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MORTALITY AND ANTI-FEEDANT EFFECT OF NANOEMULSION FORMULATIONS OF ROTENONE AGAINST *Spodoptera litura*

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FP 2016 40

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SERDANG, SELANGOR DARUL EHSAN

2015/2016

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MORTALITY AND ANTI-FEEDANT EFFECT OF NANOEMULSION FORMULATIONS OF ROTENONE AGAINST *Spodoptera litura.*

BY

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A project report submitted to the Faculty of Agriculture, Universiti Putra Malaysia, in fulfillment of the requirements of PRT 4999 (Final Year Project) for the award of the degree of Bachelor of Agriculture Science.

Faculty of Agriculture
Universiti Putra Malaysia
2015/2016

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CERTIFICATION OF APPROVAL

This project entitled Mortality And Anti-Feedant Effect Of Nanoemulsion Formulations Of Rotenone Against *Spodoptera litura* is prepared by Normala Binti Adam and submitted to the Faculty of Agriculture in fulfillment of the requirement of PRT 4999 (Final Year Project) for the award of the degree of Bachelor of Agriculture Science.

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ACKNOWLEDGEMENT

Thanks to Almighty Allah for giving me strength and ability to completed this final year project and thesis writing within two semesters.

Foremost, I would like to express my sincere gratitude to my project supervisor, Prof. Dr. Dzolkhifli Bin Omar for the continuous support of my Final Year Project study and research, for his motivation, encouragement and guidance in conducting this project throughout this year. His guidance helped me in all the time of research and writing of this thesis.

Besides my supervisor, I would like to thanks laboratory assistance of Toxicology Laboratory, Mr. Jarkasi Sarbini and Mr. Mohamed Zaki Yusof for their helps and guidance.Both of them helped me a lots by giving ideas and suggestion finding the insects for rearing and provide all equipment needed in this research study.

A special thanks to Dr.Norhayu Binti Asib who have directly and indirectly helped me during conducting the laboratory works and analyzing the data. Her fully commitment indirectly had been assuring the project smoothness.

Last but not least, I would like to thank my parents, Adam Bin Lana, Saerah Binti Suta for their moral support and motivation and dear friends who had given a full support in completing this project. My research would not have been possible without their helps. May the Almighty blessed all of you.

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LIST OF ABBREVIATION

S. litura	*Spodoptera litura*
I. aquatica	*Ipomea aquatica*
Ppm	Part per million
Cm^2	Centimeter square for area
LC_{50}	Lethal Concentration that given 50% mortality
SE	Standard Error
SD	Standard Deviation

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ABSTRACT

The toxicity of nanoemulsion of rotenone F1, F2, F3 in comparison with crude extract of rotenone was evaluated against *Spodoptera litura* (Lepidoptera : Noctuidae) for their mortality and antifeedant activity. All formulations containing 1% of rotenone were used in this study. Test on mortality and antifeedant activity of *S. litura* were determined by leaf dip method (Karunaratne & Arukwatta, 2008). The area of leaf discs *I. aquatica* used was 60 cm^2. There were five treatments (218.4, 163.8, 109.2 and 54.6ppm) with five replications for each treatment used in this research study. The leaf discs dipped in distilled water were used as control. The mortality of *S. litura* was recorded at 24, 48 and 72 hours after treatments. Antifeedant activity was recorded after the 3^{rd} instar larvae were exposed to treated leaf disc for 24 hours. The mortality results indicated that nanoemulsion formulations F1, F2, F3 showed highly significant different with crude extract but no significant different between the nanoemulsion formulations F1, F2, F3 was observed. Among the formulations, LC_{50} values of nanoemulsion formulations were lower than crude extract indicating they were effective against *S. litura* by causing high mortality even at low concentration. Nanoemulsion formulation F1 was found to show a highly significant in reduction in food consumption. When compared with other formulations, nanoemulsion F1 showed higher antifeedant effect on the larvae at all concentrations tested. At concentration 273, 218.4 and 163.8 ppm, the leaf area consumed were 15.29, 18.01, 24.45cm^2 respectively 24 hours after treatment.

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ABSTRAK

Dalam kajian penyelidikan ini, keberkesanan nanoemulsion F1 rotenone, F2, F3 dan ekstrak mentah rotenone telah diuji terhadap Spodoptera litura (Lepidoptera: Noctuidae) untuk kematian dan aktiviti antifeedant. Semua formulasi mengandungi 1% rotenone digunakan dalam kajian ini. Ujian ke atas kematian dan aktiviti antifeedant S. litura ditentukan melalui kaedah celup daun (Karunaratne & Arukwatta, 2008). Luas daun I. aquatica digunakan adalah 60 cm². Terdapat lima kepekatan berbeza digunakan (218.4, 163.8, 109.2 dan 54.6 ppm) dengan lima ulangan bagi setiap kepekatan yang digunakan dalam kajian penyelidikan ini. Daun yang dicelup dalam air suling digunakan sebagai kawalan. Kadar kematian S. litura direkodkan selepas 24, 48 dan 72 jam rawatan. Keputusan kematian menunjukkan bahawa rumusan nanoemulsion F1, F2, F3 menunjukkan yang perbezaan yang ketara dengan ekstrak mentah tetapi tiada perbezaan yang ketara di antara rumusan nanoemulsion F1, F2, F3 diperhatikan. Antara rumusan , nilai LC50 rumusan nanoemulsion adalah lebih rendah daripada ekstrak mentah menunjukkan mereka berkesan terhadap S. litura dengan menyebabkan kematian yang tinggi walaupun pada kepekatan yang rendah. Formulasi nanoemulsion F1 didapati menunjukkan yang perbezaan yang amat ketara dalam pengurangan dalam penggunaan makanan. Berbanding dengan rumusan lain, nanoemulsion F1 menunjukkan kesan antifeedant lebih tinggi ke atas larva pada setiap kepekatan diuji. Pada kepekatan 273, 218.4 dan 163.8 ppm, kawasan daun yang dimakan adalah 15.29 , 18.01 , 24.45cm2 masing-masing 24 jam selepas rawatan.

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CHAPTER 1

1.1 Introduction

Spodoptera litura is one of most destructive insect pest in agriculture and well known as important polyphagous insect pest which causes serious crop losses (Singh *et al*.,1997). It is widely distributed over the world and present in tropical countries in large numbers even during rainy season (Talukder and Howse, 1994). In Malaysia, *S. litura* is the major insect pest of various important crops. Rao *et al*. (1993) and Muralikrishna *et al*. (2008) reported that *S. litura* has about 150 host species and attacking more than 112 different species of crop cultivated. Crops in colvolvulaceae family are also included.

Colvolvulaceae is an economically important family crop in Malaysia. The most common one is *Ipomea batatas* (sweetpotato) and it is closely related *to Ipomea aquatica* (kangkung). Previous studied on *I. aquatica* shown that this plant is a productive summer-growing crop which capable of achieving high protein level (Snyder *et al*., 1981). However, this vegetable is attacked by a wide range of host specific and insect pests (Snyder *et al.*, 1981). Westphal (1993) reported Lepidoptera insects that feed on the *I. aquatica* are *Diacrisia strigatula* Walker and *Spodoptera litura* (Fabricius). According to Snyder*et al.* (1981), the sweet potato hornworm, *Spodoptera* spp, salt marsh caterpillar, and olive green swamp grasshopper are causing large damage on*I. aquatica*leaves.

The development of synthetic insecticides began in the 1940's and caused decreasing of botanical insecticides usage in commercial agriculture. Synthetic insecticides are widely used by many farmers to control insect pests. However, repeated

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application of synthetic insecticide has lead to secondary outbreaks, pest resistant problem and harmful to environment and human health. The best alternative for protecting crops from insect pests is by using botanical insecticides like rotenone which is extracted from Derris plant. Plant extracts use as insecticides are less toxic, easily biodegradable and as alternative to the synthetic insecticides (Arivoli and Samuel, 2012).

Although there were many studied published on rotenone, but it's very little information on the toxicity of nanoemulsion formulations of rotenone extract against *S. litura*. Nanoemulsion is new developed technology and now become important for agrochemical industry to produce effective insecticide. Its characteristics are small droplets size, transparent, thermodynamically stable dispersions containing surfactant and other ingredients made them attractive in agrochemical industry. Nanoemulsion offer opportunity as more effective pesticide as it can provide superior efficacy and environmental friendly.

1.2 Objectives

The objectives of this research were to determine the effect of nanoemulsion formulations of rotenone on mortality *S. litura* and the antifeedant activity of nanoemulsion formulations of rotenone against *S. litura.*

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REFERENCES

Ahmad M, Arif MI, Ahmad M. (2007). Occurrence of insecticide resistance in field populations of *Spodoptera litura* (Lepidoptera: Noctuidae) in Pakistan. Crop Prot 26:809-817.

Ahmad M, Sayyed AH, Saleem MA. (2008). Evidence for field evolved resistance to newer insecticides in *Spodoptera litura*(Lepidoptera: Noctuidae) in Pakistan. Crop Prot 27:1367-1372.

Arivoli, S., & Samuel, T.(2012). Antifeedant activity of plant extracts against *Spodoptera litura*(Fab.)(Lepidoptera: Noctiduae). *Am-Euras J Agric Environ Sci*, *12*, 764-768.

Arivoli, S., & Tennyson, S. (2013). Antifeedant activity, developmental indices and morphogenetic variations of plant extracts against *Spodoptera litura* (Fab)(Lepidoptera: Noctuidae). *J Entomol Zool Stud*, *1*(4), 87-96.

T. Noma, M. Colunga-Garcia, M. Brewer, J. Landis, and A.(2010).Oriental leafworm *Spodoptera litura*. Gooch as a part of Michigan State University IPM Program and M. Philip of Michigan Department of Agriculture.

Baskar, K., Sasikumar, S., Muthu, C., Kingsley, S., & Ignacimuthu, S. (2011). Bioefficacy of *Aristolochia tagala* Cham. against *Spodoptera litura*Fab.(Lepidoptera: Noctuidae). *Saudi Journal of Biological Sciences*, *18*(1), 23-27.

Brown, E. S., & Dewhurst, C. F. (1975). The genus *Spodoptera* (Lepidoptera,Noctuidae) in Africa and the Near East. *Bulletin of Entomological Research*, *65*(02), 221-262.

© COPYRIGHT UPM

CABI. (2007). Crop protection compendium: global module. Commonwealth Agricultural Bureau International, Wallingford, UK. Retrieved from: http://www.cabi.org/compendia/cpc/.

CABI. (2010).Crop protection compendium: global module. Commonwealth Agricultural Bureau International, Wallingford, UK. Retrieved from: http://www.cabi.org/compendia/cpc/

Devlin, J. F., & Zettel, T. (1999). *Ecoagriculture: initiatives in Eastern and Southern Africa*.Weaver Press.

Fernandes, C. P., de Almeida, F. B., Silveira, A. N., Gonzalez, M. S., Mello, C. B., Feder,D &Falcão, D. Q. (2014). Development of an insecticidal nanoemulsion with *Manilkara subsericea* (Sapotaceae) extract. *J. Nanobiotechnology*, *12*, 22.

Finney,D.J.,(1971). Probit Analysis, third ed. Cambrige University Preaa, London,p.383.

Grdiša, M., & Gršić, K.(2013). Botanical insecticides in plant protection. *Agriculturae Conspectus Scientificus (ACS)*, *78*(2), 85-93.

Grubben, G.J.H.,(2004). *Ipomea aquatica* Forssk. [Internet]. Record from PROTA$U. Grubben,G.J.H. & Denton, OA.(Editor). PROTA (Plant Resources of Tropical Africa/Ressource vegetales de I' Afrique troopicale), Wageningen, Netherlands. http://www.prota4u.org/search.aspInt. J.Pest Manage. Sci.,40 (1994), pp.274–279.

Gutiérrez, J. M., González, C., Maestro, A., Sole, I., Pey, C. M., & Nolla, J.(2008). Nanoemulsions: New applications and optimization of their preparation. *Current Opinion in Colloid & Interface Science*, *13*(4), 245-251.

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Isman, M. B., Koul, O., Luczynski, A., & Kaminski, J. (1990). Insecticidal and antifeedant bioactivities of neem oils and their relationship to azadirachtin content. *Journal of Agricultural and Food Chemistry*, *38*(6), 1406-1411.

Javar, S., Sajap, A. S., Mohamed, R., & Hong, L. W. (2013). Suitability of *Centella asiatica*(Pegaga) as a food source for rearing *Spodoptera litura* (F.)(Lepidoptera: Noctuidae) under laboratory conditions. *Journal of Plant Protection Research*, *53*(2), 184-189.

Krishna, T. M., Devaki, K., Reddy, K. R., & Venkateswarlu, U. (2008). Efficacy of certain new insecticide molecules against groundnut defoliator, *Spodoptera litura* (Fab.)(Noctuidae: Lepidoptera). *Current Biotica*, *2*(2), 173-180.

Lajide, L., Escoubas, P., & Mizutani, J.(1993). Antifeedant activity of metabolites of *Aristolochia albida* against the tobacco cutworm, *Spodoptera litura.Journal of Agricultural and Food Chemistry*, *41*(4), 669-673.

Mohan, S., & Fields, P. G. (2002). A simple technique to assess compounds that are repellent or attractive to stored-product insects. *Journal of Stored Products Research*, *38*(1), 23-31.

Nakasuji, F. and T. Matsuzaki. (1977).The control threshold density of the tobacco Cutworm *Spodoptera litura* on eggplants and sweet peppers in vinylhouse. *Applied Entomology and Zoology* 12: 184–189.

Prasad, K.N,; Shivamurthy, G.R.; Aradhya, Z.S.M. (2008).*Ipomea aquatica*, An Underutilized Green Leafy Vegetable: *A Review. Int. J. Bot*.4, 123-129.

Quintão FJO, Tavares RSN, Vieira-Filho SA, Souza GHB, Santos ODH.(2013). Hydroalcoholic Extracts Of Vellozia squamata: study of its nanoemulsions for pharmaceutical or cosmetic applications. *Braz J Pharmacog*, 23:101–107.

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Ranga Rao, G. V., Wightman, J. A., & Ranga Rao, D. V.(1993). World review of the natural enemies and diseases of *Spodoptera litura* (F.)(Lepidoptera: Noctuidae). *International Journal of Tropical Insect Science*, *14*(03), 273-284.

Rani, P. U., Hymavathi, A., Babu, K. S., & Rao, A. S. (2013). Bioactivity evaluation of prenylated isoflavones derived from *Derris scandens* Benth against two stored pest larvae. *Journal of Biopesticides*, *6*(1), 14-21.

Rodriguez-Saona, C. R., & Trumble, J. T.(1999). Effect of avocadofurans on larval survival,growth, and food preference of the generalist herbivore, *Spodoptera exigua*. *Entomologia experimentalis et applicata*, *90*(2), 131-140.

Saleem MA, Ahmad M, Aslam M, Sayyed AH (2008). Resistance to selected organochlorin,organophosphate, carbamate and pyrethroid, in *Spodoptera litura* (Lepidoptera: Noctuidae) Pakistan. J Econ Entomol 101:1667-1675.

Scott, I. M., Jensen, H., Scott, J. G., Isman, M. B., Arnason, J. T., & Philogène, B. J. R. (2003).Botanical insecticides for controlling agricultural pests: piperamides and the Colorado potato beetle *Leptinotarsa decemlineata* Say (Coleoptera: Chrysomelidae). *Archives of insect biochemistry and physiology*, *54*(4), 212-225.

Singh S P and Jalali S K (1997). Management of *Spodoptera litura* (Fabricius) (Lepidoptera:Noctuidae). In J. A. Wightman and G.V. Ranga Rao, eds. *Spodoptera litura* in India: Proceeding of the National Scientists Forum on *Spodoptera litura*(F.).ICRISAT Asia.

Solans, C., Izquierdo, P., Nolla, J., Azemar, N., & Garcia-Celma, M. J. (2005). Nanoemulsions. *Current Opinion in Colloid & Interface Science, 10*(3–4), 102-110. doi:http://dx.doi.org/10.1016/j.cocis.2005.06.004.

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Sullivan, M. (2007). CPHST Pest Datasheet for *Spodoptera litura*. USDA-APHIS-PPQ CPHST.Revised April 2014.

Talukder, F. A., & Howse, P. E. (1994). Laboratory evaluation of toxic and repellent properties of the pithraj tree, Aphanamixis polystachya Wall & Parker, against *Sitophilus oryzae* (L.). *International Journal of Pest Management*, *40*(3), 274-279.

Tomlin C.D.S (2000). The Pesticides Manual. 12th Ed. British Crop Protection Council. Surrey.England, 178-179.

Wang L, Dong J, Chen J, Eastoe J, Li X. (2009). Design and optimization of a new self-nanoemulsifying drug delivery system. *J Colloid Interface Sci*, 330:443–448.

Wang, L.,Li, X.,Zhang,G.,Dong,J., & Eastoe,J.(2007). Oil-in-water nanoemulsions for pesticide formulations. *Journal of Colloid and Interface Science*, *314*(1), 230-235.

Ware G.W., Whitacre D.M. (2004). The Pesticide Book. 6 Edn., MeisterPro Information Resource, Ohio, USA, 488.

Westphal, E. (1993).*Ipomea aquatica* Forsskal Pp. 181-184 in Plant Resources in South East Asia. Number 8. Vegetables. Edited by J.S Siemonsma & K. Piluek. Pudoc Scientific Publishers, Wageningen.

Wikipedia. Rotenone. RetrievedAugust(2015)from :

https://en.m.wikipedia.org/wiki/Rotenone.

Wikipedia.*Spodoptera litura*Scientific Classification.Retrieved June 2015 from: https://en.m.wikipedia.org/wiki/*Spodoptera_litura*

Zubairi, S. I., Sarmidi, M. R., & Aziz, R. A. (2014). A study of rotenone from Derris roots of varies location, plant parts and types of solvent used (2014) Advances in Environmental Biology, 8 (2), pp. 445-449. *Advances in Environmental Biology*, *8*(2), 445-449.

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