Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 3, No. 11, p. 71-77, 2013
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

The effectiveness of combination Mahogany (*Swietenia mahogany*) seed and Sour Sup (*Annona muricata*) leaf pesticide to the time of stop feeding and LC50 Mortality on Armyworm (*Spodoptera litura* F.)

Muhammad Fathoni H.*, Bagyo Yanuwiadi, Amin Setyo Leksono

Department of Biology, Faculty of Mathematics and Natural Sciences, Brawijaya University, Indonesia

Article published on November 7, 2013

Key words: *Spodoptera litura*, botanical pesticide, stop feeding, mortality.

Abstract

Spodoptera litura Fabr. is one of polyphagous insect that attacks lot of crop species. Integrated Pest Management (IPM) is a effort to suppress insect pest population. Utilization of plant materials as ingredients insecticide is considered necessary because biodegradable, relatively safe for human, animal, non-target as well as agricultural production. This study uses a combination of Sour Sup (*Annona muricata*) and Mahogany seed (*Swietenia mahogany*) as a botanical pesticide. The purpose of this study was to determine the effect of single and combined Mahogany seed (MS) and Sour Sup (SS) leaf extracts against Time stop-feeding and mortality. In this study, concentrations applied to armyworm larvae are control, 100 g/l, 150 g/l, 200 g/l, 250 g/l, 300 g/l and a combination both of them (150 SS + 150 MS; 250 SS + 50 MS; 50 SS + 250 MS; 200 SS + 100 MS; and 100 SS + 200 MS g/l). The results showed that the use of extracts of Sour Sup leaf and Mahogany seed as insecticide either alone or in combination against pests *S. litura* causing stop eating, causing larval mortality, the ability of larvae to pupae, as well as the ability to imago. However, the the most effective concentration is combination of pesticides obtained in MS 200 and SS 100 g/l with mortality as much as 53.33% at the 72nd hour after application.

***Corresponding Author:** Muhammad Fathoni H. ✉ hamzah.toni@gmail.com

Introduction

Pest is one of the important issues that considered in the general business of crop production because pests can reduce the production of both qualitative and quantitative. Spodoptera litura F. (Armyworm) is one of the potentially damaging insect pests of agricultural crops, especially in the larval stadia. This pest has a characteristic as a leaf miner or polyphagous or has a broad host range that includes rice, pepper, cabbage, potatoes, tobacco, and other agricultural crops (MOA, 2005).

Management control of Armyworm by the farmer are using synthetic pest such as Dichloro-Diphenyl-Trichloro-ethane (DDT), edrin, Carbofuran and Tomorin. In addition to the expensive of that pesticide, the use of chemical insecticides are bad for agriculture, as it can cause pollution of biotic and abiotic as well as the occurrence of pest resistance, pest resurgence, accumulation of chemical residues in crops, killing natural enemies, environmental contamination by chemical residues and accidents for users. Due to the negative effects of synthetic insecticides, it would require alternative insecticides that are selective to insects and relatively safe for the environment (Hadiwijaya, 1990). Alternative insecticides that are developed today are insecticides that utilize natural ingredients derived from plants as known as botanical insecticides.

The use of botanical pesticides is biodegradable, relatively safe for humans; non-target animals and farm produce because the residue is easily lost. Botanical pesticides can kill or disrupt insect pests and diseases through the unique work, which can be through a combination of various means or singly. How it works is very specific pesticide plant includes: damage the developing eggs, larvae and pupae, inhibits moulting, disrupt communications insect repellent eat, inhibit the reproduction of female insects, reduces appetite, and block the ability of insects to eat.

The family of plants that are considered as a potential source of plant-based insecticide is Meliaceae, Annonaceae, Astraceae, Piperaceae, and Rutaceae (Tengkano 2003). The potential natural active ingredients contained in this study utilizing the Sour Sup leaf (SS) and Mahogany seed (MS) as a botanical insecticide either singly or in combination. Muharsini *et al.* (2006) reported that extracts of Sour Sup leaf can be used to control myasis disease caused by the larvae of Chrysomya bezziana. Susanti (2007) reported that the seed extract of soursop effect on diamondback moth Crocidolomia binotalis Zell. Another course of a study showing that acetogenin in Sour Sup leaf compound containing active substances which are suspected larvasidal, and the ingredients are well acetogenin as insecticides, acaricides, antiparasitic and bactericidal. Acetogenin from Annonaceae family is a substance that can be used as an insecticide. Besides that, there are carboxylic acid group (stearic acid, oleic acid, oleic ethyl, octadekanoic acid, octadekanoic ethyl ester, hexadinoic esther dioctil, and palmitic acid). The palmitic acids from Mimba seed have an bioactivity against *Aedys aegypti* larvae with LC50 58, 70 ppm (Suirta, 2007). Mulyawati (2007), said that Paitan leaf, Tobacco leaf and Sour Sop leaf extract can press the population of Thrips (*H.haemorrhoidalis)* pest with LC 50 28,9650 mm?L at 24 hour after application.

The purpose of this study was to determine the effect of single and combined Mahogany seed and Sour Sup leaf extracts against Time stop-feeding and mortality.

Materials and method

The design study

This experiment were used single concentration dose of botanical pesticide there are 0 (control), 100, 150, 200, 250, 300 g / l. Each concentration was used 10 animals treated with three replication. The independent variables include the larvae of

Spodoptera litura and botanical pesticides Sour Sup leaf (SS), Mahogany seed (MS), and the combination of SS and MS. Dependent variables include symptoms that occur in larvae of Spodoptera litura result of botanical pesticide application especially time of stop-feeding and mortality.

Botanical pesticides application

Each of the prepared botanical insecticide was puted in a small bowl. The pests were given *Jatropha* leaves for feed. Applications of botanical pesticide were given by dipping method. Subsequently the leaves were placed in plastic vials, each of which included a 1 larva of S. litura third instars. The mortality S. litura observed at 0, 24, 48, 72, 96, 120, 144, and 168 hours after application and time to stop eating was observed at 1, 2, 4, 6, 8, 10, 12, and 24 hours after application.

Analysis of the data

The data of number of larvae S. litura were stopped eating and mortality were analyzed with analysis of variance (ANOVA) at 5% level of confidence with the SPSS 16.0 program. The relations between them were analyzed using regression correlation analysis, and the LC50 values were analyzed using probit regression. If the control treatment there were no deaths or deaths larvae of S. litura less than 10% the percentage of larval mortality was calculated using the formula:

P = x / y x 100%

Description:

P: percentage of dead larvae of S. litura

X: number of dead larvae test

Y: number of test larvae (Bedjo, 2008).

Results and discussion

The effect of botanical pesticide to the time of stoop feeding Armyworm larvae

All tested botanical pesticide showed high efficiency in morality of the tested pests. In spite of that, significant differences in efficiency were found.

The result of botanical pesticide agains S. litura larvae showed in Fig. 1. The results showed that the administration of botanical pesticide made from Mahogany seed and Sour Sup leaf may increase the time to stop-feeding of S. litura larvae within 24 hours after application.

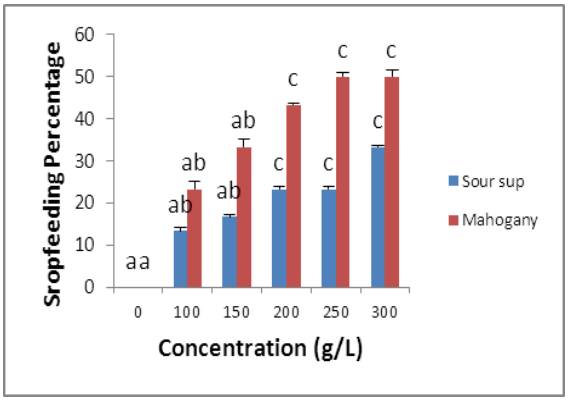

Fig. 1. Percentage of Stop-fedding larva *S.litura*.

In the botanical pesticide MS showed that the concentration of 100 g, 150 g, 200 g, 250 g, and 300 g respectively 23.33%; 33.33%; 43.33%; 50.00%; and 50.00%. In the botanical pesticide SS showed that the concentration of 100 g, 150 g, 200 g, 250 g, 300 g respectively 13.33%; 16.67%; 23.33%; 23.33% and 33.33%.

The effectiveness time for stop-feeding by *S.litura* larvae showed in Table 1. On a combination of botanical pesticide MS 200 g/l and SS 100 g/l were able cause stop-feeding respectively 0; 3.33%; 3.33%; 13.33%; 16.67%; 23.33%; 26.67%; 26.67%; 33.33%; 43.33%; 50.00%; 66.67% on each hour observations. The effectiveness of vegetable materials in time to stop eating armyworm larvae instar 2 at 24 hours after application is the combination of MS 200 g/l+SS 100g/l (66,67%), followed by a combination of MS 150 g/l+SS 150 g/l (60.00%), and the single material MS 300 g/l (50.00%). In addition to the difference in resistance and larval cuticle layer of influence the amount of insecticide into the digestive tract so that the effects of the active ingredients that work will be different in stopping eating.

Tabel 1. Time of stop fedding larva *S. litura*.

Treatment (300 g/l)	Stop Fedding *S.litura* (%) Observation Hours after application											
	2	4	6	8	10	12	14	16	18	20	22	24
Control	0	0	0	0	0	0	0	0	0	0	0	0
MS	0	3,33	3,33	6,67	10,00	13,33	16,67	23,33	23,33	36,67	43,33	50,00
SS	0	0	0	3,33	3,33	6,67	13,33	13,33	16,67	23,33	23,33	30,00
M 150 + SS 150	0	3,33	10,00	13,33	16,67	26,67	30,00	30,00	33,33	33,33	43,33	60,00
MS 250 + SS 50	0	3,33	3,33	6,67	6,67	6,67	13,33	16,67	16,67	20,00	26,67	40,00
MS 50 + SS 250	0	0	0	0	3,33	6,67	10,00	16,67	16,67	20,00	23,33	33,33
MS 200 + SS 100	0	3,33	3,33	13,33	16,67	23,33	26,67	26,67	33,33	43,33	50,00	66,67
MS 100 + SS 200	0	0	0	3,33	10,00	10,00	13,33	13,33	23,33	30,00	33,33	46,67

The effect of botanical pesticide to the mortality of Armyworm larvae

All tested botanical pesticide showed high efficiency in mortality of tested pets. Based on the Figure shows that the administration of SS and MS on mortality *S. litura* 120 hours to have a significant difference (P <0, 01). This indicates that there are significant concentrations (SS) and (MS) on mortality *S. litura*. Based on the result of mortality show that SS concentration of 100 g, 150 g, 200 g, 250 g, 300 g respectively 6.67%; 13, 33%; 20.00%; 30.00%; (36.67%). In the botanical pesticide of MS showed a concentration of 100 g, 150 g, 200 g, and 250 g, 300 g respectively 20.00%; 40.00%; 46.67%; 53.33% and 60.00%.

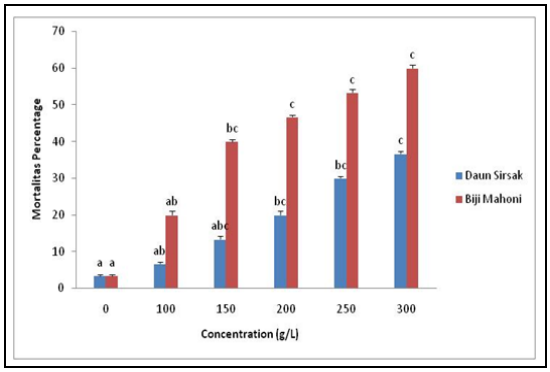

Fig. 2. Percentage of mortality larval *S.litura* after treatment by natural pesticide.

The result of LC_{50} showed the rate mortality of *S. litura* larvae that caused by botanical pesticide has a pattern the length periode of observation will increase mortality of larvae. The observations every 24 hours after applications during 168 hours on MS capable of produce lethal for larvae as much as 50% amounted to at concentrations 494.220; 435.510; 365.231; 289.759; 237.266; 203.337; 171.113 g/l, whereas on botanical pesticide SS extract capable of produce lethal for larva *S. litura* 50% are at concentration 491.166; 435.082; 408.930; 403.885; 351.656; 314.906; 279.160 g/l.

The value of LC_{50} that effective and efficient from botanical pesticide MS amounted to 237.266 g/l at 120 hours after application, then from SS amounted to 279.160 g/l on 168 hours after application. It means that the level of effectiveness of MS is more quickly 48 hours if compared with SS. Whereas the combination of MS and SS which most effective for mortality larvae up to 50% is comparison of MS 200+SS 100 g/l and MS 250+SS 50 g/l with time 72 hours after application.

The value of LC_{50} will progressively increase when the observations done within time which increasingly shorter. Sinta (2012), said that the influence of vegetable pesticides seed of Bengkoang against Armyworm on crop Soybean, obtained the value of LC_{50} within observation time 24, 48, 72, 96, 120, 144, 168 hour after application amounting to 225.813; 173.945; 172; 398; 148.71; 141.37; 125.028 g/l. Whereas in research Putri (2010), the value LC50 from insecticides ektrak seed sour Sop in pest control trip be obtained 83.1925; 22.9497; 21.1132; 19.0617; 16.9272 g/l. The level of effectiveness pesticide vegetable from plant materials has a respective advantages because every plant has an active ingredients that can be sensitive for pests that

treatment, so cause the level of death, for it the selection of time who proper in the application will influential from the effectiveness insecticides. According to Jeyasankar (2012), every plants which containing toxins has a concentrations of who different-diff, that the the higher the concentration, then the number of toxins who regarding skin insects increasingly a lot, so that can inhibit the growth and cause the death of insects more a lot.

Table 2. Velue of concentration mortality (LC_{50}) *S. litura* **.**

Pesticide	Lethal Concentration (LC_{50}) *S. litura*						
	24	48	72	96	120	144	168
MS	494,220 -3,424+0,007x	435,510 -3,588+0,008x	365,231 -3,152+0,009x	289,759 -2,257+0,006x	237,266 -1,581+0,007x	203,337 -1,219+0,006x	171,113 -0,834+0,005x
SS	491,166 -4,366+0,009x	435,082 -3,877+0,008x	408,930 -3,306+0,007x	403,885 -2,240+0,006x	351,656 -1,992+0,006x	314,906 -1,860+0,006x	279,160 -1,499+0,005x

The increase of concentration cause changes at a speed time stop-feeding. The increase of concentration that given to the pests followed by the increase of stop feeding. The feeding activity of the insects can be stop because the influence of chemical substances that stimulates chemoreceptors then continued on central nervous system of the insect. The next process the influence of chemical substances can damage particular network of digestive organ, glands that produce enzyme or nerve tissue insect. According to Coloma *et al* (2002), the compound of Sour Sup of active substance as a insecticide also capable of inhibit transfer electron on site I by blocking the bonding of enzyme NADH with ubiquinone in the chain of transfer electron on process cell respiration who consequently the process of formation of metabolic energy become obstructed and will cause the shrinkage of body volume as well as dries who resulting in death due loss of energy.

The time to stop-feeding after treatment by botanical pesticide of Mahogany seed extract is higher than the Sour Sup leaf extract, because Family Maliaceae contains limonoid. The limonoid is derivatives of Azadirachtin that acts as anti-feeding that can affect appetite (Bhurat, *et al*, 2011). The impact of Azadirachtin on all phases of insect growth larva, pupa, and adult insects. Its mechanism of action will affect the metabolism of insect hormones on the brain. Where azadirachtin this will indirectly modify both hormone synthesis and response to steroid hormone and juvenile hormone and also the pheromone (Hummel *et al*, 2012). Saponin content of which is owned by MS is also acting as antifeedan (D'incao *et al*, 2012). Saponin is one of the secondary metabolites that have small molecular weight. Saponins have anti-nutritional effects and cause toxic effects if consumed. So can result in weight loss (Alexander, 2009). The Sour Sup leaf extract has active substance that are aceetogenin, among others acimicyn, bulatocyn and squamocyn, which is the content of these insecticides. According Taufiqurrohman (2004), the content of this compound at a particular concentration resulted antifeedan. Suitable or appropriate concentrations in insects can cause toxicity (poisonous insects), primarily as a stomach poison and resulted in the death of the insect. So also by Kardinan (2002), seeds, leaves, and roots of Sour Sup contain a chemical compound annonain that can act as insecticides, larvicides, insect repellent and anti-feedant work as a poison by contact and stomach poison. Jiang-Hu *et al* (2003); Achmad (2009) mentions that bullatacyn content owned plants have potential as anti-feedan in insects.

The content of secondary metabolites that can lead mortality in the MS such as saponins and rotenone. Saponins are secondary metabolites that can cause death in different phases of growth of insects

(Alexander *et al* (2009); D'incao *et al* (2009)). The flavonoid content is owned by MS is rotenone. Rotenone is one that isoflavones can inhibit cellular respiration and energy metabolism at the level of the mitochondrial respiratory chain (Ntalli, 2012). Rotenone compound that is also owned by SS applications pesticide plant using the SS can cause the death of the larvae. The use a combination of both materials are shown to have a positive interaction can work synergistically because it has a background of different active substances and mutual synergism in lethal larvae of S. litura.

Conclusion

The use of botanical pesticides that derived from mahogany seed, Sour Sup leaf and a combination of both of them can increase the time to stop-feeding and mortality of *S.litura* larvae, with the highest palatability score on 24 hours after application on MS (50.00%), SS (33.33%), SS combination MS 200 + 100 g / l at 66.67%. At MS, the value of LC50 (at 237.266 g / l at 120 hours after application), SS (279.160 g / l at 168 after application). It means that the effectiveness of the MS faster 48 hours than the SS in achieving LC_{50}.

References

Achmad SA. 2009. Ilmu Kimia dan Kegunaan Tumbuh-Tumbuhan Obat Indonesia. Bandung: ITB.

Alagarmalai Jeyasankar, Selvaraj Premalatha, Kuppusamy Elumalai. 2012. Biological activities of *Solanum pseudocapsicum* (Solanaceae) against cotton bollworm, *Helicoverpa armigera* Hübner and armyworm, *Spodoptera litura* Fabricius (Lepidotera: Noctuidae). Asian Pac J trop Biomed 2 **12**, 981-986

Bedjo, *2008*. Potensi Berbagai Isolat SL-NPV Asal Jawa Timur untuk Pengendalian *Spodoptera litura* Fabricius (Lepidoptera: Noctuidae). Tesis. Program Pasca Sarjana Universitas Brawijaya. Malang. 103

Bhurat MR, Bavaskar SR, Agrawal AD, Bagad YM. 2011. *Swietenia mahagony* Linn. A phytopharmacologycal review. Asian JPharm.Res 1 **1**, 1-4

Coloma AG, Gutierrez E. De La Pena D, Cortez. 2002. Insecticidal and Mutagenic Evaluatiuon of Two Annonaceous Acetogenins. J. Nat. Prod.63.

D'Incao MP, Gosmann G, Machado V, Fiuza, LM, Moreira GRP. 2012. Effect of saponin extracted from *Passiflora alata* Dryander (Passifloraceae) on development of the *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera, Noctuidae). International Journal of Plant Research **25**, 151-159

Departemen Pertanian. 2005. Ulat grayak http://www.deptan.go.id/ditlinhorti/opt/bw_merah/ult_grayak.htm. Accessed at Janary 15th, 2013

Hans E, Hummel DF Hein, Schmutterer, H.. 2012. The coming of age of azadirachtins and related tetranortriterpenoids. J.Biopest **5**, 82-87

Jan Alexander A, Auðunsson AA, Benford D, Cockburn A, Cravedi J. Dogliotti E, Domenico AD, Férnandez-Cruz ML, Fink-Gremmels J, Fürst P, Galli C, Grandjean P, Gzyl J, Heinemeyer G, Johansson N, Mutti A, Schlatter J, van Leeuwen R, Van Peteghem C, Verger P. 2009. Saponins in *Madhuca longifolia* L. as undesirable substances in animal feed. Scientific opinion of the panel on contaminants in the food chain. The EFSA Journal.979, 1-36

Kardiman Adan, Ruhnayat A. 2002. Mimba, Budidaya dan Pemanfaatan. Jakarta, Agromedia Pustaka.

Mulyawati AP. 2009. Efektifitas Insektisida Botani dari Ekstrak Air Campuran Daun Paitan *(Titonia diversifolia),* Daun Tembakau *(Nicotiana*

tabacum L.) dan Daun Sirsak *(Annona muricata* Linn.*)* terhadap Penekanan Populasi Hama Daun *Heliothrips haemorrhoidalis* Bouch pada Tanaman Jarak Pagar *(Jatropha curcas)*. Not published. Malang, Kimia UIN Malang.

Saghal G, Ramanathan S, Sasidharan S, Mordi MN, Ismail S, Mansor SM. 2009. Phytochemical and antimicrobial activity of *Swietenia mahagony* crude methanolic seed extract. Tropical biomedicine **26(3),** 274-279

Sinta. 2012, Uji Efektifitas Berbagai Bahan Nabati Biji Sour Sup, Bawang Putih, dan Biji Bengkoang Terdahap hama *Spodotera Litura* F.Skripsi. Not published. Malang, Biology Departement, Faculty of Math. And Natural Sciences, Brawijaya University

Suirta P, Gumiati. 2007. Isolasi dan Identifikasi Senyawa Aktif Larvasida Dari Biji Mimba *(Azadirachta indika*. Juss*)* terhadap Larva Nyamuk Demam Berdarah *(Aedes aegypti)*. Bali, Jurusan Kimia FMIPA Universitas Udayana

Taufiqurrohman. 2004. Pengaruh Penambahan Ekstrak Daun Tembakau (*Niciana tabaccum* L.) pada Spodoptera Nuclear Polyhedrosis Virus (SINPV). Skripsi Not published. Malang, Faculty of Agriculture, Brawijaya University

Tengkano W, Suharsono. 2003. *Spodoptera litura* Sebagai Hama Pemakan Daun. Lokakarya Pemanfaatan Nuclear Polyhedrosis Virus (NPV) Sebagai Agens Hayati Untuk Mengendalikan Hama Pemakan daun Kedelai *Spodoptera litura F.* Malang, Balitkabi. 20p.

Toyib H. 1990. Seminar Pengelolaan Hama dan Tungau Dengan Sumber Hayati, Soekerman di Perlindungan Tanaman Menunjang Terwujudnya Pertanian Tangguh Dan Kelestarian Lingkungan. Jakarta. PT Agricon

Yuningsih, Muharsini S, Wardhana AH. 2006.Uji Keefektifan Biji Sour Sup *(Annona muricata)* dan Akar Tuba *(Derris elliptica)* terhadap Larva *Chymsomya bezziana* secara In Vitro. Bogor, Balai Penelitian Veteriner.