

# Control of Locust *Schistocerca gregaria* (Orthoptera: Acrididae) by Using Imidacloprid

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**Abstract:** The effect of imidacloprid IMI on the target insect pest *Schistocerca gregaria* and the C50 recorded, 278, 214 223, 249 and 240 mg/L for newly hatched, nymphs, Last nymphal stage Adult ♀ and Adult ♂ respectively. Under semifield conditions, the corresponding LC50 obtained, 221, 243, 254, 256 mg/L for newly hatched, nymphs, Last nymphal stage Adult ♀ and Adult ♂ respectively of *S. gregaria*. Also, under semi field conditions, the number of *S. gregaria* were significantly decreased after the IMI first applications. The infestation number obtained  $1.1 \pm 2.1$ ,  $9 \pm 2.1$ ,  $13 \pm 3.8$  and  $21 \pm 3.6$  individuals after 20, 50, 90 and 120 days as compared to  $12.2 \pm 3.4$ ,  $36 \pm 3.5$ ,  $58 \pm 6.6$  and  $98 \pm 8.7$  individuals in the control.

**Keywords:** locust, *Schistocerca gregaria*, imidacloprid (IMI).

## 1. Introduction

Imidacloprid, (1-[(6-chloro-3-pyridinyl)methyl]-4,5-dihydro-2H-imidazol-2-amine (IMI), is a systemic and chloronicotinyl insecticide, that specifically blocks the microtubular neuronal pathway. It has recently been demonstrated to be highly effective as a systemic insecticide [Byrne et al 2005,2006]. Imidacloprid is the first commercially available representative of a new chemical class, the chloronicotinyl or neonicotinoid insecticides. It was synthesized in 1985 and the first registration was achieved in France (1991). It is a systemic broad-spectrum insecticide and acts as a contact and stomach poison against sucking and some biting insects (rice hoppers, aphids, thrips, whitefly, termites etc.). It can be applied for seed, soil or foliar treatment. The molecule exhibits a novel mode of action as it is an agonist of the nicotinic acetylcholine receptor leading to paralysis and death of pest organisms. The life history of the desert locust, *S. gregaria* (Forsk.), and the epidemiology of its outbreaks were obscure until the 20<sup>th</sup> Century. One of the discoveries of importance in this century was that of solitary and gregarious phases. The life history of the desert locust, *Schistocerca gregaria* (Forsk.), and the epidemiology of its outbreaks were obscure until the 20<sup>th</sup> Century. One of the discoveries of importance in this century was that of solitary and gregarious phases. A most prominent feature of the 'arbeh' is that it can exist as scattered individuals within the 'recession areas' or, when gregarious, as swarms throughout the 'invasion areas'. This is because the locust exists in different phases. When breeding conditions lead to an increase in the number of locusts crowded together, the insects have the ability to change their color, behavior, shape and physiology, with color and behavior being the characteristics to change first. Aim of this work to evaluate the Imidacloprid IMI against locust.

## 2. Materials and Methods

### 2.1 Insect rearing

Locust was reared under laboratory condition for several generations on semi-artificial diet as mentioned by Sharaby et al. (2010).

### 2.2 Preparation of Nano- Imidacloprid

Imidacloprid Nanoparticles were synthesized by hydrolyzing 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.

### 2.3 Efficacy of Imidacloprid against the Target Insect Pests

The insecticide imidacloprid were tested at the 6 concentrations: 6 g, 5g, 4g, 3g, 2g, 1g. The insecticide, prepared 6 concentrations (prepared according Sameh et al., 2009) Percentages of mortality were calculated according to Abbott's formula (Abbott, 1925), while the LC50 values was calculated throughout probit analysis (Finney, 1971). The experiment was carried out under laboratory conditions at  $26 \pm 2^\circ\text{C}$  and 60-70% RH

### 2.4 Bioassays

The insecticidal efficacy of nano- imidacloprid were tested at three dose rates, 0.25, 0.50 and 1 g/kg wheat against the 3rd instar larvae of *S. gregaria* (Orthoptera: Acrididae). For

each case, four glass jars as replicates were used. Each replicate was treated individually with the respective nano-imidacloprid quantity and then shaken manually for one minute to achieve equal distribution of the imidacloprid. Subsequently, ten 3rd instar larvae of the two tested species were introduced into each glass jar and covered with muslin for sufficient ventilation. Twelve replicates glass jars containing untreated wheat served as control. Mortality was assessed after 7 d of exposure in the treated and untreated jars. Mortality was corrected according to Abbott (1925). All tests were conducted at  $27 \pm 2^\circ\text{C}$  and  $65 \pm 5\%$  relative humidity (RH). All the experiments were repeated three times.

The ovipositional deterrent effects of nano Imidacloprid were also tested. The nano- Imidacloprid were used at the rate of 0.5 g/kg wheat. Four replicates of 100 g wheat for each treatment were used. Each replicate was treated individually with the formulations for 1 min and put inside glass jars. Four replicates in jars containing untreated wheat served as control. Subsequently, one paired of newly emerged adults were introduced into each jar. The number of deposited eggs on treated or untreated wheat/female was counted and the percent repellency values were calculated according to the equation of Lwande et al. (1985),  $D = (1 - T/C) \times 100$ , where: T and C represent the mean number of deposited eggs per female of the treated and check set, respectively.

Efficacy of tested nano- imidacloprid applied alone on the mean number of deposited eggs of target insects for conducting the combination tests with imidacloprid formulations (0.5 g/kg of grains). The imidacloprid alone were used at rate (1.0 g/kg) of grains. Four replicates of 100 g grains for each treatment were used. Each replicate was treated individually with treatments and then shaken manually for 1 min to achieve equal distribution of the dust in the entire formulation quantity and was placed in glass jar. Four replicates jar containing untreated grain served as control. Subsequently, one paired of newly emerged adults were introduced into each jar. The number of deposited eggs on treated or untreated grains/female was counted. The data was analyzed using analysis of variance (ANOVA), where significant differences between the treatments were observed. Mean values were significantly separated by using the least significant difference (LSD) test at 5% level (Sokal and Rohlf 1981).

## 2.5 Efficacy of Imidacloprid against the target insect pests

The insecticide Imidacloprid were tested at the 6 concentrations: 6 g, 5g, 4g, 3g, 2g, 1g. The insecticide, prepared 6 concentrations (prepared according Sameh *et al.*, 2009) Percentages of mortality were calculated according to Abbott's formula (Abbott, 1925), while the  $LC_{50}$  values was calculated throughout probit analysis (Finney, 1971). The experiment was carried out under laboratory conditions at  $26 \pm 2^\circ\text{C}$  and 60-70% RH. Nano- Imidacloprid, were prepared by the National research center team microbiological team according to Leiderer *et al.* (2008). The tested pathogens) was considered the standard for comparison with the other ones.

## 3. Results and Discussion

Table 1 show the effect of IMI on the target insect pest *S. gregaria* and the  $LC_{50}$  recorded, 278, 214, 223, 249 and 240 mg/L for newly hatched, nymphs, Last nymphal stage Adult ♀ and Adult ♂ respectively. Under semifield conditions, the corresponding  $CS_{50}$  obtained, 221, 243, 254, 256 mg/L for newly hatched, nymphs, Last nymphal stage Adult ♀ and Adult ♂ respectively of *S. gregaria* (Table 2).

Also, under semi field conditions, the number of *S. gregaria* were significantly decreased after the IMI first applications. The infestation number obtained  $1.1 \pm 2.1$ ,  $9 \pm 2.1$ ,  $13 \pm 3.8$  and  $21 \pm 3.6$  individuals after 20, 50, 90 and 120 days as compared to  $12.2 \pm 3.4$ ,  $36 \pm 3.5$ ,  $58 \pm 6.6$  and  $98 \pm 8.7$  individuals in the control (Table 3).

Sabbour, 2014a reported that, under laboratory conditions, the  $LC_{50}$ s, were significantly decreased when the adult female of grasshopper *Heteracris littoralis* treated with nano-destruxin and reached to  $153 \times 10^4$  spores/ml. Also, Under semi-field conditions, the percentage of infestations of *H. littoralis* significantly decreased to  $1.0 \pm 0.3$ ,  $3 \pm 0.1$ ,  $5 \pm 3.0$  and  $10 \pm 2.9$  individuals after treated with nano-destruxin in 20, 50, 90 and 120 days, respectively as compared to  $15.2 \pm 2.9$ ,  $39 \pm 3.5$ ,  $66 \pm 9.6$  and  $98 \pm 6.6$  individuals in the control. Sabbour 2014,b found  $LC_{50}$ s of the locust *S. gregaria* after treatment with destruxin,  $210 \times 10^4$ ,  $221 \times 10^4$ ,  $250 \times 10^4$  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  $2.2 \pm 1.2$ , as compared to  $2.4 \pm 5.3$ , and  $12.2 \pm 2.2$  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. The same results obtained by Sabbour and Singer 2015. Sabbour a, b, and b 2015. Sahab et al 2015 found the insecticidal activity the nano-chitosan (CS-g-PAA) showed highest effect against the three insect of soybean. as the means number of eggs deposited /female were significantly decreased. Under laboratory and semifield condition, *Aphis gossypii* were significantly decreased to  $20.9 \pm 9.1$  and  $28.9 \pm 9.2$  eggs/female respectively as compared to  $97.3 \pm 4.9$  and  $90.3 \pm 4.9$  eggs/female in the control, respectively. The same trends were also observed against *Callosobruchus maculatus*. Sabbour 2015, a, b, c found that the nano insecticides of Imidacloprid and fungi strains cases a higher mortality for insect infestations. Our results agree with Sabbour and Abd Raheem 2015, a & b, Sabbour and Singer 2015 a&b and Sabbour and shadia 2015 who find that the nano pesticide decrease the infestation percentage of different pests.

**Table 1:** Effect of IMI against *Schistocerca gregaria* under laboratory conditions

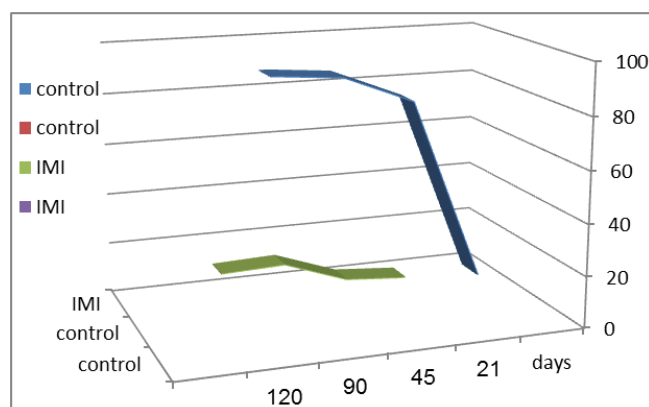
Stages	LC50 V S 95% confidence limits
Newly hatched nymphs	278 0.01 1.3 168-311
Last nymphal stage	214 0.01 0.2 200-237
Adult ♀	223 0.01 1.2 201-249
Adult ♂	249 1.01 0.2 210-300
	240 10.2 0.1 220-311

**Table 2:** Effect of IMI against *Schistocerca gregaria* under semi-field conditions

Stages	LC50 V S 95% confidence limits
Newly hatched nymphs	221 0.01 1.3 200-249
Last nymphal stage	243 0.01 0.1 210-279
Adult ♀	254 0.01 1.1 202-278
Adult ♂	356 1.00 0.1 204-350

**Table 3:** Effect of IMI against *Schistocerca gregaria* under semi field conditions

treatments	Days after treatment	No .of infestations of the target pests (Means ± S.E.)
control	20	12.2±3.4
	50	36±3.5
	90	58±6.6
	120	98±8.7
IMI	20	1.1±2.1
	50	9±2.1
	90	13±3.8
	120	21±3.6



**Figure 1:** Percentage of infestations of the target pests under semifield conditions

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