Imidaclorprid efficacy against grasshopper *Hetiracris littoralis* (Orthoptera: Acrididae)

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Abstract

Imidacloprid is a systemic insecticide which acts as an insect neurotoxin and belongs to a class of chemicals called the neonicotinoids which act on the central nervous system of insects with much lower toxicity to mammals. The effect of IMI 0ndiffernt stages of grasshoppers of *H. littoralis*, LC50 recoded, 255,298, 299 and 297 mg/L under laboratory conditions. Under semifield conditions the correspondingLC50 recorded, 133,168, 189 and 199 mg/L. The effect of IMI under semi field conditions which cleared that the infestation number of ***H. littoralis*** significantly decreased to 10±7.9 individuals after 120 days of IMI first applications as compared to 99±6.9 individuals in the controlUnder field conditions in the corn fields the number of infestations were significantly decreased to 7±2.9indiveduals as compared to 99±9.9 individuals in the control after 120 days of IMI first applications

Key wards: Nano, grasshopper, *Hetiracris littoralis Imidaclorprid* .

Introduction

Imidacloprid,(l-[(6-chloro-3-pyridinyl)methyl]-4,5-dihydro-Nnitro-1H-imidazol-2-amine (IMI), is a systemic and chloronicotinyl insecticide, that specifically blocks the microtinergic neuronal pathway. It has recently been demonstrated to be highly effective as a systemic insecticide. The grasshopper, *Heteracris littoralis* (R.) is considered one of the most harmful pests to different cultivated crops in Egypt. Its economic importance comes from attacking many cultivated crops, vegetables and even trees, feeding on it and causing great losses in quantity and quality of the attacked crop. In some cases, thousands of cultivated hectares may be attacked by the swarms of grasshoppers leaving it as a divested desert. The economic injury of *H. littoralis* in Egypt had been documented by [1, 2, 3, 4] . The development of suitable artificial diets for maintaining laboratory colonies of insects became of great importance for facilitating different investigations of the biology and behavior of insect, especially, if the green plants were not available. Till now, there is no published data about artificial rearing of *H. littoralis* in the laboratory, hence, the present research is an attempt for testing semi artificial diets with different additives in rearing *Heteracris littoralis* compared with green clover plant as a natural diet. The main aim of the present research is to evaluate the destruxin effect of on the grasshopper, *H. littoralis* under laboratory and semi-field condition for disrupting growth and development of *H. littoralis.*

MATERIALS AND MEHODS

Insect culture.

Heteracris littoralis grasshopper was reared under laboratory condition for several generations on semi-artificial diet as mentioned by [5].

Preparation of the semi-artificial diet:

The components with exception of agar were blended with water. The agar was separately dissolved in water at 100°C, cooled to 60°Cand then mixed with other blended ingredients. The diet was poured in plastic cups, leaved at room temperature for solidification and then kept in the refrigeration till using nymphal period, longevity of both males and females, pre

oviposit ion period, oviposit ion period, post oviposit ion period, fecundity of females and percent of egg hatchability besides life span of both males and females [5]

2.2 Preparation of Imidaclorprid (IMI).

Imidaclorprid were prepared according to [6]

2.3.Efficacy of imidaclorprid against the target insect pests

The insecticide imidaclorprid were tested at the 6 concentrations: 6 g, 5g ,4g,3g, 2g,1g. The insecticide, prepared 6 concentrations (prepared according [7] Percentages of 50 values was calculated throughout probit analysis [8]. The experiment was carried out under laboratory conditions at 26±2°C and 60-70% RH. 2.3.Preparation of nano- imidaclorprid Nanoparticles were synthesized by h y- drolyzing titanium tetra isopropoxide in a mixture of 1:1 anhydrous ethanol and water. 9 ml of titanium tetra isopropoxide is mixed with 41ml of anhydrous ethanol (A). 1:1 ethanol and water mixture is prepared. (B) Solution A is added in drop wise to solute ion B and stirred vigorously for 2hrs. At room temperature hydrolysis and condensation are performed, using 1M sulphuric acid and stirred for 2 hrs. Then the ageing was undertaken for 12hrs. The gel was transferred into an autoclave and tightly closed, and the mixture was subjected to hydrothermal treatment at 353K for 24hrs. After filtration the solid residue was washed thoroughly with water and ethanol mixture, dried at 373K in an oven and calcined at 773K

Field Trials:

Field trials were carried out at Nobaria region (Behera Governorate), Egypt during the two successive corn seasons 2013 and 2014 to study the effectiveness of the tested fungi IMI on corn grasshoppers. Corn (variety Giza-2) was cultivated by end of May during the two seasons in an area of about half feddan. Fungi were applied as single treatments in randomize plots. Regular agricultural practices were performed and no chemical control was used during the study period. Weeds were removed by hand. Five plots were sprayed with water as control. Samples from each treatment were collected weekly and transferred to the laboratory for investigation. Percentages of infection were estimated.

RESULTS AND DISCUSSION

Table 1, show the effect of IMI 0ndiffernt stages of grasshoppers of *H. littoralis*, LC50 recoded, 255,298, 299 and 297 mg/L under laboratory conditions.

Under semifield conditions the corresponding LC50 recorded, 133,168, 189 and 199 mg/L (Table2).

The effect of IMI under semi field conditions found in table 3 which cleared that the infestation number of *H. littoralis* significantly decreased to 10±7.9 individuals after 120 days of IMI first applications as compared to 99±6.9 individuals in the control (Table 3).

Under field conditions the infestation number were significantly decreased to 0.1±0.3, 1.4±0.6, 4±3.7 and 10±7.9 individuals in pots treated with IMI after 20, 50, 90 and 120 days after the first applications as compared to 19.2±8.9, 49±7.5, 76±9.5 and 99±6.9 individuals in the control plots (Table 4).

Figures 1 and 2show that he infestations of grasshoppers *H. littoralis* were significantly decreased during semified and field experiments. Figure 3 show the nanoparticles of the IMI Photo showed With scanning electron microscopy.

The same findings found by [9,10], who recorded Under semi-field conditions, the percentage of infestations of *H. littoralis* significantly decreased to 1.0±0.3, 3±0.1, 5±3.0 and 10±2.9 individuals after treated with nano-destruxin in 20, 50, 90 and 120 days, respectively as compared to 15.2±2.9, 39±3.5, 66±9.6 and 98±6.6 individuals in the control. Our results meet with [11,12, 13, 14, 15] who use the entomopathogenic fungi for controlling many pests.The results match with [16] who reported that under laboratory conditions results showed that the LC_{50} of *Phyllotreta cruciferaem, Pegomyia hyoscami* and

Cassida vittata of the tested fungi *Verticillium lecanii* (*V.l*), *Nomuraea rileyi* (*N.r*) and *Paecilomyces fumosoroseus* (*P.f*), respectively against the three pests ranged between $5.4x10^6$ and $1.43x10^7$ spores/ml. Satisfactory results with the entomopathogenic fungi were reported by [17, 18, 19, 20.21]. [21] as they found that the fungi; *B. bassiana* and *M. anisopliae* reduced the LC_{50} of *S. littoralis* under laboratory conditions. The obtained results are similar to other studies carried out by [22, 23].

Figure (1 & 2) show that the percentage of infestations were significantly decreased during both two seasons These results are also agree with [18,19], who proved that the application with bioinsecticides increased the yield and decreased the infestation with insect pests. Also, results were in accordance with[20] who reported that the virulence of *B. bassiana* against *C. capitata* ranged between 8 to 30% and decrease the infestation among the olive fruits. [23] recorded that *C. capitata* mortality ranged between 69 and 78% after bioinsecticides treatments.

The results were matched with [24, 25, 26,, 27], when they controlled cereal aphids with entomopathogenic fungi. They found that the infestation was reduced after fungi applications under laboratory and field conditions. [28, 29, 30, 31] found that the fungi reduced insect infestations of cabbage and tomato pests under laboratory and field conditions.

Nanoparticles [32, 33, 34] present possibilities for more efficient and effective control of pests, but our relative lack of information on how they act and how they can be contained are giving regulators pause before allowing their release into the environment. Nanopesticides hold promise for reducing the environ-mental footprint left by conventional pesticides. As EPA has noted, “these novel products may allow for more effective targeting of pests, use of smaller quantities of a pesticide, and minimizing the frequency of spray-applied surface disinfection. These could con-tribute to improved human and environmental safety and could lower pest control costs”. Nanotechnology research [34] opens up opportunities of agricultural productivity enhancement involving nanopor-ous zeolites for slow release and efficient dos-age of water and fertilizer, anocapsules for herbicide delivery and vector and pest management and nanosensors for pest detection. The atom by atom arrangement allows the manipulation of nanoparticles thus influencing their size, shape and orientation for reaction with the targeted tissues.

In this manor [4, 5, 6, 9, 10, 11] reported that, under laboratory conditions, the LC_{50}s, were significantly decreased when the adult female of grasshopper *Hetiracris littoralis* treated with nano-destruxin and reached to $153X10^4$ spores/ml. Also, Under semi-field conditions, the percentage of infestations of *H. littoralis* significantly decreased to 1.0±0.3, 3±0.1, 5±3.0 and 10±2.9 individuals after treated with nano-destruxin in 20, 50, 90 and 120 days, respectively as compared to 15.2±2.9, 39±3.5, 66±9.6 and 98±6.6 individuals in the control. Sabbour 2014,b found LC_{50}s of the locust *S. gregaria* after treatment with destruxin , $210 X 10^4$, $221 X 10^4$, $250 X 10^4$ spores/ml, of newly hatched nymphs last nymphal stage and adult stage., respectively The effect of nano-destruxin against *S. gregaria* under semi-field conditions show that after 20 days, the infestations number were significantly decreased to 2.2±1.2, as compared to 2.4±5.3, and 12.2±2.2 individuals after treated with destruxin and in the control. Sabbour, 2013 a,b reported that. Desert locust *Schistocerca gregaria* bioassayed by using the leaves containing early stages larvae and the data were recorded after 1, 2, 3 and 4 days after treatment. Results showed that range of mortality was between 84-65% based on the end point data. The minimum of three days to achieve 60% mortality was proved by probit analysis of time-mortality responses. They found That, the range of mortality was between

88-65% based on the end point data. The minimum of three days to achieve 50% mortality was proved by probit analysis of time-mortality responses.

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Table 1.Effect of IMI against the grasshopper *H. littoralis* under laboratory conditions.

stages	LC_{50} (mg/L)	Slope	Variance	95% Confidence limits
Newly hatched nymphs	255	0.01	1.3	148-287
Last nymphal stage	298	0.01	0.2	200-311
Adult ♀	299	0.01	1.1	200-381
Adult ♂	297	1.01	0.2	210-310

Table 2. Effect of IM against the desert locust *H. littoralis* under semi-field conditions.

stages	LC_{50} (mg/L)	Slope	Variance	95% Confidence limits
Newly hatched nymphs	133	0.01	1.3	101-248
Last nymphal stage	168	0.01	0.2	110-279
Adult ♀	189	0.01	1.1	120-297
Adult ♂	199	1.00	0.1	10-358

Table (3): Effect of IMI against *H. Littoralis* under semi field conditions

Treatments	Days after treatment	No .of infestations ***H. littoralis*** (Means ± S.E.)
Control	20	22.2±2.7
	50	51±3.5
	90	77±9.9
	120	99±9.9
IMI	20	1.0±0.1
	50	2±0.1
	90	3±3.0
	120	7±2.9
F –test	12.4	
LSD 5%	11.8	

Table (4): Effect of IMI against *H. Littoralis* under field conditions

Treatments	Days after treatment	No .of infestations ***H. littoralis*** (Means ± S.E.)
Control	20	19.2±8.9
	50	49±7.5
	90	76±9.5
	120	99±6.9
IMI	20	0.1±0.3
	50	1.4±0.6
	90	4±3.7
		10±7.9

	120
F –test	12.4
LSD 5%	11.8

Fig(1). Effect of IMI on grasshopper *H. Littoralis* under semi field conditions

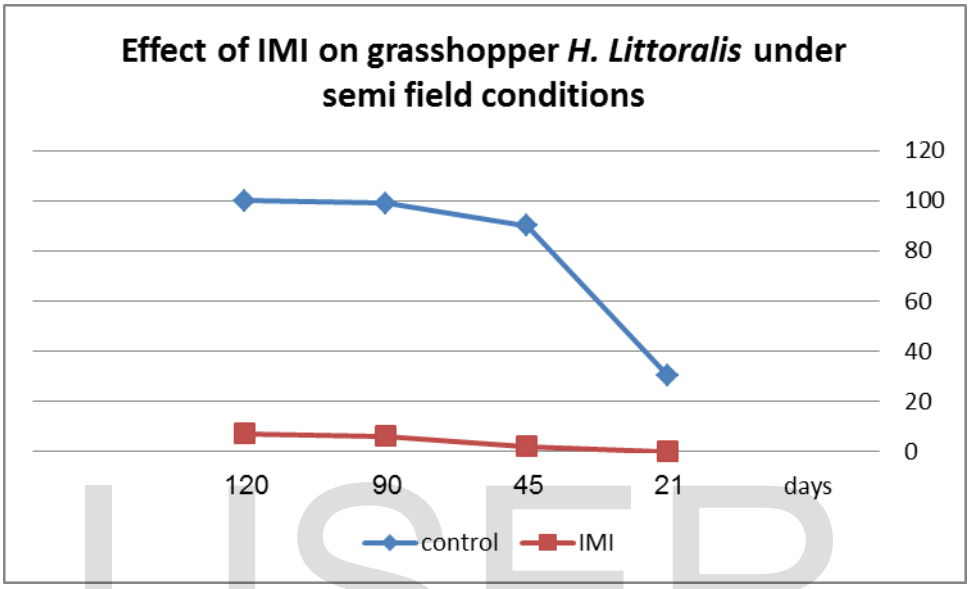


Fig (2). Effect of IMI on grasshopper *H. Littoralis* under field conditions

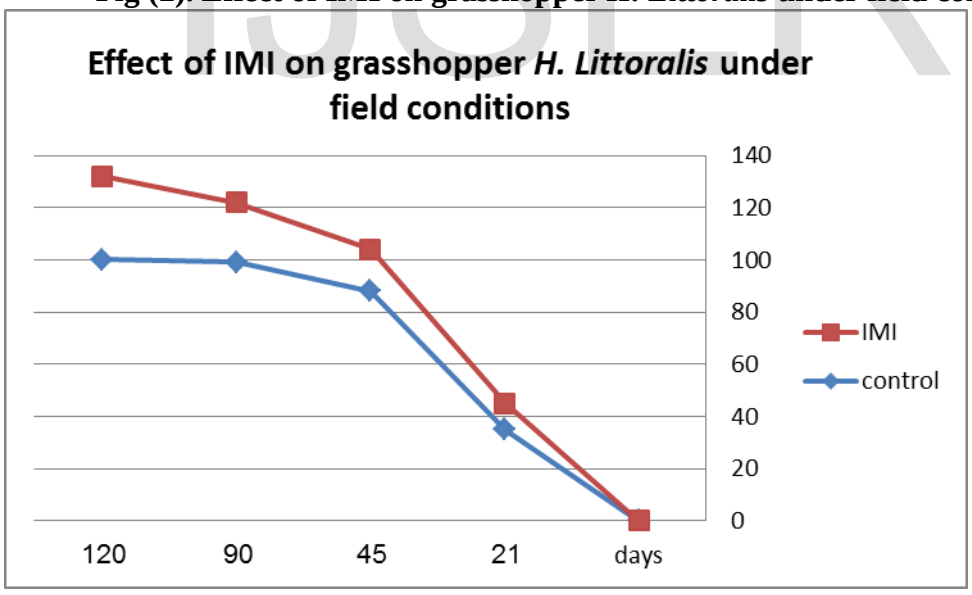
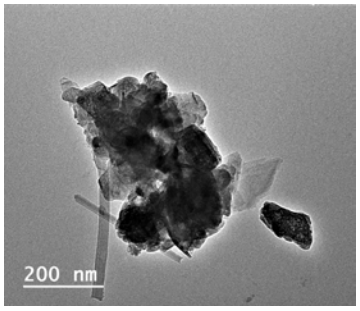


Fig2, scanning electron microscopy of IMI.



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