Control of locust Schistocerca gregaria (Orthoptera: Acrididae) by using imidaclorprid

Sabbour M.M1 and S.M. Singer2
1.Department of Pests and Plant Protection,2.Vegetabe research Dep. National Research Centre, Dokki, Cairo, Egypt
E-mail: sabbourm@yahoo.com Tel.: +202/01223305136 Fax: +202/33370931

Abstract— The effect of imidaclorprid 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±2.1, 9±2.1, 13±3.8 and 21±3.6 individuals after 20, 50, 90 and 120 days as compared to 12.2±3.4, 36±3.5, 58±6.6 and 98±8.7 individuals in the control .

Key wards: locust , Schistocerca gregaria, imidaclorprid (IMI)..

1 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 [Byrne et al 2005,2006]. Imidacloprid is the first commercially available representative of a new chemical class, the chloronicotiny 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 20th 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 20th 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.

IJSER staff will edit and complete the final formatting of your paper.

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).

2.3.Preparation of nano- imidaclorprid.

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.

2.4.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 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±2°C and 60-70% RH.

2.5.Bioassays

The insecticidal efficacy of nano- imidaclorprid 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-imidaclorprid quantity and then shaken manually for one minute to achieve equal distribution of the imidaclorprid. 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 ± 2°C and 65 ± 5% relative humidity (RH). All the experiments were repeated three times.

The ovipositional 591 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) x 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- imidaclorprid applied alone on the mean number of deposited eggs of target insects for conducting the combination tests with imidaclorprid formulations (0.5 g/kg of grains).The imidaclorprid 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).

2.6. Efficacy of Imidacloprid against the target insect pests.

The insecticide Imidacloprid were tested at the 6 concentrations: 6 g, 5g ,4g,3g, 2g,1*g*.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±2°C and 60-70% RH. Nano- Imidaclorprid , 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 0f IMI on the target insect pest *S. gregaria* and the LC50 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 C50 obtained, 221, 243, 254, 256 mg/L for newly hatched , nymphs, Last nymphal stage Adult ♀ and Adult ♂ respectively of *S. gregaria* (Table2).

Also, under semi field conditions, the number of *S. gregaria* were significantly decreased after the IMI first applications. The infestation number obtained 1.1±2.1, 9±2.1, 13±3.8 and 21±3.6 individuals after 20, 50, 90 and 120 days as compared to 12.2±3.4, 36±3.5, 58±6.6 and 98±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 *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. 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±9.1 and 28.9±9.2 eggs/female respectively as compared to 97.3±4.9 and 90.3±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.

4. Acknowledgments

This research was supported by Agric. Department, National Research Centre, and Cairo, Egypt. Project No (10120601).

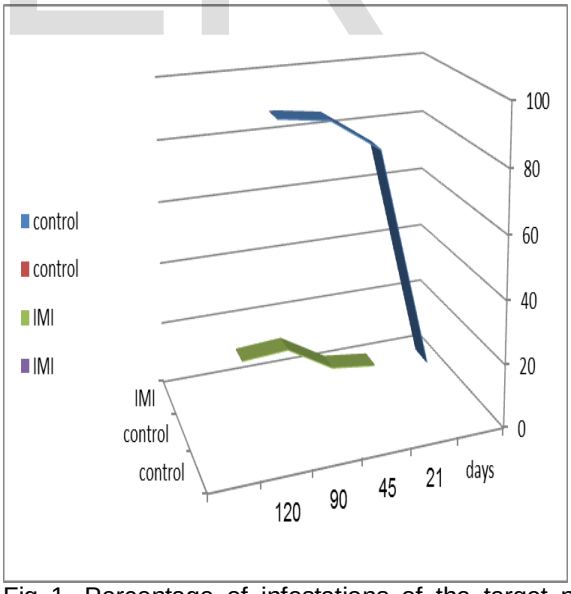

Fig 1. Percentage of infestations of the target pests under semifield conditions

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
	214	0.01	0.2	200-237
Last nymphal stage	223	0.01	1.2	201-249
	249	1.01	0.2	210-300
Adult ♀	240	10.2	0.1	220-311
Adult ♂				

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
	243	0.01	0.1	210-279
Last nymphal stage	254	0.01	1.1	202-278
Adult ♀	356	1.00	0.1	204-350
Adult ♂				

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

5. CONCLUSION

The nature product IMI is effective aginist the locust *S. gregaria* under laboratory semi ield and field conditions.

6. REFERENCES

Abbott, W.W. (1925). A method of computing the effectiveness of an insecticide. J. Econ. Entomol 18: 265-267.

Abdel-Rahman, M.A.A.; Abdel-Mallek, A.Y. and Hamam, G.A. (2006). Comparative abundance of entomopathogenic fungi of cereal aphids in Assiut. Egypt. J. Boil. Pest Cont., 16: 39-43.

Byrne, F.J. and N.C. Toscano, Uptake and persistence of imidacloprid in grapevines treated by chemigation, Crop Prot. 25 (2006) 831–834.

Finney, D.J. (1971). Probit Analysis, Cambridge: Cambridge University Press.

Abdel-Rahman, M.A.A. (2001). Seasonal prevalence of entomopathogenic fungi attacking cereal aphids infesting wheat in southern Egypt. Inter. Symposium. Agric. Agadir-Morocco, 7-10: 381-389.

Abdel-Rahman, M.A.A. and Abdel-Mallek, A.Y. (2001). Paramilitary records on entomopathogenic fungi attacking cereal aphids infesting wheat plants in southern Egypt. First Conference for safe Alternatives to pesticides for pest managements, Assiut: 183-190.

Abdel-Rahman, M.A.A.; Abdel-Mallek, A.Y.; Omar, S.A. and Hamam, A.H. (2004). Natural occurrence of entomopathogenic fungi on cereal aphids at Assiut. A comparison study between field and laboratory observations. Egypt. J. Boil. Sci., 14: 107-112.

Castillo, M.A.; Moya, P.; Hernandez, E. and Primo-Yufera, E. (2000). Susceptibility of *Ceratitis capitata* Wiedenmann (Diptera: Tephritidae) to entomopathogenic fungi and their extract. Biol. Cont. 19: 274-282.

El-Husseini, M.M.; Shahira, S.M.; Amal, A.M.; El-Zoghby, A.; Sahar S. Ali, Naglaa, A.M. Omar; Agamy, E.A.; Abou Bakr, H.E.; Nada, M.S.; Sherin Tamer; Kamal, H.M. and Ibrahim, A.M. (2004). Isolation, Production and use of entomopathogenic fungi for controlling the sugar beet insect pests in Egypt. Egypt. J. Biol. Pest Control. 14(1): 265-275.

Espin, G.A. T. laghi De .S.M.; Messias, C.L. and Pie-Drabuena, A.E. (1989). Pathogencidad de *Metarhizium anisopliaenas* diferentes fases de desenvolvimento de *Ceratitis capitata* (Wied.) (Diptera: Tephritidae). Revista Brasileria de Entomologia, 33: 17-23.

Finney, D.J. (1971). Probit Analysis, Cambridge: Cambridge University Press.

Leiderer, P. and Dekorsy, T.. (2008). Interactions of nanoparticles and surfaces Tag der mÄundlichenPrÄufung: 25. April.http://www.ub.unikonstanz.de/kops/ volltexte/2008/5387/; http:// nbn-resolving.de/ urn:nbn:de:bsz:352-opus-53877.

Qiao, Meihua; Daniel E. Snyder, Jeffery Meyer, Alan G. Zimmerman, Meihau Qiao, Sonya J. Gissendanner, Larry R. Cruthers, Robyn L. Slone, Davide R. Young (12 September 2007). "Preliminary Studies on the effectiveness of the novel pulicide, spinosad, for the treatment and control of fleas on dogs". Veterinary Parasitology: 345–351. Retrieved 3 May 2012.

Rice, R.E. (2000). Bionomics of the olive fruit fly *Bactrocera* (*Dacus*) *oleae*. Univ. of California Plant Prot. Quart, 10:-1-5.

Roberts, D.W. and Humber, R.A. (1981). Entomogenous fungi In Biology of Conidial Fungi (G.T. Cole and W.B. Kendrick, eds), vol. 2, pp. 201-236. Academic Press, New York.

Rombach, M.C.; Aguda, R.M. and Robert, D.W. (1988). Production of *Beauveria bassiana* in different liquid media and subsequent conditions mycelium. Entomo., 33: 315-234.

Sabbour, M.M. and Shadia E. Abed El-Aziz (2002). Efficacy of some botanical oils formulated with microbial agents against the cotton leafworm and greasy cutworm attaching cotton plants. Bull. Ent. Soc. Egypt. ser. 28, 2001-2002: 135-151.

Sabbour, M.M. and Sahab, A.F. (2005). Efficacy of some microbial control agents against cabbage pests in Egypt. Pak. J. Biol. Sci. 8: 1351-1356.

Sabbour, M.M. and Sahab, A.F. (2007). Efficacy of some microbial control agents against *Agrotis ipsilon* and *Heliothis armigera* in Egypt. Bull. N.R.C. Egypt. 13

Sabbour, M.M. and Shadia, E. Abd-El-Aziz (2010). Efficacy of some bioinsecticides against *Bruchidius incarnatus* (BOH.) (Coleoptera: Bruchidae) Infestation during storage. J. Plant Prot. Res. 50 (1): 28-34.

Sabbour, M.M.2014a. Evaluating toxicity of extracted nano - Destruxin against the desert locust *Schistocerca gregaria* in Egypt . J. Egypt. Acad. Environ. Develop. 15(2): 9-17.

Sabbour, M.M. 2014b. Evaluating Toxicity of nano-Extracted Destruxin from *Metarhizium anisopliae* Against the grasshopper *Hetiracris littoralis* in Egypt. J.Egypt. Acad. Environ. Develop. 15(2): 1-7.

Sabbour M.M. 2013a. Evaluating toxicity of extracted destruxin from *Metarhizium anisopliae* against the desert locust *Schistocerca gregaria* in Egypt. J.Egypt. Acad. Environ. Develop. 14(1): 35-41.

Sabbour M.M. 2013b. Evaluating toxicity of extracted destruxin from

*Metarhizium anisopliae a*gainst the grasshopper *Hetiracris littoralis* in Egypt. J.Egypt. Acad. Environ. Develop. 14(1): 29-34.

Sabbour M.M and S.M. Singer. 2015a. The entomotoxicity of Destruxin and Nano-Destruxin against three olive pests under laboratory and field conditions International Journal of Scientific & Engineering Research, Volume 6, Issue 8, August-2015

Sabbour M.M and S.M. Singer. 2015b. Efficacy of Nano *Isaria fumosorosea* and *Metarhizium flavoviride* against Corn Pests under Laboratory and Field Conditions in Egypt. International Journal of Science and Research (IJSR). ISSN (Online): 2319-7064.

Sabbour, Magda and MA Abdel-Raheem.2015 a. TOXICITY OF THE FUNGUS BEAUVERIA BASSIANA AND THREE OILS EXTRACT AGAINST *SITOPHILUS GRANARIES* UNDER LABORATORY AND STORE CONDITIONS. American J. of innovative research and applied sci. 251-256.

Sabbour, Magda and MA Abdel-Raheem.2015b. Determinations the efficacy of *Beauveria brongniartii* and *Nomuraea rileyi* against the potato tuber moth *Phthorimaea operculella* (Zeller). ***The American Journal of Innovative Research and Applied Sciences .*** 202-197:(6)1

Sabbour M. M. 2015a. Laboratory and Store Efficacy of Nano-Extracted Destruxin from Metarhizium anisopliae Against Indian Meal Moth Plodia interpunctella (Lepidoptera-Pyralidae) . Journal of Nanoscience and Nanoengineering. Vol. 1, No. 3, 2015, pp. 142-147. (http://www.openscienceonline.com/journal/ajbls).

Sabbour M. M. 2015b. The Toxicity Effect of Nano Fungi *Isaria fumosorosea* and *Metarhizium flavoviride* against the Potato Tuber Moth, *Phthorimaea operculella* (Zeller). American Journal of Biology and Life Sciences. 3 (5):155-160.

Sabbour, M.M. 2015c. Nano-Imidaclorprid Against Three Olive Pests Under Laboratory and Field Conditions Open Science Journal of Bioscience and Bioengineering 49-45 :(5)2 90.

Sabbour, M.M. 2015d. Efficacy of some nano-Imidacloprid against red flour beetle *Tribolium castaneum* and confused flour beetle, *Tribolium confusum* (Coleoptera: Tenebrionidae) under laboratory and store conditions. Advances in Biochemistry & Biotechnology. 1-13.

Sabbour, M.M. and Shadia El-Sayed Abd-El-Aziz. 2015. Efficacy of some nano-diatomaceous earths against red flour beetle *Tribolium castaneum* and confused flour beetle, *Tribolium confusum* (Coleoptera: Tenebrionidae) under laboratory and store conditions. Bull. Env.Pharmacol. Life Sci., Vol 4 [7] June 2015: 54-59.

Sahab, A. F.; Waly, A.I., Sabbour, M. M. and Lubna S. Nawar. 2015. Synthesis, antifungal and insecticidal potential of Chitosan (CS)-g-poly (acrylic acid) (PAA) nanoparticles against some seed borne fungi and insects of soybean. Vol.8, No.2, pp 589-598.

Sahab, A.F. and Sabbour, M.M. (2011). Virulence of four entomopathogenic fungi on some cotton pests with especial reference to impact of some pesticides, nutritional and environmental factors on fungal growth. Egyp. J. Boil. Pest Cont., 21 (1): 61-67.

Sameh, A. Moustafa; Ahmed, E. Abd El-Mageed; Mostafa, M. El-Metwally and Nabil, M. Ghanim (2009). Efficacy of Spinosad, Lufenuron and Malathion against olive fruit fly, *Bactrocera oleae* (Gmelin) (Diptera: Tephritidae) Egypt. Acad. J. biolog. Sci., 2 (2): 171-178.

Shadia, E. Abdel Aziz and Nofel, M.A. (1998). The efficacy of bacteria, fungi and natural products in baits against the greasy cutworm *Agrotis ipsilon* (Hufn.) (*Lepidoptera*: *Noctuidae*) in Egypt. J. Egypt. Ger. Soc. Zool., 27. Ent. 129-139.

Tanda, Y. and Kaya, H.K. (1993). Insect Pathology. Academic Press, San Diego, CA, USA.