obtained are transformed into probity which permit to establish a regression line based on the logarithms decimal of the doses used. With the help of the curve we determine all doses remarkable mathematical processes according to Finney (1971). The method of Swaroop *et al*. (1966), allows the calculation of the confidence interval for the LD50.Comparison of means is performed by parametric tests. The calculations were realized by the program XLSTAT.

Results and Discussion

Study of mortality of *E. ceratoniae* larvae exposed to Spinosad

The analysis of variance of the corrected mortality of larval of first stage after 24h, 48h, 72h, 96h and 120hof exposure duration to Spinosad shows very highly significant differences between the four doses used with respectively $P<0.0001$; $P=0.0095$; $P= 0.0304$; $P=0.0003$ et $P =0.0015$(Table 1).

Our results showed that the application of four doses of Spinosad between 30 ppm and 240 ppm on the first stage larvae of the date moth caused mortality which varies between 15.00 and 97.22 % for different duration's exposure of larvae to the product. The insecticide effect of the Spinosad increases more than the duration of exposure of larvae to biopesticide increase.

The two highest concentrations of Spinosad (120 ppm and 240 ppm) resulted in the most significant mortality of larvae *E. ceratoniae*83.33 and 97.22 % respectively in lethal time long enough (120 h). While the lowest dose used (24 ppm) induced in 24 h and 48 h the lowest mortality rate with 15.00 and 30.56 % respectively (Table 1).

The analysis of the results of this bioassay, presented in Table 2. showed that they are negatively correlated to different lethal time (24h, 48h, 72h, 96h and 120h).For 24 h gives an estimated value of LC50 (117.74 ppm) and CL 90 (663.98 ppm). At 120 h, the CL50 was 22.39 ppm and 119.20 for CL90.

Study of female fertility and eggs of *E. ceratoniae*

The statistic analysis (ANOVA) of the average number of eggs laid per female and the average number of eggs hatched from *E. ceratoniae* issue from

Lots handled by five doses (30 ppm, 60 ppm, 120 ppm, 240 ppm) showed very highly significant difference with P <0.0001 (Table 3).

Table 3. show that the highest number of eggs was recorded at the female's control (without treatment), followed by females issue from treated larvae's with doses of 30 ppm, 60 ppm, 120ppm and 240 ppm. The results showed that the application of various concentrations of Spinosad on the first instar larval of *Ectomyelois ceratoniae* inhibits the development and growth of larvae and causes their death. From the observations recorded we note that mortality rates are positively correlated to the different doses used, regardless of the duration of exposure of larvae to Spinosad.

Table 1: Corrected mortality ratesof first stage larvae of *E.ceratoniae* treated with the Spinosad

Time of exposure	**Concentrations**				F	P
	30ppm	**60ppm**	**120ppm**	**240ppm**		
24 hhours	15.00±5.77	32.50±9.57	50.00±8.16	70.00±11.55	25.967	< 0.0001
48 hhours	30.56±13.65	38.06±14.15	63.89±21.29	79.17±18.93	6.047	0.0095
72 hhours	45.56±19,94	56.11±22.96	73.89±24.82	92.22±9.69	4.188	0.0304
96 hhours	43.06±14,61	53.89±6.64	27.50±14.78	94.44±11.11	13.970	0.0003
120 hhours	56.39±12.00	78.06±8.25	83.33±9.62	97.22±4.81	9.883	0.0015

Table 2.Toxicological parameters of Spinosad after 24h, 48h, 72h, 96h and 120h of time exposure.

Doses	**Control**	**30ppm**	**60ppm**	**120ppm**	**240ppm**	**d.f.**	**F**	**P**
Average number of eggs laid per female	159.67±28 .27	107.33±27,48	95.5±53,87	66.67±19.22	54.67±19.4	5	7,96	0,0001
Average rate of hatched eggs (%)	87.00±4.24	9.00±1,41	8.00±2,83	2.00±2.83	0.00±0.00	5	82,770	0.0001

Table 3.Average number of eggs laid per female and percentage of hatched eggs

Time of exposure	**Regression equation**	**R^2**	**P**	**CL50**	**CL90**	**S (Slope)**	**Lower limit of LC50**	**Upper limit of LC50**
24 h hours	**Y=1.467+1.706*X**	0.998	0.0011	117.74	663.98	3.83	87.75	157.97
48 h hours	**Y=2.230+1.503*X**	0.966	0.0169	69.66	496.22	4.59	49.90	97.25
72 h hours	**Y=2.361+1.658*X**	0.950	0.0255	39.06	231.56	3.98	28.86	52.85
96 h hours	**Y=2.018+1.863*X**	0.922	0.0396	39.87	194.34	3.42	30.46	52.18
120 h hours	**Y=2.617+1.765*X**	0.939	0.0308	22.39	119.20	3.66	16.86	29.75

Our results confirm the biological control test carried out in Tunisia in 2000 on the date palm and show that Spinosad is very effective against date moth even at a low dose (Khoualdia et al., 2002). According to (Kirst H. A., 2010) and (Thompson et al., 2000)Spinosad is an insecticide (larvicide) relatively broad spectrum registered for many cultures. It is deemed effective against larval Lepidoptera and Diptera. The effect of Spinosad through ingestion requires a longer lethal time, even with low doses it can cause total mortality of larvae. Arlaet al. (1998) state that Spinosad is 5 to 10 times more effective through ingestion than by contact.

Conclusion

For this work we have determined that Spinosad has a larvicidal activity against the *Ectomyelois ceratoniae*. The observed mortality is positively correlated with the dose and duration of exposure of larvae's to Spinosad. The calculatedLD50 is positively correlated with the duration of exposure of larvae's to the bio pesticide; it is low in a longer time-lethal and high for a short time-lethal.

We have also found that the treatment with Spinosad on the larvae of the first stage significantly reduces fertility females and eggs even at very low doses. So the Spinosad react on the development and growth of carob moth.

The obtained results show that Spinosad is promising as larvicidal against the *Ectomyelois ceratoniae*; it might be a good alternative to chemical pesticides, while preserving human health and the environment.

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