International Research Journal of BIOLOGICAL SCIENCES

Volume 02 | Issue 01 | 2020

SciRange PUBLICATIONS
www.scirange.com

SciRange

Open Access

International Research Journal of Biological Sciences

Research Article

pISSN: 2663-5968, eISSN: 2663-5976

Toxicity of the Three Oils Extract against *Sitophilus granaries* Under Laboratory and Store Conditions

Magda M.A. Sabbour

Department of Pests and Plant Protection, Agriculture Division, National Research Center, 33rd El Bohouth St., Dokki, Giza, Egypt

ARTICLE INFORMATION

Received: January 20, 2020

Accepted: February 12, 2020

Corresponding Author:
Magda M.A. Sabbour,
Department of Pests and Plant Protection, Agriculture Division,
National Research Center,
33rd El Bohouth St., Dokki, Giza, Egypt

ABSTRACT

The stored products pests spread rapidly especially in the stores. This situation is causing a lot of damages to the stored seeds and destructive to the seeds amounts. The present study aims to evaluate the toxicity of three oil extract on *Sitophilus granaries.* Three essential oils were used in the bioassay tests: Coriander, mint, sesame. The result showed that the *S. granarius* were significantly decreased after the test of three oils coriander, mint and sesame extract treatments. The larval mortality percentages recoded were 80.11, 30.10 and 2.21 after coriander, treatments at the concentrations of 5, 0.5 and 0.05%. The corresponding concentrations of, mint gave the larval mortality 50.11, 21.22 and 6.41 % of the *S. granarius*, respectively. When sesame treated with the last concentrations the larval mortality were significantly decreases to 39.61, 29.81 and 22.613% as compared to zero in the control. The oviposition deterrent effect showed in the mean number of eggs where significantly decreased to 11.0±9.8, 27±7.1 and 25±6.8 eggs/female, when treated with 3% of the oil Coriander, mint and sesame, respectively compared to 199±8.9 in the control. The essential oils incorporation would control the stored pests and the release of the nano formulation denied the rapid vaporization and degradation; also, it increases the constancy and denied the lower effective application dosages.

Key words: Plant oils, *Sitophilus granaries*, coriander, mint, sesame

INTRODUCTION

The stored insect pests caused a lot of damages to the stored seeds. They also caused a contamination in the seeds. They produce an unfavorable odor and flavors. Theses pests cause about 10-15% grain reductions[1]. The rice is important edible seed in Egypt. *S. granarius* (Coleoptera: Curculionidae) is a harmful stored seeds insect pests. This harmful pests strike many stored seeds as, rice, maize and wheat. Many secondary metabolites were determined against stored insects, used repellant and deterrent due to their strong odoriferous nature[2]. The biocontrol by using a safe substance as eco-friendly to the environments is required. These substances represented in essential oils, natural microbes and etc.

Biological control agents include microbial control agents, plant extracts and essential oils and considered as a friendly factor to control many stored pests. The chemical pesticides used for controlling the stored pests. So it is necessary to find another

material to control the harmful pests. Several microbial control agents have been tested on invertebrate pests in glass houses, row crops, orchards, ornamentals, stored products and forestry[3]. The essential oils may consider one among the attractive or repellent effects and in some cases they showed an insecticidal action on serious stored pests. The essential oils derived from the natural plants and contain cyclic and monocyclic mono-terpenes which are effective repellents against stored insect pests. This work aimed to evaluate the natural oils and the nano oils on the target stored pests of *S. granarius*.

MATERIALS AND METHODS

Rearing the insect pests: The wheat weevil (*Sitophilus granarius*) (Linnaeus) collected from the infested seed, then it reared on stored rice seeds at laboratory conditions 28±2°C and 60±5% R.H.

Tested oils: Three essential oils were used in the bioassay tests: Coriander, mint, sesame. The method used is the steam distillation of dried plants then the essential oils were gained[4]. Five drops of the emulsifier TritonX-100 were mixed thoroughly with five ml of each tested emulsions essential oils, then add water and obtained the wanted concentrations (2% v/v). This emulsifier added to last concentrations then used as check.

Insecticidal activity of tested oils: The wheat weevil (*Sitophilus granarius*) (Linnaeus) used in the experiment which built to examine the premier as well as the continual effect of the tested essential oils on the *S. granarius* weevils mortality cumulative through the successive period (24, 48, 96 and 168 h).

A granules of foams have one cm in diameter were treated at the time (zero time) with tested essential oils at concentrations of 2 %. Then the foam dried and then put with 100 g of sterilized heated seeds of rice fixed each with a hard string. All the examined treatments tested were used directly as non-choice experiment. The treated foam granules treated by the examined essential oils were then mixed with rice seeds at 2 g foam/100 g rice seeds according to Abdel-Aziz and Ismail[5] and Abd El-Aziz[6]. After *S. granarius* emerged take a pair of newly weevils emerged, then put them in 20 mL glass jars with treated or untreated seeds of rice and covered with muslin cover. Every day collect the dead weevils and counted in each jar and calculate the percentages of mortality then determine the correct values by using the Abbott formula[7]. Place a new pairs of the emerged *S. granarius* weevils then place them with the treated or untreated rice seeds in 250 mL glass jars then cover them with muslin. Every day the *S. granarius* dead weevils counted in each glass jar and the probit analysis of the percentages of mortality were corrected by the Abbott formula. The LC50 was calculated through Finney[8] under laboratory conditions. The experiment was made at the conditions of 26±2°C and 60-70% R.H. Each experiment replicated four times.

RESULTS

The effect of grain weevil, *S. granarius* decreased significantly after oil extract treatments. The percentage of larval mortality demonstrated in Table 1. The accumulation mortality after the tested oils recorded as 36.9, 51.2, 62.2, 90.0 at time 0, 2, 4 and 7 days of coriander oil application on *S. granarius* as compared to 0.0, 0.0, 0.2 and 0.1 at corresponding time.

The accumulation of *S. granarius* at 0 time were, 45.3, 29.5 and 31.1 after nano coriander, nano mint and nano sesame respectively as compared to 0.0 in the control. The last corresponding treatments recoded 98.3, 83.8 and 90.9, respectively after seven days of applications as compared to 0.2 in the control showed in Table 2.

Table 3 show that, the percentages of egg reductions by female recoded, 99.3, 93.2 and 90.7% after treated with nano coriander, nano mint and nano sesame respectively as compared to 100% in the control. The adult emergence significantly decreased to 1% after nano coriander treatments as compared to 100% in the control. The malformations were significantly increased to 100% after nano coriander treatments as compared to zero in the control.

Table 1: Accumulations mortality of target pest adults during the first week of broad bean seeds in treated foam with different oils

Tested oil	Time (days)	*S. granaries*
Coriander	0	36.9
	2	51.2
	4	62.2
	7	90.0
Mint	0	27.6
	2	34.3
	4	56.1
	7	89.0
Sesame	0	30.2
	2	44.3
	4	57.1
	7	87.3
Untreated	0	0.0
	2	0.0
	4	0.2
	7	0.1
F test	24.0	
LSD 5%	9.2	

Table 2: Accumulations mortality of target pest adults during the first week of broad bean seeds in treated foam with different nano oils

Tested oil	Time (days)	*S. granaries*
Nano coriander	0	45.3
	2	53.9
	4	643
	7	98.3
Nano mint	0	29.5
	2	36.9
	4	48.5
	7	83. 8
Nano sesame	0	31.1
	2	33.2
	4	55.3
	7	90.9
Untreated	0	0.0
	2	0.0
	4	0.3
	7	0.2
F test	29.1	
LSD 5%	28.2	

Table 3: Effect of oils tested on number of laid eggs/female and % of adult emergence (F1) of *S. granarius* during storage periods

Tested materials	Reduction of eggs laid/female (%)	Adult emergence (F1) (%)	Malformation (%)
Nano coriander	99.3	1	100
Nano mint	93.2	9	100
Nano sesame	90.7	6	99
Control	100	100	0
F test	38.7		
LSD 5%	19.9		

Table 4: Effect of nano oil on the number of laid eggs/female and % of adult emergence (F1) of target pests during storage periods

Tested materials	No. of eggs /♀±SE	Adult emergence (F1) (%)	Adult malformation (%)
Nano coriander	10.3±0.0	0.1	99
Nano mint	20.4±1.21	2	99
Nano sesame	20.4±5.38	1	98
Control	297.9±7.89	100	0
F test	36.7		
LSD 5%	18.7		

When the tested nano oils applied on the target pests *S. granarius*, the number of eggs laid/female, significantly decreased to 20.4±1.21, 20.4±5.38 and 297.9±7.89 eggs/female after nano coriander, nano mint and nano sesame respectively as compared to 297.9±7.89 eggs/female in the control (Table 4). The adult malformation percentages reached to 99% after nano coriander treatments as compared to zero in the control.

DISCUSSION

The number of eggs laid/female reduced in number after treatments with the essential extracted oils: coriander, mint and sesame when compared to the untreated. Many authors such as, Shaaya *et al.*[9] found that essential edible oils were considered highly effective as a control agents on the target pests of *S. granarius* and play a series role in the store to control the stored-grain control. Lisansky[10] reported that the essential oil of plants, clove and eucalyptus and the vapors damages the insect fecundity. The data obtained proved that auspicious female oviposition toxicity and suppression deterrence of *S. granium* eggs and the emergence of the adult[9].

Abd El-Aziz[11] found that the fungi *B. bassiana* formulations LD50 decreased the infestations to 97% especially after the coconut oil addition. Also, the properties of the oil cutinophilic could permit to a large of fungal conidia number in order to penetrate the males and females adult mouth parts. The thin cuticle membranes oil carriers were disturbed by the essential oils inoculum over, which are more easily penetrated by *B. bassiana* fungi[11]. The fungi *B. bassiana* combined with mustard oil increases in the insecticidal pathogenicity of to the stored *C. maculatus* beetles and it may be refer to some dehydration found in the insect cuticle structural level, which may help in fungus germ penetration of the cuticle. The same obtained by Hassan and Charnley[12] who recorded that, when the fungus *M. anisopliae* applied on in *Manduca sexta* their cuticle-synthesis inhibitor by the dimilin. Quintela and McCoy[13] similarly recorded the combinations of the fungus *B. bassiana* and chloronicotinyl insecticide imidiaclopride have a Synergistic effects on the stored insect *Diaprepes abbreviatus* L. (Coleoptera: Curculionidae)[14,15]. These results meet with Athanassiou *et al.*[16] and Sabbour and Abd El Aziz[17] who found that essential oils at different doses could control many stored insect pests. Chander and Ahmed[18] and Jacobson[19] cleared that, many essential oils like the stored seeds of *Acorus catamus* reduce the insect infestations in the green seeds and give a bean to protection from infestation under store conditions. Also, Kavallieratos *et al.*[20] found that when the treated particles of clove oils, at concentrations of 5%, which put in between the sacks give a highest mortality to the harmful *C. maculatus*. The same obtained, results recorded by Saxena *et al.*[21], Surabaya *et al.*[22], Maheshwari *et al.*[23] and Sabbour[24]. Sabbour[24] found that, the plant oils mixed with the fungus *B. bassiana* and may reduce the infestation of insect *Cassida vittata* and *C. maculatus.* Saxena *et al.*[21], Sabbour[24] and Magda *et al.*[25] examined the modified diatomaceous earth combined with two fungi to control of *Bruchidius incarnates* and *Rhyzopertha dominica*. Accordingly Hanafi[26] mentioned that in order to decrease the chemical insecticides must use the useful biological insecticides which showed a more effectiveness in preventing stored seeds by insects inside the stores.

Hanafi[26] reported that when the castor bean oil examined on *S. granarius* adults, it shows a moderate effect. The mustard (bulk) caused a mortality effect lower than the other tested oils. The nano-essential oils give higher mortality that the bulk one. The mortality percentage of many tested essential oils cause a toxicity effect and attribute the insects to their chemical components. The *Portulaca oleracea* plant have different chemical constituents of, as alkaloids, lavonoids, fatty acids, terpenoids, vitamins, proteins polysaccharides, sterols and minerals that had been detected[27]. Rodriguez and Levin[28], Sabbour[29] and Ketoh *et al.*[30] incorporated the essential oils with the form of nano formulations against stored product pests. Rodriguez and Levin[28] and Ketoh *et al.*[30], found that the stored product pests reduced by the repellence of the essential oils lead to use a low dosages.

CONCLUSION

This study explained and proved that the nano-oils coriander, sesame and mint are the most effective oils against the tested *S. granium.* These results will be beneficial and very important in controlling many stored insect pests. The present work also showed that tested nano oils have been found significantly efficient against tested insects as more insect mortality, a smaller number of eggs, less adult emergence, high percentage of adult malformation and less percentage of weight loss.

REFERENCES

1. Baby, J.K., 1994. Repellent and Phlagodeterrent Activity of Sphaeranthus Indicus Extract Against *Callosobruchus chinensis*. In: Proceeding of the 6th International Working Conference on Stored-Product Protection, Highly, E., E.J. Wright, H.J. Banks and B.R. Cham (Eds.). Canberra, 17-23 April 1994, CAB International, Wallingford, UK., pp: 746-748.
2. Deshpande, R.S., P.S. Adhikary and N.P. Tipris, 1974. Stored grain pest control agents from *Nigella sativa* and *Pogostemonheyneamus*. Bull. Grain Technol., 12: 232-234.
3. Lacy, L.A., R. Frutos, H.K. Kaya and P. Vail, 2001. Insect pathogens as biological control agents: Do they have a future? Biol. Control, 21: 230-248.
4. Robert, E.D. Nastrand Company Inc., A.E.M. Toronto Hassan, and K.A. Charnley, 1989. Ultrastructural study of penetration by *Manduca sexta*. J. Invertebr. Pathol., 54: 117-124.
5. Abdel-Aziz, S.E. and I.A. Ismail, 2000. The effectiveness of certain plant oils as protectants of broad bean against the infestation by *Bruchidius incarnatus* Schm. (Cleoptera: Bruchidae) during storage. Annals Agriculture Science, Ain Shams University, 45: 717-725.
6. Abd El-Aziz, S.E., 2001. Persistence of some plant oils against the bruchid beetle, *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae) during storage. Arab. Univ. J. Agric. Sci., 9: 423-432.
7. Abbott, W.S., 1925. A method of computing the effectiveness of an insecticide. J. Econ. Entomol., 18: 265-267.
8. Finney, D.J., 1964. Probit Analysis. 2nd Ed., Cambridge. University Press. England, pp: 318.
9. Shaaya, E., M. Kostjukovski, J. Eilberg and C. Sukprakarn, 1997. Plant oils as fumigants and contact insecticides for the control of stored-product insects. J. Stored Prod. Res., 33: 7-15.
10. Lisansky, S., 1989. Biopesticides fall short of market projections. Perform. Chem., 16: 396-387.
11. Abd El-Aziz, S.E., 2001. Persistence of some plant oils against the bruchid beetle, *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae) during storage. Arab. Univ. J. Agric. Sci., 9: 423-432.
12. Hassan, A.E.M. and K.A. Charnley, 1989. Ultra structural study of penetration by *Manduca sexta.* J. Invertebr. Pathol., 54: 117-124.
13. Quintela, E.D. and C.W. McCoy, 1998. Synergistic effect of imidacloprid and two entomopathogenic fungi on the behavior and survival of larvae of *Diaprepes abbreviates* (Coleoptera: Curculionidae) in soil. J. Econ. Entomolol., 91: 110-122.
14. Abd El-Gawad, H. and A. Abd El-Aziz, 2004. Evaluation of different integrated pest management concept for controlling the legumes beetles *Callosobruchus maculatus* (F (and *Callosobruchus chinensis* (L.) on faba bean and cowpea seeds. Bull. Entomol. Egypt Entomol. Econ., 30: 105-122.
15. Athanassiou, C.G., N.G. Kavallieratos, B.J. Vayias, J.B. Tsakiri, N.H. Mikeli, C.M. Meletsis and Ž. Tomanović, 2008. Persistence and efficacy of *Metarhizium anisopliae* (Metschnikoff) Sorokin (Deuteromycotina: Hyphomycetes) and diatomaceous earth against *Sitophilus granarius* (L.) (Coleoptera: Curculionidae) and *Rhyzopertha dominica* (F.) (Coleoptera: Bostrychidae) on wheat and maize. Crop Protect., 27: 1303-1311.
16. Sabbour, M.M. and S.E. Abd El Aziz, 2007. Evaluation of some bioinsecticides and packing materials for protecting broad bean against *Callosobruchus maculatus* (Coleoptera: Bruchidae) infestation during storage. In: Proceedings of the 2nd International Conference of Economic entomology, Cairo, Egypt, 8-11 December, 2007, Entomological Society of Egypt. 2007, pp: 255-267.
17. Sabbour, M.M. and S.E. Abd El-Aziz, 2010. Efficacy of some bioinsecticides against *Bruchid iusincarnatus* (Boh.) (Coleoptera: Bruchidae). Infestation during storage. J. Plant Protect. Res., 50: 28-34.

18. Chander, H. and S.M. Ahmed, 1986. Efficacy of oils from medicinal plants as protectants of green gram against the plus beetle. *Callosobruchus chinensis*. Entomology, 11: 21-28.
19. Jacobson, M., 1975. Insecticides from plants. A review of literature. USDA Agriculture Handbook, 461: 1954-1971.0
20. Kavallieratos, N.G., C.G. Athanassiou, M.P. Michalaki, Y.A. Batta and H.A. Rigatos *et al*., 2006. Effect of the combined use of *Metarhizium anisopliae* (Metschnikoff) Sorokin (Deuteromycotina: Hyphomycetes) and diatomaceous earth for the control of three stored-product beetle species. Crop Protect., 25: 1087-1094.
21. Saxena, B.P., O. Koul and K. Tikku, 1976. Non-toxic protectant against the stored grain insect pests. Bull. Grain Technol., 14: 190-193.
22. Surabaya, S. C.K. Babu, C. Krishnappa and K.C.K. Murty, 1994. Use of locally available plant products against *Callosobruchus chinensis* in red gram. Mysore J. Agric. Sci., 28: 325-345.
23. Maheshwari, H.K., M.K. Sharma and S.C. Dwivedi, 1998. Effectiveness of repel in as surface protectant against plus beetle, *Callosobruchus chinensis* infesting cowpea. Int. J. Trop. Agric., 16: 229-232.
24. Sabbour, M.M., 2009. Evaluation of two entomopathogenic fungi against some insect pests infesting tomato crops in Egypt, IOBC/wprs Bull., 49:273-278.
25. Sabbour, M.M. and S.E. Abd-El-Aziz, 2014. Control of *Bruchidius incarnates* and *Rhyzopertha dominica* using two entomopathogenic fungi alone or in combination with modified diatomaceous earth. Elixir Entomol., 68: 22239-22242.
26. Hanafi, A., 1999. Integrated pest management of potato tuber moth in field and storage. Potato Res., 42: 373-380.
27. Michalaki, M., C.G. Athanassiou, N.G. Kavallieratos, Y.A. Batta and G.N. Balotis, 2006. Effectiveness of *Metarhizium anisopliae* (Metschnikoff) Sorokin applied alone or in combination with diatomaceous earth against *Tribolium confusum* Jacquelin du Val: Influence of temperature relative humidity and type of commodity. Crop Protect., 25: 418-425.
28. Rodriguez, E. and D.H. Levin, 1975. Biochemical Parallelism of Repellents and Attractants in Higher Plants and Arthropods. In: Recent Advances in Phytochemistry Biochemical Interaction Between Plants and Insects. Wallace, J.M. and R.L. Mansell (Eds.)., Plenum Press, New York, pp: 215-270.
29. Sabbour, M.M., 2002. Evaluation studies of some bio-control agents against corn borer in Egypt. Ann. Agric. Sci., 47: 1033-1043.
30. Ketoh, G.K., H.K. Koumaglo, I.A. Glitho and J. Huignard, 2006. Comparative effects of *Cymbopogon schoenanthus* essential oil and piperitone on *Callosobruchus maculates* development. Fitoterapia, 77: 506-510.