NUSANTARA BIOSCIENCE
Vol. 8, No. 2, pp. 141-144
November 2016

ISSN: 2087-3948
E-ISSN: 2087-3956
DOI: 10.13057/nusbiosci/n080202

Short Communication: Qualitative determination of secondary metabolic compounds and macro-nutrients some botanical pesticide plants of East Kalimantan, Indonesia

INCE RADEN[1,♥], SUYADI[2,♥], THAMRIN[1]

[1]Faculty of Agriculture, Universitas Kutai Kartanegara. Jl. Gunung Kombeng, No. 27, Tenggarong, 75513, East Kalimantan, Indonesia, ♥email: irad_unikarta@yahoo.com

[2]Department of Agrotechnology, Faculty of Agriculture, Universitas Mulawarman. Jl. Paser Balengkong, Gunung Kelua, Samarinda Ulu, Samarinda-75123, East Kalimantan, Indonesia. ♥♥email: suyadi@faperta.unmul.ac.id

Manuscript received: 19 December 2015. Revision accepted: 10 June 2016.

Abstract. *Raden I, Suyadi, Thamrin. 2016. Qualitative determination of secondary metabolic compounds and macro-nutrients some botanical pesticide plants of East Kalimantan, Indonesia. Nusantara Bioscience 8: 141-144*. The existence of natural alternative inputs for crop husbandry was considered as important resource of good agricultural practices to attend an environmentally friendly agricultural management. There are numerous potential plants for botanical pesticide used native in East Kalimantan, and those plants have been used by farmer to pest control, but they didn't know secondary metabolic compound and macronutrient in the plants. Pest control and soil fertility management were two main problems of agricultural development in East Kalimantan. This study aims to determine various secondary metabolic compounds and macronutrients content of six botanical pesticide plants, i.e. marigold (*Tagetes erecta* L.), neem tree (*Azadirachta indica* L.), sweet flag (*Acorus calamus* L.), brotowali (*Tinospora crispa* L.), soursop (*Annona muricata* L.), and golden trumpet vine (*Allamanda cathartica* L.). Some laboratory analysis were implemented in the study, variables used to determine secondary metabolic compounds were flavonoids; steroids; alkaloid; tannins; triterpenoids; and saponins, while, variables used to determine macronutrients were Nitrogen, Phosphorus, Potassium, Magnesium, and Calcium. Results showed that all of six botanical pesticides evaluated in this study were containing potential secondary metabolic compounds (SMC), soursop leaves containing three kinds of SMC (flavonoids, steroid, and tannin), whereas golden trumpet vine leaves only containing one kind of SMC (tannin), and the other four botanical pesticides (marigold, neem tree, sweet flag, and brotowali) containing two kinds of SMC (flavonoids and tannin). Furthermore, based on macronutrients content analysis, marigold contains macronutrient higher than other plants as liquid fertilizer source followed by neem tree, soursop, and sweet flag.

Keywords: Botanical pesticide, macro nutrient, marigold, neem tree, sweet flag, brotowali, sour-sop, golden trumpet vine

INTRODUCTION

Kutai Kartanegara District of East Kalimantan, Indonesia located in the tropical rain forest climatic zone, as we recognize that forest ecosystem in the tropic was rich in species diversity of fauna and flora (Molino and Sabatier 2001). Some of plant species found in the forest were potential for the botanical pesticide sources, and some parts of those plant can be utilized as raw material for botanical pesticide to control pests attacking crops; Asha and Ganjewala 2011; Choudhary et al. 2010; Ahmed et al. 2006; Castillo-Sánches et al. 2010; Priyanka et al. 2013). Some farmer in Kutai Kartanegara District frequently used some plants as botanical pesticide to control pests attacking their crop, those botanical pesticide plants commonly found around their farm, although they did not know the metabolic secondary compound in the plant, e.g. marigold (*Tagetes erecta* L.), neem tree (*Azadirachta indica* L.), sweet flag (*Acorus calamus* L.), brotowali (*Tinospora crispa* L.), soursop (*Annona muricata* L.), and golden trumpet vine (*Allamanda cathartica* L.). Botanical pesticides were prospective input for pest control in crops husbandry, it was environmentally friendly and relatively safe for consumers.

Botanical pesticide mode of action on target pest can be the role of an active ingredient solely or complex compound derived from plants (leaves, fruit, seeds or roots). The expression impact of botanical pesticide on the pest might be acting as a repellent, pullers, infertility, pest killers and other impacts on pest growth and development, as well as on their behavior (Hollingworth 2001; Mahmun and Ahmed 2011; Yunita et al. 2009). However, application of botanical pesticides in farm scale still faced some limitation or difficulties. Their effectiveness in controlling crop pests was reduced easily due to height temperature and long storage period, as illustrated in inducing finding by Znidarcic et al. (2010) and Znidarcic et al. (2013).

Pest control and soil fertility management were two main problems faced by farmer in crop production in Kutai Kartanegara District as well as East Kalimantan in general, especially for increasing quality of agricultural products. Furthermore, the two problems generally considered as the limiting factors in crops production. To solve those

problems farmer mostly depends on inorganic pesticides and fertilizers. There are some disadvantage use inorganic pesticides, i.e., decreasing of quality agricultural land and crops are less healthy, if used excessively. However, availability and utilization of botanical pesticide plants were prospective to solve those problems. Botanical pesticide plants can be formulated to settle the two problems simultaneously, because in the application it will control the pest and supply some macronutrients to the crop as liquid fertilizer.

Based on the explanations stated above, the study aims to determine various secondary metabolic compounds and macronutrients content of six botanical pesticide plants, i.e. marigold (*Tagetes erecta* L.), neem tree (*Azadirachta indica* L.), sweet flag (*Acorus calamus* L.), brotowali (*Tinospora crispa* L.), soursop (*Annona muricata* L.), and golden trumpet vine (*Allamanda cathartica* L.). Furthermore, to observe the most effective botanical pesticide plants to control pests as well as beneficial as liquid fertilizer.

MATERIALS AND METHODS

The study was conducted from April to July 2014, including field observation and laboratory analysis activities. Field observation was carried out to gather raw material of botanical pesticide plants. Followed by, laboratory analysis to determine the existence of secondary metabolic and macronutrient content of each species of botanical pesticide. Plant materials of botanical pesticide were harvested from Loa Kulu sub-district, around food crop area. Leaves were plants part material used as botanical pesticide for all species, except for brotowali used rod and leaves as botanical pesticide material.

Preparation of raw material of botanical pesticide for laboratory analysis was conducted in the Laboratory of Agriculture Faculty, Kutai Kartanegara University. Raw materials of botanical pesticide plants used for laboratory analysis as the following: leaves of marigold, leaves of neem tree, leaves of sweet flag, rod and leaves of brotowali, leaves of soursop, and leaves of golden trumpet vine. The material being analyzed is prepared by means of each raw material botanical pesticide ingredient thinly sliced, then put it on the paper for dried for 24 hours, then, each of raw material of pesticides is blended up into powder. After that, placed in a plastic cup container, and labeled and then sealed with a plastic cover so that the samples remain sterile and not contaminated with microbes. Furthermore, phytochemical analysis of each botanical pesticide plant was conducted at Forest Products Laboratory, Faculty of Forestry, Universitas Mulawarman, Samarinda, East Kalimantan, Indonesia.

The qualitative phytochemical analysis was used to analyze the secondary metabolic contents of botanical pesticide plants, and the indicator of secondary metabolic used in this analysis were flavonoids; steroids; alkaloid; tannins; triterpenoids; and saponins. Meanwhile, analysis used for determining macronutrients were the Kjeldahl method for nitrogen determination, and the Atomic absorption spectroscopy (AAS) method for P_2O_5; K_2O; Mg; and Ca determination.

RESULTS AND DISCUSSION

The best botanical pesticide plant could be selected from six species candidate based on the secondary metabolic content as pest control agent and the macronutrients content as fertilizer for the crop. To select the appropriated botanical pesticide will be depend on the crop management problem, if it focused on the pest problem - must be selected the most effective botanical pesticide to control the pest target, if it focused on the crop's growth and production - must be selected the highest in macronutrient content of the botanical pesticide. However, combination of both selection focuses will be the most accepted justification for application of botanical pesticide in practical by farmers.

Qualitative content of the secondary metabolic compounds

Botanical pesticide is a biopesticide, natural plant products and might be grown by farmers with minimum cost and extracted by simple method. Botanical pesticides are secondary metabolites, e.g. alkaloids, terpenoids, phenolics, and minor secondary chemicals. It was estimated that as many as 2121 plant species have been reported as botanical pesticides. Those botanical pesticide materials can be used as alternative chemical pesticides (Mamun and Ahmed 2011).

Based on qualitative phytochemical analysis, specimens of six botanical pesticide plants were contained various secondary metabolic as shown in Table 1. Tannin was found in all botanical pesticide plants secondary metabolic and occurred in all botanical pesticide plants. Furthermore, those six plants, in general, could be divided into three groups based on the secondary metabolic content, i.e. (i) golden trumpet vein (tannin only), (ii) soursop (tannin, flavonoids, and steroid), and (iii) the rest four plants species contained both tannin and flavonoids. The group differences will affect the effectiveness of those botanical pesticides in controlling a target pest.

Flavonoids have toxic effects, antimicrobial or protector plants from pathogens, as well as antifeedant. Hollingworth (2001) reported that rotenon a flavonoid compound has a lethal effect on insects. Rotenon worked as poisons cellular respiration, which inhibits electron transfer in NADH-coenzyme ubiquinone reductase (complex I) of the electron transport system in the mitochondria. Five of the six botanical pesticide plants contain this type of compound, whereas golden trumpet vine the only plant species showing negative responses (-), it means that the golden trumpet vine does not contain flavonoids.

Based on the analysis of qualitative phytochemical, it was known that one of six botanical pesticide plants species (soursop) contained steroids. Steroids are known as compounds that have a toxic effect, Yunita et al. (2009) reported that leaves extract of teklan (*Eupatorium riparium*) contain secondary metabolites such as steroid that affected and inhibited the development of *Aedes aegypti*.

Table 1. The secondary metabolic compounds of six botanical pesticide plants from Kutai Kartanegara District, East Kalimantan Province of Indonesia

Species	Common name	Qualitative of secondary metabolic compounds					
		Flavonoids	Steroid	Alkaloids	Tannin	Triterpenoids	Saponin
Annona muricata L.	Soursop	+	+	-	+	-	-
Acorus calamus L.	Sweet flag	+	-	-	+	-	-
Allamanda cathartica L.	Golden trumpet	-	-	-	+	-	-
Azadirachta indica L.	Neem tree	+	-	-	+	-	-
Tagetes erecta L.	Marigold	+	-	-	+	-	-
Tinospora crispa L.	Brotowali	+	-	-	+	-	-

Table 2. Macronutrients of six botanical pesticide plants from Kutai Kartanegara District, East Kalimantan Province of Indonesia

Species	Common name	Macronutrients				
		N-total (%)	P_2O_5 (%)	K_2O (%)	Mg (Fp = 20^x)	Ca (Fp = 20^x)
Acorus calamus L.	Sweet flag	1.51	3.22	3.48	13.49	100.83
Allamanda cathartica L.	Golden trumpet	0.18	0.98	3.02	43.34	350.12
Annona muricata L.	Soursop	0.21	1.14	4.89	30.76	201.17
Azadirachta indica L.	Neem tree	3.09	1.46	3.73	35.63	1142.40
Tagetes erecta L.	Marigold	3.30	3.10	6.63	42.27	182.06
Tinospora crispa L.	Brotowali	0.59	3.82	3.77	16.02	102.40

Qualitative phytochemical test showed that all of six plants species were containing tannins, and expressed a positive response in the laboratory test. Tannins are phenolic metabolites, which naturally produced by plants. They can defend plants against pathogen microorganisms and viruses (Unver et al. 2014). According to Yunita et al. (2009), tannin to be antimicrobial, and it has a bitter taste that may cause inhibition of insects feeding. Saponins and tannins are the main active principles of botanical pesticides. Botanical pesticide formulations are obtained by drying and powdering the rhizomes and applied in an aqueous solution. It reduces the infestation of red mites (60-88%) and kills eggs (33-70%) of the red mite in tea.

Macronutrients

In order to increase the beneficial impact of the application of the botanical pesticides, in the laboratory analysis of botanical pesticide plants, it was not only analyzing the secondary metabolic content also analyzing the macronutrients content of the plants. Furthermore, the application of botanical pesticide in the field will control the pest problem, and at the same time, it will supply macronutrient for better plant growth and development. The results of the laboratory analysis of six botanical pesticide plants for their macronutrient content were listed in Table 2.

Based on the results of laboratory analysis showed that marigold was the best candidate of botanical pesticide, because this plants not only effective to control some crop's pest, but also contain macronutrient higher than other plants as liquid fertilizer (Table 2)**.** According to standard of liquid fertilizer industry of Indonesian Government (Permentan No. 70/Permentan/SR.140/10/ 2011), marigold was fulfilled the requirement as liquid fertilizer in term of nitrogen, P_2O_5, K_2O content. While, the other five plants species were partly fulfilling the requirement, e.g. sweet flag and brotowali for P_2O_5 and K_2O content, neem tree for nitrogen and K_2O content, soursop and golden trumpet vine for K_2O content. Furthermore, magnesium (Mg) and calcium (Ca) were importance nutrient required by plant could be fulfilling by botanical pesticide plants insufficient level.

Nitrogen such as ammonium and nitrate were very important component in agriculture productivity, such as in practical aspects of fertilizers intensive program application for food crops production (Mendonca and Schiavinato 2005). The role of phosphorus in plant growth has been investigated by many teams (Hinsinger 2001; Pant and Reddy 2003; Shafeek et al. 2004); all of them were agree that the presence of phosphorus (P) in the soil encourages plant growth, because phosphorus was an essential nutrient. Currently, lack of this element from soil supply would be repaired by the use of biological manure and/or chemical fertilizers. Furthermore, P and K were important nutrients for growth and production of the vine (Ruiz and Sadzawka 2005), both nutrients can generate a positive interaction in the productivity of vineyards, even when other agronomic factors, such as irrigation and N management can equally affect the expression of the yield potential of pisco vineyards (Sierra and Alfaro 2008). The magnesium has been shown as an important nutrient in the production of green mass. If the plants were developed until grain formation, the dry weight could continue to increase for an additional period during the bean formation, covering the seed development and maturation (Oliveira et al. 2000).

So, available information about the secondary metabolic and macronutrient content of six botanical pesticide plants will offer an alternative choice to utilize them properly. Furthermore, utilization of the botanical pesticide will be more popular and accepted by farmers. Then, problems related to pest control and fertilization, and the quality of agricultural production will get higher.

In conclusion, all of the six botanical pesticide plants determined in this study were potential to be used and develop as botanical pesticide in practical for specific pest. Furthermore, according to the standard of liquid fertilizer industry of Indonesian Government, those plants were fulfilling or partly fulfilling to utilize as liquid fertilizer source material. Considering for both purposes, as botanical pesticide and also liquid fertilizer source, marigold will be the best candidate selected as botanical pesticide to be developed and evaluated more intensive.

REFERENCES

Ahmed SM, Manhas LR, Verma V, Khajuria RK. 2006. Quantitative determination of four constituents of *Tinospora* sp. by a reversed-phase HPLC-UV-DAD method. Broad-based studies revealing variation in content of four secondary metabolites in the plant from different eco-geographical regions of India. Journal of Chromatographic Science 44 (8) 504-509.

Asha DS, Ganjewala D. 2011. Antioxidant activities of methanolic extracts of *Acorus calamus* (L.) rhizome and leaves. J Herbs Spices Med Plants, 17:1-11.

Castillo-Sánchez LE, Jiménez-Osornio JJ, Delgado-Herrera MA. 2010. Secondary metabolites of the Annonaceae, Solanaceae and Meliaceae families used as biological control of insects. Trop Subtrop Agroecosyst 12: 445-462.

Choudhary MI, Ismaila M, Alia Z, Shaari K, Lajis NH, Atta-ur-Rahman. 2010. Alkaloidal constituents of *Tinospora crispa* . Nat Prod Comm 5 (11): 1747-1750.

Shafeek MR, Faten S, Abd Al Ali El, Aisha H. 2004. The productivity of broad bean plant as affected by chemical and/or natural phosphorus with different bio-fertilizer. J Agric Sci Mansoura Univ 29 (5):2727-2740.

Hinsinger P. 2001. Bioavailability of soil inorganic P in the rhizosphere as affected by root-induced chemical changes: a review. Plant Soil 237 (2): 173-195.

Hollingworth RM. 2001. Inhibitors and Uncouplers of Mitochondrial Oxidative phosphorylation. In: R. Krieger, J. Doull, D. Ecobichon, D. Gammon, E. Hoyson, L. Reiter, J. Ross. (eds). Handbook of Pesticide Toxicology, Vol. 2. Academic Press, San Diego.

Oliveira IP, Asher CJ, Edwards DG, dos Santos RSM. 2000. Magnesium sulphate and the development of the common bean cultivated in an Ultisol of Northeast Australia. Sci. Agric. vol. 57 n.1 Piracicaba.

Mamun MSA, Ahmed M. 2011. Prospect Of Indigenous Plant Extracts In Tea Pest Management. Int J Agril Res Innov Tech 1 (1&2): 16-23.

Mendonca EHM, Schiavinato MA. 2005. Growth of *Crotalaria juncea* L. supplied with mineral nitrogen. Brazilian Arch Biol Technol 48: 181-185

Molino JF, Sabatier D. 2001. Tree diversity in tropical rain forest: A validation of the intermediate disturbance hypothesis. Science 294 (11): 1702-1704.

Pant HK, Reddy KR. 2003. Potential internal loading of phosphorus in wetlands constructed in agricultural. Land Water Res 37: 965-972.

Priyanka D, Shalini T, Navneed VK. 2013. A brief study of Marigold (*Tagetes species*): A review. Intl Res J Pharm 4 (1): 43-48.

Ruiz R, Sadzawka A. 2005. Nutrición y fertilización potásica en frutales y vides. Colección Libros INIA N° 14. 80 p. Instituto de Investigaciones Agropecuarias, Centro Regional de Investigación La Platina, Santiago, Chile.

Sierra CB,Alfaro RP. 2008. Potassium and phosphorus in muscat rosada grape yield in elqui valley soil. Chilean J. Agric. Res. 68: 297-303.

Unver E, Okur AA, Tahtabiçen E, Kara B, Samli HE. 2014. Tannins and their impacts on animal nutrition**.** Turkish J Agric Food Sci Technol 2 (6): 263-267.

Yunita EA, Suprapti NH, Hidayat JS. 2009. Leaf extract teklan (*Eupatorium riparium*) on mortality and development of larvae of *Aedes aegypti*. Biome 11 (1): 11-17.

Znidarcic D, Ban IID, Milan-Oplanic M, Karic L, Pozra T. 2010. Influence of postharvest temperatures on physicochemical quality of tomatoes (*Lycopersicon esculentum* Mill.). J Food Agric Environ 8: 21-25.

Znidarcic D, Sircelj H, Kacjan-Marsic N. 2013. The influence of temperature and storage time on Cantaloupe melons physicochemical quality. Italy J Food Sci 25: 459-464.