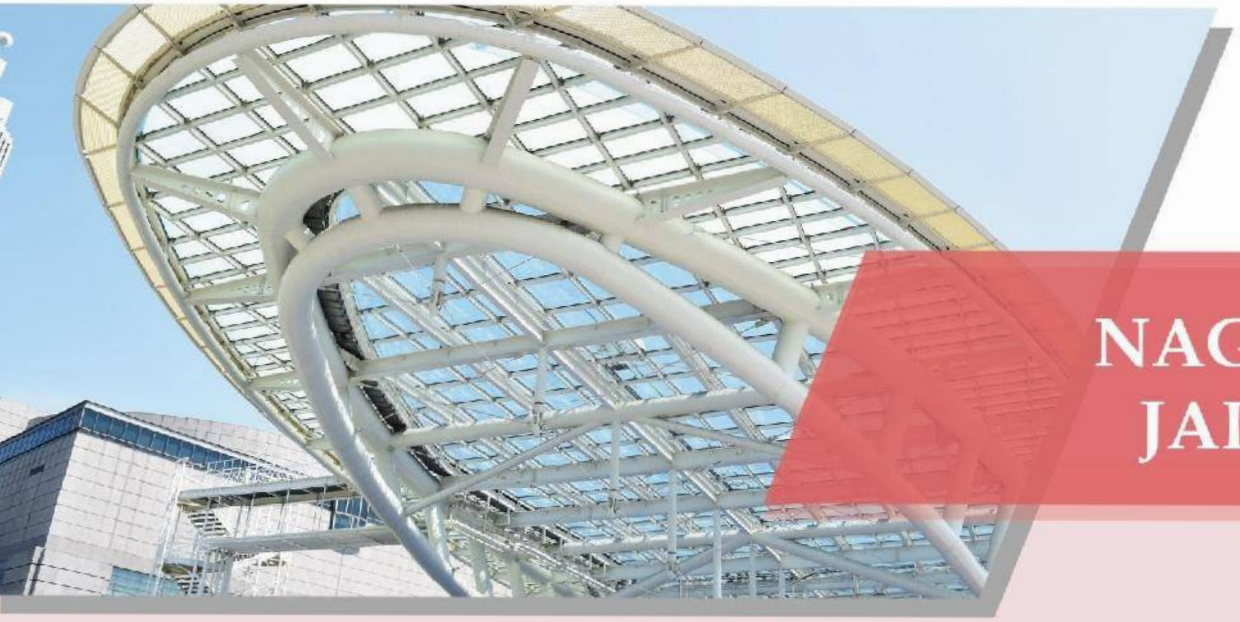
March 29-31, 2017

Conference Proceedings



NAGOYA
JAPAN

ACEAIT

Annual Conference on Engineering and Information Technology

APLSBE

Asia-Pacific Conference on Life Science and Biological Engineering

ISFAS

International Symposium on Fundamental and Applied Sciences

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ACEAIT

Annual Conference on Engineering and Information Technology

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ISFAS

International Symposium on Fundamental and Applied Sciences

ISBN 978-986-89298-5-2

Content

Welcome Message

Local Host

Michiko Miyamoto

Professor
Akita Prefectural University, Japan

Dear Conference Delegates,
I would like to extend a very warm welcome to all of you to joint conferences in Nagoya, Japan, organized by the Higher Education Forum (HEF).

Nagoya is located at the center of Honshu (the main island of Japan) and has a long history dating back 1900 years, when Atsuta Jingu (one of Japan‟s most important Shinto shrines) has a close relationship with the legendary people who appear in Kojiki (the oldest history book of Japan), was established. Nagoya is the birthplace of three notable feudal lords, Oda Nobunaga, Toyotomi Hideyoshi and Tokugawa Ieyasu, and developed as the castle town of the Owari, one of the three branches of the ruling Tokugawa family during the Edo Period (1603 - 1867). Nagoya plays an important role in Japan's industrial society. The Toyota Motor Corporation, a global automotive industry leader, maintains its headquarters just outside of Nagoya. Today, Nagoya continues to draw attention and keeps on developing as a Japanese international city.
Nagoya has many famous attractions to entice the keen traveler, including Nagoya Castle (one of Japan‟s Three Famous Castles), Atsuta Jingu, and Osu Kannon Temple (a popular Buddhist temple in the heart of the city).
Nagoya is home to arguably some of Japan‟s best food as well. It has always been a popular destination for people in the know with some of the country‟s best and most interesting culinary delights, such as Miso Katsu (Deep fried pork cutlet topped with a thick miso sauce), Tebasaki (Deep fried spicy chicken wings), Miso Nikomi Udon (an udon that‟s stewed in a miso based broth with hatcho-miso), Ankake Spaghetti (spaghetti topped with a spicy and sticky sauce), Tenmusu (A rice ball containing shrimp tempura).
Enjoy this opportunity to both share your research and experience Nagoya!.

Michiko Miyamoto
Local host
Professor, Akita Prefectural University

General Information for Participants

■ Registration

The registration desk will be situated on the **2F of Building 2** at the **Nagoya Congress Center** during the following time:

08:30-16:00 Thursday, March 30, 2017
08:30-14:00 Friday, March 31, 2017

Lunch Venue: Cafeteria Cascade on B1F of Building 3

■ Organizer

Higher Education Forum (HEF)
Tel: + 886 2 2740 1498 | www.prohef.org

■ A Polite Request to All Participants

Participants are requested to arrive in a timely fashion for all addresses, whether to their own, or to those of other presenters. Presenters are reminded that the time slots should be divided fairly and equally between the number of presentations, and that they should not overrun. The session chair is asked to assume this timekeeping role and to summarize key issues in each topic.

■ Preparation for Oral Presentations

All presentation rooms are equipped with a screen, an LCD projector, and a laptop computer installed with Microsoft PowerPoint. You will be able to insert your USB flash drive into the computer and double check your file in PowerPoint. We recommend you to bring two copies of the file in case that one fails. You may also connect your own laptop to the provided projector; however please ensure you have the requisite connector.

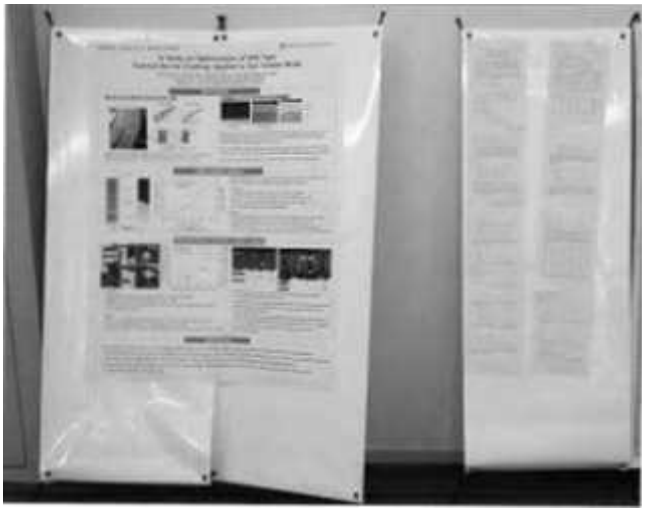
Preparation for Poster Presentation

Materials Provided by the Conference Organizer:

1. X-frame display & base fabric canvases (60cm×160cm)
2. Adhesive tapes or binder clips

Materials Prepared by the Presenters:

1. Home-made Poster(s)
2. Material: not limited, can be posted on the canvases
3. Recommended poster size: 60cm*160cm

	
A 60cm*160cm poster illustrates the research findings.	1. Wider than 60cm (left) 2. Copy of PowerPoint slides in A4 papers (right)

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International Committee of Nature Sciences

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Conference Venue Information

Nagoya Congress Center
1-1 Atsuta-nishimachi, Atsuta-ku, Nagoya 456-0036
Tel:+81-52-683-7711
Fax:+81-52-683-7777

Floor Map (2nd floor, Building 2)


Hall Allocation
Plenary / Session
Session / Meeting
Bldg.2
Bldg.3
Bldg.4
Bldg.1
Cafeteria Cascade
RESTAURANT
CAFETERIA
RECEPTION HALL
SHICHIFUKUJIN HALL
CENTURY HALL
EVENT HALL
ADMINISTRATION
FLOW LINE
1
2
3
4

Conference Schedule

Wednesday, March 29, 2017
Internal Meeting
(HEF Staff Only)

Thursday, March 30, 2017 Oral Presentation(2nd floor, Building 2)		
Time	**Schedule**	**Venue**
08:30-16:00	**Registration**	**Foyer area**
09:00-10:30	Biological Engineering & Biomedical Engineering & Chemical Engineering	Room 221
10:30-10:50	**Tea Break**	**Foyer area**
10:50-11:50	**Keynote Speech** **Dr. Donald L. Amoroso** Auburn University Montgomery Topic: *Innovation in ASEAN 2025*	Room 221
11:50-13:00	**Lunch Time**	**Cafeteria Cascade (B1, Bldg. 3)**
13:00-14:30	Mechanical Engineering and Technology (1)	Room 221
14:30-14:50	**Tea Break**	**Foyer area**
14:50-16:20	Civil Engineering & Materials Science and Engineering	Room 221

Thursday, March 30, 2017 Poster Session(Room 225, 2nd floor, Building 2)	
Time	**Information**
09:30-10:30	Poster Session (1)
	Computer Engineering and Technology / Electrical Engineering and Technology / Information Engineering and Technology
13:30-14:30	Poster Session (3)
	Materials Science and Engineering / Biological Engineering / Biomedical Engineering / Chemical Engineering
15:00-16:00	Poster Session (4)
	Mechanical Engineering and Technology

Friday, March 31, 2017 Oral Presentation(2nd floor, Building 2)		
Time	**Schedule**	**Venue**
08:30-14:00	**Registration**	**Foyer area**
09:00-10:30	Computer Engineering and Technology & Information Engineering and Technology	Room 221
	Environmental Engineering & Geology, Earth and Environmental Sciences	Room 222
10:30-10:50	**Tea Break**	**Foyer area**
10:50-11:50	Mechanical Engineering and Technology (2)	Room 221
	Fundamental Sciences & Nanotechnology	Room 222
	Agricultural Engineering and Technologies	Room 223
11:50-13:00	**Lunch Time**	**Cafeteria Cascade (B1, Bldg. 3)**
13:00-14:30	Electrical Engineering and Technology	Room 221
	Life Sciences	Room 222

Friday, March 31, 2017 Poster Session(Room 225, 2nd floor, Building 2)	
Time	**Information**
09:30-10:30	Poster Session (5)
	Life Sciences (1) / Nanotechnology
11:00-12:00	Poster Session (6)
	Life Sciences (2) / Agricultural Engineering and Technologies / Environmental Engineering / Geology, Earth and Environmental Sciences

Keynote Speech
Room 221, 2nd Floor
10:50-11:50, Thursday, March 30, 2017

Topic: Innovation in ASEAN 2025

Dr. Donald L. Amoroso
Lowder-Weil Endowed Chair and Professor of Information Systems
Auburn University Montgomery
President and CEO of Axcell LLC

Abstract:
With the entrance of the Association of Southeast Asian Nations, there has been a strong initiative for innovation. The size of ASEAN is projected to have a combined GDP of $3.5 trillion by 2020 and projected to rank as the 5th largest economy in the world. With over 125 million consumers and a projected populations in 2020 of 800 million people, there is much potential for innovation, impact, and social change. ASEAN Impact Challenge is a regional challenge designed for impact-driven innovators within the ASEAN region. The initiative is open to innovations with the potential and capacity to develop and scale, while providing long-term solutions and impact on pressing community, social and environmental issues around the theme of Innovations for Urban Impact. We will discuss the ASEAN ecosystem and the opportunities for innovation over the next ten years.

Brief Introduction of Dr. Donald L. Amoroso
Dr. Amoroso is the Lowder-Weil Endowed Chair and Professor of Innovation and Strategy at Auburn University Montgomery, Alabama, United States. He is Visiting Professor and Research Fellow at Asian Institute of Management in Manila, Philippines and Palawan State University, Philippines. He has been Visiting Professor at Tsukuba University, Japan, Addis Ababa University, Ethiopia, and Australian Defence Force Academy, Canberra Australia. His industry experience includes working in General Electric Capital as Assistant Vice President and Director of Enterprise Solutions, with Solista/GartnerGroup as a consulting partner, and with Northrup-Grumman in finance. He worked with the Center for the Commercialization of Advanced Technologies (CCAT) in Washington D.C. and San Diego where he led over 24 innovation projects and assisted in the start up of 14 new companies. Dr. Amoroso received his MBA and Ph.D. from the University of Georgia in 1984 and 1986, respectively.
In research, Dr. Amoroso is conducting a five-year project studying consumer intention to adopt mobile wallet applications in different ASEAN ecosystems in Southeast Asian countries, Japan, China, and Korea. Dr. Amoroso is working with colleagues at twelve Japanese, fifteen Chinese, and six Philippine universities to understand innovation processes in organizations, in addition to consumer adoption. Dr. Amoroso has been on the editorial board of key journals and has written

five books, published in 121 refereed academic journals and over 70 conferences in the past 30 years.

In consulting, Dr. Amoroso is Founder and CEO of Axcell LLC Consulting Group, with over 25 years of consulting, mentoring, seminars, and facilitation in the spaces of leadership, innovation and strategy. Organizations that want to break the competitive boundary in their industry consult with Dr. Amoroso, especially in the area of big data and analytics, innovation and design thinking, and strategic planning with Blue Ocean Strategy. He coaches and mentors over 65 executives and has been working with organizations to establish portfolio management offices (PMO) and has mentored 207 aspiring CIOs in multiple countries.

Biological Engineering & Biomedical Engineering & Chemical Engineering

Thursday, March 30, 2017 09:00-10:30 Room 221

Session Chair: *Cholid Badri*

APLSBE-819
Modeling of Artificial Mandible and Integrated Condylar Prosthesis Using Polyetheretherketone (PEEK) and Titanium Materials in Reconstructive Maxillofacial Surgery
Cholid Badri | *Universitas Indonesia*
Anwar Soefi Ibrahim | *Universitas Indonesia*
Benny Syarifsyah Latief | *Universitas Indonesia*
Sastra Kusuma Widjaj | *Universitas Indonesia*
Vincentius Sutarmo Setiadji | *Universitas Indonesia*

APLSBE-814
Optimum Criteria for Intrusion of a Maxillary Central Incisor in Lingual Orthodontics: A Numerical Study
Abhishek M. Thote | *Visvesvaraya National Institute of Technology, Nagpur, Maharashtra*
Rashmi Vikram Uddanwadiker | *Visvesvaraya National Institute of Technology, Nagpur, Maharashtra*
Krishna Sharma | *Sharad Pawar Dental College, Wardha, Maharashtra*
Sunita Shrivastava | *Sharad Pawar Dental College, Wardha, Maharashtra*
Gangadhar Navnage | *Visvesvaraya National Institute of Technology, Nagpur, Maharashtra*

ACEAIT-8405
Intelligent Electric Power Wheelchair for Physically and Mentally Disabled
Benchalak Muangmeesri | *Valaya Alongkorn Rajabhat University*
Dechrit M | *Rajamangala University of Technology*
Arom K | *Phamongkutklao Hospital*
Suthee P | *Phramongkutklao College of Medicine*

ACEAIT-8298
Thermal Instability Assessment of De-Lithiated Cathode Materials of Lithium Nickel Manganese Cobalt Oxide Reacted with Electrolytes
Hao-Hsin Yu｜*National United University*
Yu-Ling Chen｜*National United University*
Chen-Shan Kao｜*National United University*
Yih-Shing Duh｜*National United University*

ACEAIT-8308
Thermal Runaway Hazards Study of Commercial High Capacity 26650 Lithium-Ion Batteries by Confinement Test
Jia-Hui Jeng｜*National United University*
Chen-Shan Kao｜*National United University*
Yih-Shing Duh｜*Jen-Teh Junior College of Medicine, Nursing and Management*
Yu-Ling Chen｜*National United University*

ACEAIT-8343
Highly Efficient Capture of Bladder Epithelial Cancer Cells by Stretched Polycarbonate Nanopillars
Wen-Huei Chang｜*National Pingtung University*
Shang-Hui Yu｜*National Cheng Kung University*
Yi-Chun Chiu｜*Taipei City Hospital*
Yi-Jui Chen｜*National Cheng Kung University*
Zi-Yi Yang｜*National Cheng Kung University*
Chih-Chia Huang｜*National Cheng Kung University*
Chun-Hung Lin｜*National Cheng Kung University*

APLSBE-812
Formulation of Mixed Extracts of *Tephrosia vogelii* and *Piper aduncum*

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Abstract

The objective of this study was to make formulation of mixed extracts of *Tephrosia vogelii* and *Piper aduncum* in the form of emulsifiable concentrate (EC) and wettable powder (WP), which had insecticidal activity against *C. pavonana* cabbage pest. The rasio of *T. vogelii* and *P. aduncum* was 1:5 which was stable in water distillation and hard water. EC and WP formulations have insecticidal activity against *C. pavonana* with LC_{50} and LC_{95} of EC formulation were 0.15% and 0.13% and WP formulation 0.35% and 0.31% respectively. Besides causing the mortality of *C. pavonana*, EC and WP formulations inhibited the development of treatment larvae. The inhibition development of larval from second to third instar approximately 2.31 days, and the third to fourth instar 2.38 days compared to control. Residue of EC and WP formulations killed 100% *C. pavonana* at first day treatment, but Formulations persistence were significantly decreased on the second and third days after treatment. The addition of sunscreen ingredients did not affect the extract persistence on broccoli leaves.

Keywords: botanical pesticide, emulsifiable concentrate (EC), formulation, persistence, wettable powder (WP)

1. Background

Active ingredients were obtained from plant through extraction and isolation method namely extract or fraction. Extracts or fractions which have insecticidal activity cannot be used directly to control a target pest. Pure active compounds are very toxic against untarget organism and cultivation plants, besides incorrect handling will reduce theirs activities (ESCAP 1991). Instead, activities of active ingredient will be increased by various ingredient addition i.e carrier ingredients, adhesive ingredients, emulsifier ingredients, sunscreen and others (Mollet dan Grubenmann 2001). Formulation technology closely related to security storage aspects, simple application, and activity of active compound.

Two common formulations in agriculture field are *emulsifiable concentrate* (EC) and *wettable powder* (WP). EC formulation contain 20-50% active compound, 40-60% solvent, and 5-10% emulsifier. WP formulation contain 20-50% active compound, 30-70% carrier ingredient like kaolin, and 10-20% wetting agents (Waxman 1998; Mollet and Grubenmann 2001). Compatibilty between each ingredients are needed to improve performance of insecticides active compound according to Collaborative International Pesticides Analytical Council standard (CIPAC) (1980). Formulations should be stable on distilled water and hard water. Some physical aspects were observed related stability test such as color, foam, precipitate, and oil layer. Asman et al. (1999) was explained the separation on the top of formulation or precipitation on the base of formulation container should not exceed 2 mL.

Some botanical insecticide has been formulated on industrial scale, for example “Mimba” (*Azadirachta indica*) by Aegis Azzanim Private Ltd (India) was containing emulsifier 6 % and solvent 90 %. *Piper nigrum* extract has been formulated by R. Bradbury (ecosafe natural product, Saanichton, British Columbia Canada) and formula was containing 20 % extract, 70 % tetrahidrofurfuril alcohol, and 10 % emulsifier alkamuls (el-719 ethoxylated castor oil) (Scott *et al.* 2004). Potency of mixture extract of *T. vogelii* : *P. aduncum* (1:5) is very large to develop as botanical insecticide. Development in formulation technology are need to make mixture extract *T. vogelii* : *P. aduncum* (1:5) effective against target pest, stable in storage, and ready used by farmers in field. Objective of this research was to make formulation from mixture extract of *T. vogelii* : *P. aduncum* (1:5) in form *emulsifiable concentrate* (EC) and *wettable powder* (WP) wich have insecticides activities against cabbage pest *C. pavonana*.

2. Methods

The research was carried out in the laboratory of Insects Physiology and Toxicology, Plant Protection Department, Faculty of Agriculture, Bogor Agricultural University from April 2012 to February 2013.

2.1 Election of Tensida

Tensida was used according to standard of CIPAC. Several tensida i.e Agristick 400 L, Besmor 200 AS, Indostick 100/20 AS, Latron 750 L, Munstick, Prosticker, Teepol, and Tween 80 were tested the stability of their emulsion on distilled water and hard water. Each treatments was using 3 replication with criteria cream phase separation at the top or precipitation on the base should not exceed 2 mL (Lina et al.2009).

2.2 Election of Additional Ingredient

Two types of additional ingredient, p-aminobenzoat acid (PABA) and *optical brightner* (OB) were tested at 1% concentration (Rossalia 2003). Each additional ingredient was mix to mixture extract of *T. vogelii* : *P. aduncum* (1:5) containing methanol (1%) and Tween 80 (0.2%) then dilluted with water. Suspension with different additional ingredient were sprayed to broccoli leaf. Treated broccoli were put on the place that exposed to the sun but protected from the rain. Each treatment leaves were picked in the following hours 0.5, 1.5, 3, and 6. At the time each leaves were cuted in small size and put into a petri dish with tissue paper. Fifteen second instar larvae of *C. pavonana* was added and left eating the experiment leaves during 48 hours. Experiments repeated five times, mortality of larvae were noted and the data were processed using ANOVA.

2.3 Production of Formulations

Mixture extract wich has best performance in toxicity test was used as basic active compound ingredients. Production of liquid formulation (EC: emulsifiable concentrate) and dry formulation (WP: wettable powder) were contain 20% mixture extract as an active ingredient. Formulation of 20 EC was made by mixing the mixture extract, emulsifier, and solvent (methanol) with proportion of volume 20%, 10%, and 70%, repectively. Formulation of 20 WP was made by mixing the mixture extract, emulsifier, and carrier material (kaolin) with proportion of weight 20%, 10%, and 70%, respectively. Composition of active ingredient, emulsifier, solvent or carrier were modiffy of research of Rossalia (2003).

2.4 Formulations Stability Test

Base on previous studies Tween 80 used as emulsifier, because it has the best criteria than 7 others. Formulation stability test was started by making hard water according to WHO standard (WHO 1989). Hard water made from 0.4022 g $CaCl_2.2H_20$ and 0.139 g $MgCl_2.6H_2O$, than dissolve in aquadest up to 1L volume.

Distilled water or hard water (80 mL) were poured into beaker glass 250 mL then put in to water bath at temperature 30℃ ± 1℃ while stirring at 4 rounds per second using stirrer glass. 5 mL mix formulations (Concentration 5%) was added in to beaker glass using Mohr pipette. The Time criteria is 10-12 second, height of pipette from beaker glass reach 2 cm from water surface and liquid drop directed at the beaker glass middle part. Then added distilled water or hard water

while stirring until the volume of mixture reaches 100 mL, then poured into a measuring glass 100 mL. The measuring glass closed and flipped back 10 times, the observation including color change, cream formed at the top of beaker glass, foam formed, and separations at 0.5 and 2 hours.

2.5 Formulation Toxicity Test against Crocidolomia Pavonana

EC and WP formulations were tested by preparing formulation in accordance with the desired concentration and dilluted with water. Pieces of broccoli leaf (4 cm x 4 cm) were dipped one by one in suspension until wet, then dried in the air. Control leaf was dipped in the appropriate control solution. One piece of treatment leaf and control leaf put separately in a petri dish (diameter 9 cm) with wipes which were exceeds dish diameters. The petri dish were put on upside down position. A pedestal wipes was put on the cover of the dish and the base of dish was put on wipes, so that larvae could not get out from the dish.

Fifteen second instar larvae of *C. pavonana* were puted into each petri dish containing a treatment leaf or a control leaf. Larvae were left to eat on treated leaf or control leaf around 48 hours. Each treatments and control were used 5 replications. After 48 hours treatment leaves were replaced with new untreated leaves. Died larvae were counted and disposed from the dish, while survival larvae feeding untreated leaves until the larvae reach fourth instar. Total number of dead larvae and developmental period of survival larvae were noted. Mortality larvae data was processed by probit analysis using POLO-PC programs (LeOra Software 1987). Data of developmental period of larvae were expressed as an average value $\pm$ standard deviation.

3. Results

3.1 Election Of Tensida

Tensida was used in this studies has been tested at previous research by Lina *et al.* (2009). Two types of tensida with best test results were Tween 80 (having active ingredient polyethylene glycol sorbitan monoleat) and agristick 400 L (having active ingredient alkylaryl polyglycol ether (Table 1). Tween 80 can dissolve mix extract of *P. aduncum* and *T. vogelii* very well, while Agristick 400 L can dissolve *P. aduncum* extract very well but less perfect to dissolve *T. vogelii* extract. The use of Agristick as tensida caused extract agglomerate in the wall of tube, finaly proportion of extract concentration in a mixture not appropriate, because insoluble perfectly.

Table 1: Emulsifier stability test according to CIPAC standard

Types of Tensida	Types of solvent	Time of observation (minutes)	
		30	120
Tween 80	Distilled water	Good solubility, the color is white milk, there are foam in measuring glass (1 mL)	Good solubility, the color is white milk, there are foam in measuring glass (1 mL)
	Hard water	Good solubility, the color is white milk, there are foam in measuring glass (1 mL)	Good solubility, the color is white milk, there are foam in measuring glass (1 mL)
Agristick	Distilled water	Good solubility, the color is white milk, there are no cream or separation	Good solubility, the color is white milk, there are no cream or separation
	Hard water	Good solubility, the color is white milk, there are no cream or separation	Good solubility, the color is white milk, there are no cream or separation.

The commonly used emulsifier in pesticides formulation are non-ionic emulsifier, because easy mix with various types of oil and not cause phytotoxic like in cationic emulsifier (Hassall 1990). Besides non-ionic tensida would increase absorption of hydrofilic active ingredient subtance in the cuticle of plants or insects (Mollet dan Grubenmann 2001).

Tween 80 is non ionic tensida like an oil performance, yellowish, and distinctive smell. Soluble in organis solvent such as methanol, ethanol, etyl acetate, and soluble in polar solvent also such as water. Tween 80 has surface tension 22.533 dyne/cm unsoluble in mineral oil and vegetable oil. Stable when mixed with weak acids and weak bases, however when added strong acids or strong bases would show saponification reaction. Tween 80 fairly stable and does not cause saponification reaction when interfering with *T. vogelii* : *P. aduncum* (1:5) because pH of this mixture was 5.03 and categorized weak acids. Explanation of Grayson *et al.* (1996) that emulsifier and wetting agent could increase effectiveness of fungicide. Because emulsifier substance and wetting agent were helping penetration and adhesions of fungicide active ingredient into the plant tissue throught reduction of surface tension and angle contact.

3.2 The Additional Sunscreen Ingredient

Additional of sunscreen p-aminobenzoat acid (PABA) and *optical brightner* (OB) on mixture extracts showed that both sunscreen not capable to delay decomposition of active ingredient by sunlight, there is no significant different when compared between extract using sunscreen with extract without sunscreen (F=0.09, P= 0.91). The results were obtained significantly at the time treatment, when extract sprayed on broccoli leaf and then exposed directly under sunlight, decomposition of active ingredient was running and survive until 3 hours of treatment only (F=12.99, P=0.004). Ultraviolet rays of the sun affect pesticide residues in nature (Matsumura 1985). Decomposition of active ingredient of mix extract was happened very fast when plants

sprayed directly with formulation under sunlight exposure (12 pm GMT). Additional sunscreen was added into *T. vogelii* : *P. aduncum* (1:5) formulation to inhibit decomposition of active ingrediens. The results showed that activity formulation without sunscreen not significantly different with formulation using sunscreen.

Some previous studies were explained that additional PABA 0.2% (w/v) on crude extract or fraction of *Dysoxylum acutangulum* not exhibitting significant different activity against *C. pavonana* larvae after exposure 1-14 days under day light than sample without additional PABA 0.2% (w/v) (Irmayetri 2001). Rossalia (2003) said the addition of PABA until 1% in EC and WP formulations not exhibitting different of active ingredient activity *D. acutangulum* against *Spodoptera litura* for the same exposure time on soybean leaf. Syahputra (2004) was noted that the additional PABA on EC and WP formulation of *Callophylum soulattri* extract not increase persistency more than five days of sample formulation

Persistency in this case show by activity of mixture extract of *P. aduncum* : *T. vogelii* was short than active ingredients of *D. acutangulum.* It was affected by nature characteristic of active ingredient itself and workings of active ingredient. On *Dysoxylum* sp. the active ingredient work as an insect growth regulator, where the death larvae was caused by a failure in change of the skin process. When pesticide residues sufficient for inhibiting of change of the skin process the death of insect test will continue happened until last instar (Hudaya 2003, Irmayetri 2001, Rossalia 2003).

3.3 Formulation and Its Stability

Formulation of 20 EC dan 20 WP were made in laboratory referring to Rossalia (2003). EC formulation was shaped dark brown emulsion, while WP formulation was shaped greenish white powder (Fig. 1) and its have a distinctive smell.

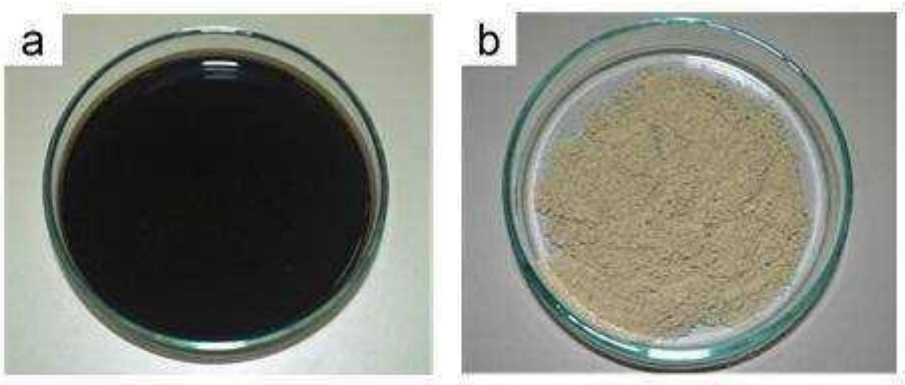

Fig. 1: Mix formulation of *T. vogelii* : *P. aduncum* (1:5) in EC (a) and WP (b) form

Twenty percent active ingredient on EC and WP formulation was the most ideal amount combine with surfactant materials (10%) and solven/carrier (70%). Increasing amounth of active

ingredient into 30% and 40% cause non homogeneous mixing of active ingredient with surfactant and solven in EC formulation. The increasing of active ingredient on WP formulation will reduce the composition of carrier subtance (kaolin) so the formulation become wet and sticky was not reach CIPAC standard because particle size > 5µm (Rossalia 2003). Hassall (1990) was mentioned that the particle of flour insecticide should less than 50 µm.

Table 2: Formulation stability test of emulsifiable concentrate (EC) on distillate water and hard water

Characteristic	Distilled water (minutes)		Hard water (minutes)	
	30	60	30	60
Color	Turbid yellow	Turbid yellow	Turbid yellow	Turbid yellow
Foam	On the top measuring glass 0.7 mL	none	On the top measuring glass 0.5 mL	none
Precipitation	none	none	0.3 mL	0.5 mL
Others	Brown oil granules 0.1 mL	Brown oil granules 0.1 mL	Brown oil granules 0.1 mL	Brown oil granules 0.1 mL

Formulation stability test on distilled water and hard water show results as on Table 2. EC formulasion has turbid yellow color on distilled water and hard water. Observation on distilled water at first 30 minutes was appearing foam on the top measuring glass (0.7 mL), while on hard water was 0.5 mL foam. Then foam were disappeared at 60 th following minutes. Precipitation also found on hard water about 0.3 mL and increased to 0.5 mL at 60th minutes observation. Precipitation in hard water was normal category compared with research result from Syahputra (2005) that 66 EC formulation of *C. soulattri* extract and 21 EC formulation of dicloromethane fraction were shaped a sticky solid precipitation. This is becomes application problems in field and needs filtration to minimize clog of spray nozzle.

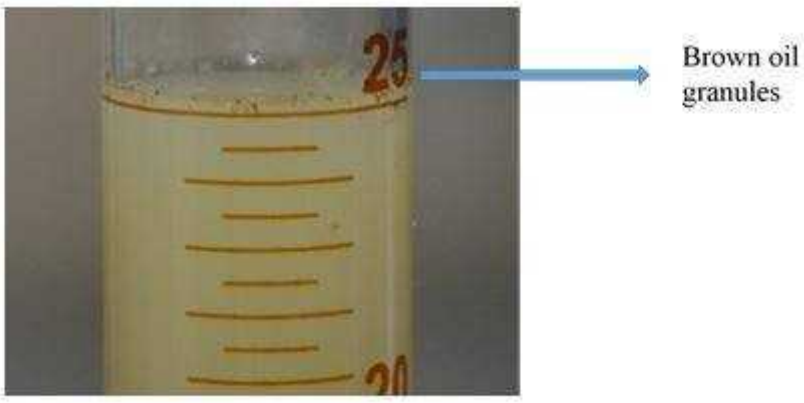

Fig. 2: EC formulation stability test at first hours

Brown oil granules was observed at the top of measuring glass about 0.1 mL (Fig. 2). Oil granules were expected derived from non polar compound of *P. aduncum* and *T. vogelii* extract.

Overall, this EC formulation still according to CIPAC standard as Satiti (1988) explanation of normal limit for emulsion stability, in early perfect emulsification, 30 minutes later maximum cream 4 mL, 190 the following minutes maximum cream 8 mL and maximum oil free 1 mL.

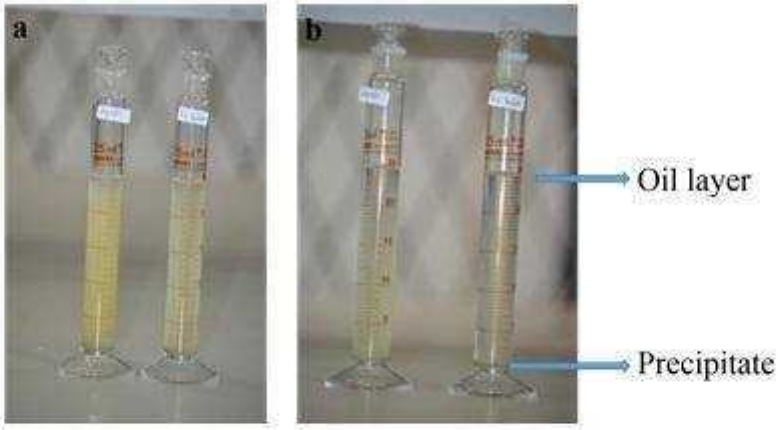

Fig. 3: WP formulation stability on distilled water and hard water a). Observation at 30th minutes, b).Observation at 1st hour

WP formulation has turbid yellow color and changed to clear yellow after one hours observation on distilled water and hard water. Precipitation was founded in a bottom of mesuring glass 1.5 mL for distilled water and increasing to 2 mL at one hour observation. Precipitation in hard water appears 2 mL and increasing to 2.6 mL at one hour obsservation (Table 3). The precipitation will return homogenous when performed a stirring process. One deficiency of WP formulation is appearing of precipitation that require constant stirring when application (Bohmont 1997). In WP formulation also observed oil layers about 1 mL on distilled water and hard water which begin to appear at 15 early minutes. Oil layer do not increase until 1 hours observation the (Fig. 3).

Table 3: WP formulation stability test of *T. vogelii* : *P. aduncum* (1:5) on distilled water and hard water

Characteristic	Distilled water (minutes)		Hard water (minutes)	
	30	60	30	60
Color	Turbid yellow	Turbid yellow	Turbid yellow	Turbid yellow
Foam	None	None	None	None
Precipitation	1.5 mL	2 mL	2 mL	2.6 mL
Others	1 mL oil layer on the top	1 mL oil layer on the top	1 mL oil layer on the top	1 mL oil layer on the top

3.4 Formulation Toxicity against Crocidolomia Pavonana

Mortality pattern of *C. pavonana* larvae was treated with EC and WP formulation shown in Figure 4 and Figure 5. Mortality of *C. pavonana* larvae was started at first days treatment especially in high concentration and increase sharply at second days treatment. On third day and

continous days larvae mortality was very low even in some concentration there was no additional mortalityl.

Constant mortality after second day treatment caused larvae fed un treated leaf. As a result survival larvae will recover and stay alive until last instar. This pattern show caracteristic of mixture extract formulation more as a toxic compound than as a growth and development inhibition (Lina *et al.* 2006, Lina *et al.* 2008).

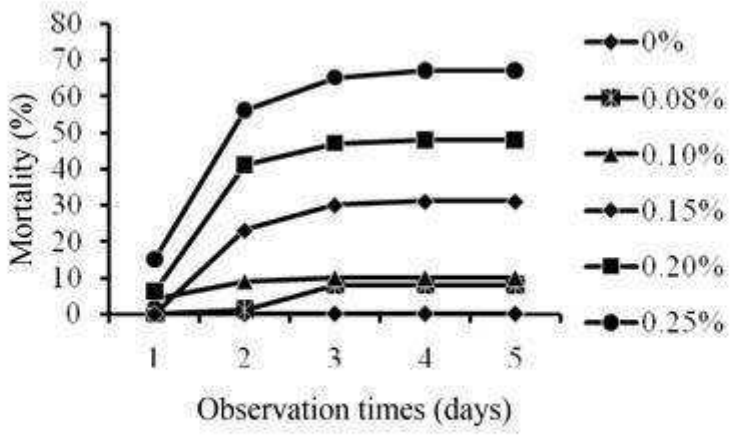

Fig. 3: *Crocidolomia pavonana* larvae mortality due to formulation treatment of EC (mix extract of *T. vogelii* and *P. aduncum* (1:5))

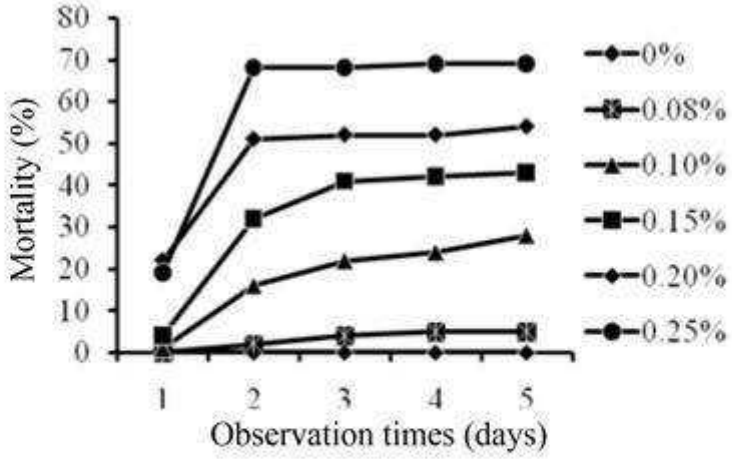

Fig. 4: Mortality of *Crocidolomia pavonana* larvae due to formulation treatment of WP (mix extract of *T. vogelii* dan *P. aduncum* (1:5))

Mortality of *C. pavonana* larvae in treatment with EC and WP formulations were caused by active compound contained in mixture extract of *T. vogelii* : *P. aduncum* (1:5). Besides toxic, this formulation work as facilitator. The facilitating worked when active compounds of *P. aduncum* inhibit of enzyme activity that decompose of toxic compound in insect bodies. When enzyme locked by *P. aduncum* active compounds, *T. vogelii* active compounds entrance to target site

directly to maximum work. Lignan compound from *P. aduncum* extract containing methylendioxiphenyl could inhibit sitocrom P450 enzym activity and reduce the toxicity of foreign compound (Metcalf 1967; Bernard *et al.* 1989). According to Bernard *et al.* (1990) dilapiol from *P. aduncum* could inhibit of sitocrom P450 enzym activity in microsom sample from digestive cells of corn borer larvae *Ostrinia nubilalis*. Therefore, *P. aduncum* extract containing dilapiol were potential as synergistic if mixed with another plants extract.

Enzyme inhibition of detoxification *xenobiotic* compound on *C. pavonana* larvae gave space for active ingredient of *T. vogelii* namely rotenon and other rotenoid compound as insecticide like deguelin and tefrosin (Delfel *et al.* 1970; Gaskins *et al.* 1972; Lambert *et al.* 1993) to work to target site. Rotenon having strong insecticidal activity against several insect types as a stomach poison and contact poison (Perry *et al.* 1998). On cell level, rotenon inhibit electron transfer between NADH dehydrogenase and coenzym Q in complex I from electron transfer chain in mitochondria (Hollingworth 2001). Inhibition on cell respiration process were caused declination of ATP production. Lack energy of cell cause nerve muscle paralysis and any other tissue, finnaly causing the death of treatment larvae.

Besides synergistic function *P. aduncum* work as neurotoxin to insects test. Piperamide compound from Piperaceae family (guininsin and piperiside) work as neurotoxin that inhibit of nerve impulses flow on axon causing paralysis (Miyakado *et al.* 1989; Morgan and Wilson 1999).

EC and WP formulation also interfere of growth and development of *C. pavonana* larvae, especially on high concentration treatment. The changes of second instar larvae to third instar larvae takes 2 days in control, while on EC and WP formulation treatment takes 2-4 days and 3-4 days respectively. The changes second instar larvae to fourth instar takes 3 days in control, while on the EC and WP formulation treatment take 4-5 days and 5-6 days respectively (Table 4). Larvae growth and development inhibition caused by residue of active ingredient which still left in insect bodies interfere physiology fungtions of *C. pavonana*.

Table 4: Development of *C. pavonana* larvae treated by 20 EC and 20 WP formulation of *T. vegelii* - *P. aduncum* (1:5) in various concentration

Concentration of formulation (%)	Larvae development time (X ± SD) (days)			
	WP formulation		EC formulation	
	Instar 2-3	Instar 2-4	Instar 2-3	Instar 2-4
0 (kontrol)	2.19 ± 0.39	3.79 ± 0.55	2.09 ± 0.29	3.31 ± 0.46
0.075	3.34 + 0.51	5.03 + 0.64	2.85 + 0.72	4.54 + 0.61
0.10	3.69 ± 0.63	5.41 ± 0.75	2.98 ± 0.62	4.65 ± 0.59
0.15	4.29 ± 0.74	5.42 ± 0.56	3.45 ± 0.66	4.95 ± 0.81
0.20	4.73 ± 0.77	5.50 ± 0.59	3.48 ± 0.51	5.52 ± 0.51
0.25	4.50 ± 0.55	6.17 ± 0.41	4.25 ± 0.46	5.63 ± 0.52

X= mean; SD= deviation standard

Similar activity of 20 EC and 20 WP formulation were show from probit analysis result. Value of LC_{50} of EC and WP formulations were 0.15 % and 0.13 % and LC_{95} value were 0.35% and 0.31%. Regression slop (b value) of 20 WP formulation higher than 20 EC formulation were 4.59 and 3.81, respectively. It means additional concentration 20 WP formulation on multiple particuler will cause death of larvae higher than the 20 EC formulation treatment (Table 5). According to Rossalia (2003) increasing of WP formulation active ingredient two fold will increase its activity two fold also. Increasing of EC formulation active ingredient two fold will decline its toxicity one and a half fold also. It was happened because of EC formulation decantation that caused precipitation of active ingredient.

Table 5: Probit Analysis of 20 EC and 20 WP formulation of *T. vogelii* and *P. aduncum* (1:5)

Treatment	b±SE	LC_{50} (CI 95%)	LC_{95} (CI 95%)
20 EC formulations	3.81±4.76	0.15 (0.131-0.195)	0.35 (0.259-0.718)
20 WP formulations	4.59±0.43	0.13 (0.107-0.167)	0.31 (0.227-0.680)

b= regression slope; SE= standar error, CI= confidence interval

4. Conclusion

Mixture formulation of *T. vogelii* : *P. aduncum* (1:5) was made on 20 EC and 20 WP form. Additional of sunscreen p-aminobenzoat acid (PABA) or optical brightner (OB) couldnt extend active ingredient persistence of mixture extract of *P. aduncum* and *T. vogelii*. Formulation stability test shows that EC and WP formulation were include to stable categories according to CIPAC standard, and deserved to be used as an control alternative in field.

EC and WP formulation of mixture extract of *T. vogelii* : *P. aduncum* (1:5) have insecticidal activity againts *C. pavonana* larvae, besides cause mortality and growth and development inhibition of survival larvae of *C. pavonana.*

4.1 Aknowledgments and Legal Responsibility

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5. References

Asman A, Rusli R, Ma"mun. 1999. *Formulasi pestisida nabati produk cengkeh*. in: Proceedings of Botanical pesticides Utilization ScientificCommunications Forum. Bogor (ID): Research Institute of Spices and Medicinal Plants, 530-537.

Bernard C. B., Arnason J. T., Philogene B. J. R., Lam J, Waddell T.1989. Effect of lignans and other secondary metabolites of the asteraceae on the mono-oxygenase activity of the European corn borer. *Phytochemistry,* 28(5), 1373-1377.

Bernard C. B., Arnason J. T., Philogène B. J. R., Lam J, Waddell T.1990.In vivo effect of mixtures of allelochemicals on the life cycle of the European corn borer, *Ostrinianubilalis.EntomolExpAppl*,57, 17-22.

Bohmont B. L.1997.*The Standard Pesticide User's Guide*.Ed. Ke-4.New Jersey (US): Prentice Hall.

[CIPAC] Collaborative International Pesticides Analytical Council.1980.CIPAC.*Handbook Analysis of Technical and Formulated Pesticides.*New York (US): CIPAC.

Delfel N. E., Tallent W. H., Carlson D. G., Wolff I. A.1970.Distribution of rotenone and deguelin in *Tephrosiavogelii* and separation of rotenoid-rich fractions.*J Agric Food Chem,* 188(3), 385-390.

[ESCAP] Economic and Social Commission for Asia and ThePasific.1991.*Agropesticides, Properties and Function in Integrated Crop Protection.*Bangkok (TH): ESCAP, United Nations.

Gaskins M. H., White G. A., Martin F. W., Delfel N. E., Ruppel E. G., Barnes D. K. 1972. Tephrosiavogelii: *A Source of Rotenoids for Insecticidal and Piscicidal Use.* Washington DC (US): United States Department of Agriculture.

Grayson B. T., Webb J. D., Batten D. M., Edwards D.1996.Effects of adjuvant on the therapeutic activity of dimathamorph in controlling vine downy mildew, survey of adjuvants types.*Pestic Sci,* 46, 199-206.

Hassall K. A.1990.*The Chemistry of Pesticides*: *Their Metabolism, Mode of Action and Uses in Crop Protection.*London (GB): Macmillan.

Hollingworth R. M.2001.Inhibitors and uncouplers of mitochondrial oxidative phosphorylation.*In* Krieger R, Doull J, Ecobichon D, Gammon D, Hodgson *et al.*, editor.*Handbook of Pesticide Toxicology*.Vol 2,1169-1227.San Diego (US): Academic Press.

Hudaya D. A.2003.*Pengaruh ekstrak daun Dysoxylum acutangulum Miq. (Melaiaceae) terhadap mortalitas dan reproduksi Plutella xylostella (L.) (Lepidoptera: Yponomeutidae)* (Thesis, Department of pests and plant diseases, Faculty of Agriculture, Bogor Agricultural University).

Irmayetri.2001.*Aktivitas residu ekstrak ranting Dysoxylum acutangulum Miq. (Melaiaceae) terhadap larva Crocidolomia binotalis Zeller (Lepidoptera: Pyralidae)*(Thesis,

Department of pests and plant diseases, Faculty of Agriculture, Bogor Agricultural University).

Lambert N, Trouslot M.F., Campa C. N., Chrestin H.1993.Production of rotenoids by heterotrophic and photomixotrophic cell cultures of *Tephrosiavogelii*.*Phytochemistry,* 34, 1515-1520.

LeOra Software.1987.*POLO-PC User's Guide*.Petaluma (CA): LeOra Software

Lina E. C., Prijono D., Dadang.2006.Pengaruh fraksi aktif *Aglaia harmsiana* terhadap fisiologi larva *Spodoptera litura* (F) (Lepidoptera: Noctuidae).*Jurnal Tumbuhan Tropika,* 6(1), 1-8.

Lina E. C., Arneti, Prijono D., Dadang. 2009. *Kelayakan Delapan Jenis Tensida untuk Mengemulsikan Bahan Nonpolar dalam Air*. in: Proceedings ofNational Seminar on Plant Protection, Bogor, 5 to 6 AugustPKPHT-IPB (Bogor) (ID): Departement of plant protection, 246-252.

Lina E.C.,Arneti, Prijono D., Dadang. 2010. Potensi Insektisida Melur (*Brucea javanica* L. Merr) dalam mengendalikan hama kubis *Crocidolomia pavonana* (Lepidoptera: Crambidae) dan *Plutella xylostella* (Lepidoptera: Yponomeutidae). *Jurnal Natur Indonesia,* 12(2), 109-116.

Matsumura F.1985.*Toxicology of Insecticides*.2nd Edition.New York (AS): Plenum Press.

Metcalf R. L.1982.Insecticides in pest management.*In* Metcalf RL, Luckman WH, editor.*Introduction to Insect Pest Management*.2nd Edition.New York (AS): J Wiley, 217-253.

Miyakado M, Nakayama I, Ohno N. 1989. *Insecticidal unsaturated isobutylamides from natural products to agrochemical leads*. *In* Arnason J. T., Philogene B. J. R., Morand P, editor. *Insecticides of Plant Origin*. Washington DC (AS): ACS, 173-187.

Mollet H, Grubenmann.2001.*Formulation Technology: Emulsion, Suspensions, Solid Forms*.Wiley-VCH Verlag.

Morgan D. E., Wilson D. I. 1999. Insect hormones and insect chemical ecology. In Barton S. D., Nakanishi K, Meth-Cohn O, Mori K, editor. *Comprehensive Natural Products Chemistry*, Vol 8,264-364. Amsterdam (NL): Elsevier.

Perry A. S., Yamamoto I, Ishaaya I, Perry R. Y.1998.*Insecticides in Agriculture and Environment: Retrospects and Prospects*.Berlin (DE): Springer-Verlag.

Rossalia D.2003.Formulasi insektisida botani dari *Dysoxylum acutangulum* Miq. (Meliaceae) (Thesis, Department of Industrial Technology, Bogor Agricultural University), 3-31.

Satiti N.1988.*Perubahan sifat fisikokimia formulasi pestisida bentuk emulsifiable concentrate (EC) dalam penyimpanan*.Research Bulletin of The center chemical industry. Jakarta, (38), 1-14.

Scott I. M., Jensen H. R., Nicol R., Lesage L.,Bradbury R., Sachez-Vindas P., Poveda L., Arnason J. T., Philogene B. J. R. 2004. Efficacy of piper (Piperaceae) extracts for control of common home and garden insect pests. *J. Econ.Entomol,*97(4), 1390-1403.

Syahputra E, Manuwoto S, Darusman L. K., Dadang, Prijono D. 2004. Aktivitasinsektisidabagiantumbuhan*Calophyllumsoulattri*Burm.f.(Clusiaceae) terhadap larva lepidoptera. *JHPT Trop*, 4(1), 23-31.

Syahputra E, Prijono D, Dadang, Manuwoto S, Darusman L. K. 2005. Bioaktivitas insektisida botani *Calophyllum soulattri* Burm.F. (Clusiaceae) sebagai pengendali hama alternatif (Doctoral dissertation, Bogor Agricultural University).

Waxman M. F.1998.The Formulator‟s Toolbox-Product Form for Modern Agriculture.In Brooks G. T. dan Roberts T. R., editor.*Pesticide Chemistry and Bioscience*.London (GB): RSC, 20-126.

[WHO] World Health Organization.1989.*Preparation of WHO standard waters*.Geneva (CH),WHO.