Fresh Siam (C*hromolaena odorata)* Weed Leaf Extract in the Control of Housefly (*Musca domestica*)

Liwayway H. Acero Ed.D.
Department of Natural Sciences, College of Arts and Sciences,
San Beda College Manila Philippines
Email: lilyacero1@yahoo.com

***Abstract*—*Chromolaena odorata* has been known as nuisance weed in agricultural farms. There are studies on its insecticidal properties, but its potential as control to housefly is not yet explored. This research was undertaken to determine the beneficial use of fresh Siam weed leaf extract (FSWLE) to eradicate housefly. Result of this study is beneficial to farmers/vegetable growers in *Sitio Pactil in Bauko Monamun Sur* Mountain Province, a partner community of San Beda College Manila in its extension or community involvement. Villagers in *Pactil* Mountain Province used chicken dung to fertilize their vegetable. Chicken dung/manure is an organic fertilizer that attracts houseflies which act as vectors of common diseases. Specifically this study seeks to find out what best concentration and what exposure technique of fresh Siam weed leaves will get rid of the houseflies. Experimental research method with five treatments was utilized. Gathered data was analyzed using ANOVA two-factorial. Findings of the study revealed that highest percentage of mortality after thirty two hours observation, was obtained from treatment 5 (60%percent FSWLE- applied as spray). Based on this result vegetable growers, farmers, household members can use FSWLE to eradicate houseflies, to prevent the occurrence of diseases that is brought about by this insect.**

Index Terms*— *Chromolaena odorata, Musa domestica

I. Introduction

Research for many decades in Philippine educational system has been viewed as a separate entity from outreach or community involvement activities. However, the current trend in the educational system is to provide a strong link between research and community involvement. This will make the output of any research endeavor tailor fit to the community where the research is in need. At the same time this will help people in the community in the attainment of better quality of life.

San Beda College of Manila, one of the private learning institutions in the Philippines is akin to the threefold functions of instruction, research and community involvement. One of the partner communities of San Beda College is *Sitio Pactil in Bauko Monamun* Sur, in mountain province. *Pactil* is located in mountainous slope range of 15 to 18 degree. It is approximately 2,300 meters above sea level [1]. The main source of livelihood of the people in *Pactil* is vegetable growing. Most of the vegetable growers/farmers used chicken dung as organic fertilizer on their farm, without realizing that the offensive odor from chicken dung attracts houseflies which act as vectors of pathogens that cause diseases.

Housefly considered one of the most important pests which cause health problems in the environment as it accompanies human during their daily activity everywhere, on work site or in rest places causing many disturbances to them [2]. As vectors of diseases house flies can transmit more than 100 human and animal disease-causing organisms, including protozoa, bacteria, viruses, rickettsia, fungi, and worms. House flies are considered intermediate hosts for tapeworms and may transmit ascaris to caged birds. Flies mechanically carry ascaris and other nematode eggs on their feet from manure to pens, feed, and water. Fly maggots ingest tapeworm and ascaris eggs from the poultry manure and retain them in the gut until maturity. In turn, infected flies are ingested by the feeding bird. Although it appears that avian influenza is spread principally by contaminated shoes, clothes, and equipment, the virus has been isolated from adult house flies [3].

The use of commercial insecticide to kill housefly can solve the housefly infestation in *Pactil.* However, chemical method is the last recourse, since chemical method will harm the environment and pose respiratory hazard to villagers. The use of herbal plants in the area is the most practical and safest method for the control of housefly infestation. There are many herbal plants in the area and one of these is the natural growing weed commonly known as “agonoi”, hagonoy or gonoy, with a scientific name *Chromolaena odorata.*

C. odorata is viewed as a major agricultural sustainability problem in many tropical countries. It was recognized as the most problematic weed in coconut plantations in Sri Lanka as early as 1944, and became a problem in rubber, palm oil, tea, coffee, cashew, teak and other plantation crops in Asia [4]. In the Philippines Siam weed is a highly invasive plant species which is poorly studied in spite of the fact that it is hard to eradicate, a nuisance in plantations, and known to harm farm animals and decimate forage and native plant species [5]. *C.*

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odorata or commonly known as *hagonoi* in Mountain province are used by the local folks to cure rheumatism by preparing a decoction from its leaves and roots. Poultice is applied to wounds. Decoction is used is also used to bathe dogs with skin diseases. Its chemical contents are the following with its uses; Steroids/ 2-deoxysugars are antimicrobial and antidiarrhoeal; anthraquinones are antimicrobial; flavonoids are antidiarrheal and antibacterial; tannins and polyphenyls are antimicrobial antidiarrheal and antihelminthic; and alkaloids are antimicrobial as antidiarrheal and anthelmintic [6].

A study on the phytochemical screening of Siam weed (*Chromolaena odorata*) revealed the presence of alkaloids, cyanogenic glycosides, flavonoids (aurone, chalcone, flavone and flavonol), phytates saponins and tannins. The anti-nutrients composition includes cyanogenic glycosides (0.05% WW and 0.13% DW), phytates (0.22% WW and 0.54% DW), saponins (0.80% WW and 1.98% DW) and tannins (0.15% WW and 0.37% DW) [7].

The studies on the Repellent Activities of Four Common Asteraceae (*Chromolaena odorata*, *Ageratum conyzoides*, *Tridax* procumbens, *Vernonia amygdalina*, applied at 0%, 2.5% and 5.0%) in Nigeria against Red Flour Beetle, *Tribolium castaneum* has demonstrated that the leaf powders of these plants could serve as a veritable alternative protectants against the storage pest of wheat, red flour beetle, therefore avoiding all the side effects of synthetic pesticides [8].

In the study on the Termicidal potential of *hagonoy* leaf extract it revealed that 60 percent hagonoy methanolic extract significantly killed termites compared with other treatments with lower percentage of hagonoy methanolic extract [9]. It can also eradicate rice weevils in storage areas [10].

Guided by the popular health motto "an ounce of prevention is better than a pound of cure," this study was conceptualized, due to the felt need of people in *Pactil* with the abundance of houseflies in their vicinity that pose health hazard. This pest should be properly eradicated, through tapping the beneficial effect of nuisance weed that could be utilized to control houseflies. To date there is no study conducted on the use of fresh extract of this weed to control houseflies, hence this study.

The objective of this study is to determine what concentration of fresh *Chromolaena odorota* leaves can eliminate houseflies. It also seeks to find out what method of application will repel houseflies and result to mortality. Result of this study could serve best the rural farmers on how to eradicate houseflies with the use of herbal plants/weed in their area.

II. Methodology

A. Materials

1) Experimental animals

One hundred houseflies were used and were assigned in five groups. First group (20 houseflies-control), no herbal extract of fresh Siam weed leaves (FSWL*)* in their cage. Second group (T2-20 houseflies), with 30% fresh herbal extract of FSWL applied by poison technique. Third group (T3-20 houseflies), with 30% FSWL applied by spray method. Fourth group (T4-20 houseflies), with 60% FSWL applied by poison technique. Fifth group (T5-20 houseflies), with 60% FSWL applied by spray technique Improvised insect cages with mixture of vinegar and sugar as insect feed, were placed in room temperature.

2) Preparation of Fresh Siam Weed Leaves Aqueous Extract (FSWLAE)

In the preparation of FSWLE, the following materials were used; *Fresh Siam weed*, purified water, kitchen knife, chopping board, blender, distilled water cheesecloth, Whatman paper no.1, and glass containers for maceration.

3) For Administration of FSWLE/Exposure Technique.

For administration of FSWLE, the following materials were used: One hundred houseflies, laboratory gown, gloves, masks and surgical cap, holding tray, clean cloth, litmus papers and mini- sprayers.

B. Methods

1) Purchase of Experimental animals

This study employed experimental research method, using one hundred houseflies in adult stage. The houseflies were caged in improvized cages with insect net as covering to provide proper ventilation (see Figure 1.). They were housed according to the experimental lay-out as shown in Table I.

2) Preparation of FSWLE

Siam weed leaves were collected locally. Dirt was removed from the leaves by rinsing with clean water. The stems were separated from its leaves manually (see Figure 2a.). The leaves were turned into smaller pieces about 1 inch by the used of kitchen knife and chopping board (see Figure 2b.). The leaves were turned into much smaller pieces by the use of blender (see Figure 2c.). Studies that served as a guide in maceration of thin leaves of plants like *C. odorata*, recommended that maceration through aqueous solution should be done in 24 hours. To maximize the extraction of tannin with the use of water, *C. odorata* powder was extracted in distilled water. One hundred gram (100 g) of powder from *C. odorata* was macerated in 200 ml distilled water. The filtrates were stored in a refrigerator at 5℃ for subsequent use in bioassays [11]. Another study on the use of pounded leaves stated that "aqueous extracts were prepared by pounding the weighed leaves of each plant material into 200 ml of distilled water with which the stock solution of each extract was prepared. These mixtures were allowed to stay for 24 hours [12]." In maceration the mixtures were placed in a glass containers (see Figure 2d. and Figure 2e.).

TABLE I. EXPERIMENTAL LAYOUT

T1- control	T2- 30% FSWLE- poison technique	T3- 30% FSWLE- spray technique	T4- 60% FSWLE- poison technique	T3- 60% FSWLE- spray technique
T1S1	T2S1	T3S1	T4S1	T5S1
T1S2	T2S2	T3S2	T4S2	T5S2
T1S3	T2S3	T3S3	T4S3	T5S3
T1S4	T2S4	T3S4	T4S4	T5S4
T1S5	T2S5	T3S5	T4S5	T5S5
T1S6	T2S6	T3S6	T4S6	T5S6
T1S7	T2S7	T3S7	T4S7	T5S7
T1S8	T2S8	T3S8	T4S8	T5S8
T1S9	T2S9	T3S9	T4S9	T5S9
T1S10	T2S10	T3S10	T4S10	T5S10
T1S11	T2S11	T3S11	T4S11	T5S11
T1S12	T2S12	T3S12	T4S12	T5S12
T1S13	T2S13	T3S13	T4S13	T5S13
T1S14	T2S14	T3S14	T4S14	T5S14
T1S15	T2S15	T3S15	T4S15	T5S15
T1S16	T2S16	T3S16	T4S16	T5S16
T1S17	T2S17	T3S17	T4S17	T5S17
T1S18	T2S18	T3S18	T4S18	T5S18
T1S19	T2S19	T3S19	T4S19	T5S19
T1S20	T2S20	T3S20	T4S20	T5S20

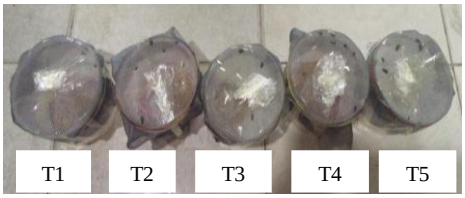

Figure 1. Experimental insects in improvised cages.

Figure 2 a. Stem of Siam Weed was separated from the leaves.

Figure 2 b. Chopped FSWL.

Figure 2 c. Chopped Siam Weed in the blender

Figure 2 d. FSWL inside the glass container

Figure 2 e. FSWL inside the glass container (Maceration)

3) Application of FSWLE/Exposure Technique

Application of FSWLE was done following this procedure. A commercial vinegar product (ChinKiang) was found to be highly attractive to adult house flies, *Musca domestica L*. Field experiments on a Nebraska dairy demonstrated that traps baited with vinegar and brown sugar captured more house flies than those baited with other house fly attractants [13]. Houseflies in T1 (control) were caged in an impovized cage without FSWLE. Only concentration of vinegar and sugar was placed inside the cage to serve as feed for the insects.Houseflies in T2 (30% FSWLE –poison technique) were provided with feeds same in T1, but the FSWLE at 5 ml per day was placed in litmus papers placed beside their feeding trough (see Figure 3.). Houseflies in T3 (30% FSWLE –spray technique) were provided with feeds and the FSWLE was sprayed 2.5 ml in the morning and 2.5 ml in the afternoon for 1.5 days. Houseflies in T4 (60% FSWLE –poison technique) were provided with feeds same in T1, but the FSWE was placed in in litmus paper beside their feeding trough (see Figure 3.). Houseflies in T5 (60% FSWLE –spray technique) were provided with feeds and the FSWLE was sprayed 2.5 ml in the morning and 2.5 ml in the afternoon for thirty two hours.

Figure 3. Placement of FSWLE in treatments 2 and 4.

III. RESULTS

A. Number of Rice Weevils per Sample, per Treatment on the Start of the Study

Table II shows the number of live houseflies per sample per treatment. To ensure uniformity and avoid bias on the controlled variables twenty live female houseflies was obtained from the same source. The total live houseflies per treatment, was twenty with a mean of twenty. It means that all samples were treated equal on the start of the study.

TABLE II. NUMBER OF RICE WEEVILS, PER TREATMENT ON THE START OF THE STUDY

Treatment	T1 (control)	T2	T3	T4	T5
Number of houseflies	20	20	20	20	20
Total	20	20	20	20	20
Mean	20	20	20	20	20

B. *Percentage of Mortality per Treatment Every Eight Hours*

Table III expresses the mortality rate per treatment. Highest mortality rate was observed in treatment 5 with 85%, followed by T3 with 82.4% treatment 4 with a mean of 72.5%, treatment 2 with 52.5%. Zero mortality was observed in the control (T1). Figure 4. expresses that treatment 5 had the highest percentage mortality, followed by treatment 3, treatment 4, treatment 2 and treatment 1 respectively. The result revealed that houseflies with 60% FSWLE sprayed technique had the highest percentage of mortality and 30% FSWLE sprayed technique, compared with 60% and 30% FSWLE in poison technique. Analysis of variance (ANOVA) resulted to significant difference among treatments with different concentrations of FSWLE and different exposure technique. Fisher Least significant difference revealed significant difference exists between the control (T1) and treatments with FSWLE, (T2, T3, T4 and T5) as indicated by different superscripts in the mean. However no significant difference exist between the comparisons of treatments as follows as indicated in the similarities of superscripts in the means of; T2 (30% FSWLE-poison technique) and T4 (60% FSWLE-poison technique); T3 vs.T4 and T4 vs. T5. Fisher least significant difference test indicated that mortality rate after thirty two hours of observation is higher in treatments with FSWLE.

It can be gleaned from the findings that, as the percentage of FSWLE increased, the susceptibility of the houseflies also increased, thus increasing mortality rate. Several studies could support the claims on this research. Preliminary phytochemical screening of *C. odorata* was carried out to ascertain the presence of some chemical constituents like alkaloids, flavonoids, saponins and tannin [14]. Phytochemical analysis revealed the presence of alkaloids, cyanogenic glycosies, flavonoids (aurone, chalcone, flavone and flavonol}, phytates, saponins and tannins. The presence of these phytochemical alters some biochemical functions of organisms [15]. Studies on the effects of higher doses of flavonoids in insects alter normal body functions. The effects of flavonoids on the transhydrogenation, NADH oxidase, and succinate dehydrogenase reactions suggest that compounds of this nature may prove valuable in the control of insect populations by affecting mitochondrial enzyme components [16]. In evergreen plants, tannins are evenly distributed in all leaf tissues. They serve to reduce palatability and, thus, protect against predators. Palatability is reduced because tannins are astringent. Astringency is the sensation caused by the formation of complexes between tannins and salivary glycoproteins [17]. Dietary tannin can reduce growth and fecundity of some insect species [18]. The test organism, *P. americana* avoided contact with the places where the leaf extract of Siam weed was dropped [19].

TABLE III. PERCENTAGE OF MORTALITY PER TREATMENT EVERY EIGHT HOURS

Treatment	Hours				Total	Mean	%
	1st eight hour	2nd eight hour	3rd eight hour	4th eight hour			
1	0	0	0	0	0	0^{a}	0
2	6	12	12	12	42	10.5^{bf}	52.5
3	12	18	18	18	66	16.5^{cg}	82.5
4	12	14	16	16	58	14.5^{dfgh}	72.5
5	12	16	20	20	68	17^{eh}	85

ANOVA

S.V	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows	77.4	3	25.8	9.8*	0.0016	3.5
Columns	789.2	4	197.3	74.9*	2.2E-08	3.26
Error	31.6	12	2.6			
Total	898.2	19				

Legend: * significant at 5% level of significance

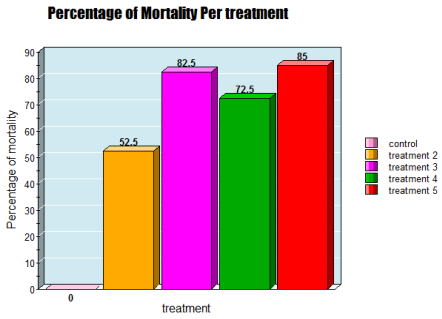

Figure 4. Percentage of Mortality Per treatment.

C. *Behavior of Houseflies Per treatment*

Houseflies in control (T1) were very active, while those in treatments with FSWLE evaded the portion of improvised cages with FSWLE. In treatments 2 and 4, houseflies stayed in the opening of the improvised cage (Figure 5a.). In this treatment the FSWLE was applied in the litmus papers around the food which were placed at the bottom of the cage (Poison technique). Houseflies in treatments 3 and 5 stayed at the bottom of the cage. The FSWLE was applied through spray method. Most of the FSWLE adhered in the opening of the cage, thus houseflies avoid their contact in the opening of the cage as shown in Figure 5b. Houseflies cannot tolerate the odor from FSWLE thus they tried to evade the areas where FSWLE accumulated. The leaves of Siam weed emit a pungent odour when crushed. The presence of an unpleasant smell caused a reduced appetite in *Vibrio harveyi* a bacteria that caused Vibrosis- disease problem in the black tiger shrimp *Penaeus monodon*. The odor of

C. odorata leaves disturbed the respiration process of post larvae of *Vibrio harveyi* [20].

Figure 5a. Houseflies in treatment 2. FSWLE applied through poison technique.

Figure 5b. Houseflies in treatment 5. FSWLE applied through spray technique.

IV. Conclusion

With the increasing cost of insecticides in the market, herbal insecticides can be used to maximize the benefits that can be derived from the indigenous plants and weeds.The result of this study expressed that the percentage of mortality increased as fresh leaves of Siam weed extract increased with the use of spray technique. To get rid of the houseflies in *Pactil Mountain* province and other places with abundance of houseflies, fresh leaves of Siam weed in aqueous solution as spray can be used, to prevent common disease brought about by this nuisance insect. A follow-up study on the use of dried Siam leaves as pesticide can be explored.

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References

[1] J. Piscos. (2013). Ora et Labora, *The Official Newsletter of Institutional Community Involvement Center, San Beda College, Manila.*[Online], vol. 2, no. 1, pp. 2-3, Available: *http://www.sanbeda.edu.ph/images/images-ICIC/ORA%20et%20LABORA%20NEWSLETTER.pdf.*

[2] J. J. Howard. (2011). Nuisance flies around a landfill: patterns of abundance and distribution, *Waste management research.* [Online], vol. 19, no. 1, pp.308-311, Available: https://www.ncbi.nlm.nih.gov/pubmed/11720265

[3] S. Rutz, "Potential of organic manures in rainfed lowland rice-based production systems on sandy soils," Doctoral thesis. derLandwirtschaftlichen Fakultät der Rheinischen Friedrich - Wilhelms - Universität zu Bonn, 2015.

[4] A. L. Awanyo (2008), Dealing with weedy problem in agriculture: the role of three agricultural land use management practices in the Forest-Savanna Ecological Zone of Ghana. *Area.* [Online].40(4). pp. 446-458. Available: https://www.jstor.org/stable/40346150?seq=1#page_scan_tab_contents

[5] E.B. Metillo and L.T.Codilla. (2011), "Distribution and abundance of the invasive plant species *Chromolaena odorata* L. in the Zamboanga Peninsula, Philippines," *International Journal of Environmental Science and Development.* [Online], vol. 2, no. 5, pp. 406-410. Available: http://www.ijesd.org/papers/160-U00031.pdf

[6] J.F. Manuel and T. R. Doctor. (2014), "Phytochemical Screening of Selected Indigenous Medicinal Plants of Tublay, Benguet Province, Cordillera Administrative Region, Philippines," *International Journal of Scientific and Research Publications.* [Online], vol. 4, no. 4, pp.1-12. Available: http://www.ijsrp.org/research-paper-0414/ijsrp-p2826.pdf

[7] C.C. Ikewuchi, C. J. Ikewuchi. N.E. Onyeik and O.E. Ayalogue. (2010), "Proximate and phytochemical profile of sansevieria liberica gérôme and labroy," *Journal of Applied Sciences and Enviromental Management*. [Online], vol. 14, no. 2, pp. 103–106. Available: http://www.bioline.org.br/pdf?ja10036

[8] O. Onumkum. (2013), "Studies on the Repellent Activities of Four Common Asteraceae in Nigeria against Red Flour Beetle, Tribolium Castaneum," *The International Journal of Engineering And Science (IJES*). [Online] .2(12).pp.90-93. Available:http://www.theijes.com/papers/v2-i12/Version-3/Version-3/M021203090093.pdf

[9] C. D. Quiambao, D.A. Valdez, I.J. Lloren and R. S. Cacapit, "The termiticidal potential of Chromolaena odorata (l.) r.m. king & H. Robinson (Hagonoy)," Thesis. Don Mariano Memorial State University, South La Union Campus, La Union, Philippines, 2009.

[10] L.H. Acero. (2013), "Dried Siam Weed (*Chromolaena odorata*) as Rice Weevils' (*Sitophilus oryza*) Eradicant," *International Journal of* Chemical *Engineering and Applications*, [Online], vol. 5, no. 5, pp. 363-366. Available: http://www.ijcea.org/papers/410-B0013.pdf

[11] O.A. Ekpete and O.S. Edori (2015), "Phytochemical screening of aqueous extract of *icacina trichantha* roots and its effect on mortality of wood termite," *World Journal of Pharmaceutical Research.* [Online], vol. 4, no. 10, pp. 213-224, Available: www.wjpr.net /download/article/1443595927.pdf

[12] A. V. Oyedokun, F. A. Okelana, I. U. Mokwunye, J. C. Anikwe and O. M. Azeez. (2011), Pesticidal efficacy of three tropical herbal plants' leaf extracts against Macrotermes bellicosus,an emerging pest of cocoa, Theobroma cacao l. *Journal of Biopesticides*, vol. 4, no. 2, pp.131-143. Available: http://www.jbiopest.com/ users/lw8/efiles/vol_4_2_252c.pdf

[13] D. B Taylor, J.J. Zhu, K. Quian, S.R. Sims and X. Zeng.(2013), "Identification of volatile compounds from a food-grade vinegar attractive to house flies (Diptera: Muscidae)," *Journal of Economical Entomology*. [Online], vol. 106, no. 2, pp. 979-987. Available**:** https://www.ncbi.nlm.nih.gov/pubmed/23786090

[14] N.C. Man. (2013), "Phytochemical analysis of leaves of *Chromolaena odorata*," *International Journal of Scientific and Research Publication*. [Online], vol. 3, no. 1, pp. 1-2.Available: https://www.researchgate.net/publication/277151507_Phytochemical_analysis_of_the_leaves_of_Chromolaena_odorata_

[15] C. Catherine, I. Jude and I. Ngozi. (2009), "Chemical Profile of Chromolaena odorata," *International Journal of Scientific and Research Publication*, [Online], vol. 3, no. 1, pp. 1-2. Available: http://scialert.net/fultext/?doi=pjn.2009.521. 524

[16] A. Opoku, I. Ogunwande and O. Lawai. (2015), "Phytoconstituents and Insecticidal Activity of Different Solvent Leaf Extracts of Chromolaena odorata L., against Sitophilus zeamais. (Coleoptera: Curculinidae)," *European Journal of Medicinal Plants*. [Online], vol. 5, no. 3, pp.237-247.Available: http://www.sciencedomain.org/abstract/6719

[17] A. Cannas. (2015), Tannins: fascinating but sometimes dangerous molecules. Cornell University of Agriculture and Life Sciences. Available: http://poisonousplants.ansci.cornell.edu/toxicagents/tannin.html.
[18] C. Fioravanti, K. Vandock and J. Mitchell. (2012), "Effects of plant flavonoids on *Manduca* sexta (tobacco hornworm) fifth larval instar midgut and fat body mitochondrial transhydrogenase," *Archives of Insect Biochemistry and Physiology*. [Online], vol. 80, no. 1, pp. 15-25, Available: https://www.ncbi.nlm.nih.gov/pubmed/22522595
[19] A. C. Udebuani, K. O. Obasi, P. C. Abara and S. U. Okuh. (2015), "Studies on the insecticidal properties of *Chromolaena odorata* (Asteraceae) against adult stage of *Periplaneta Americana*," *Journal of Entomology and Zoology Studies* [Online], vol. 3, no. 1, pp.318-321.Available: http://www.entomoljournal.com/vol3*Issue1/pdf/3-1-46.1.pdf*
[20] A. Prajitno, E. Suprayitno, H. Harlina, H. Nursyam and Rosmiati. (2015), "Potential Study of Kopasanda (*Chromolaena odorata*) Leaves as Antibacterial Against *Vibrio harveyi*, Disease causative Agent of Tiger Shrimp (*Pennaeus monodon Fabriculus*) Post larvae," *Journal of Aquaculture Research and Development.* [Online], vol. 6, no. 1, pp.372-374. Available: https://www.omicsonline. org/open-access/potential-study-of-kopasanda-chromolaena-odorata-l-leaves-asantibacterial-against-vibrio-harveyi-disease-causative-agent-of-tigershrimp-penaeus-monodon-fabricius-post-larvae-2155-9546-1000372.php?aid=62352

Liwayway H. Acero is a member of Asia Pacific Chemistry, Biology, Environment, Engineering Society, editorial member for Global Science and Technology Forum and Palawan Scientist. She is one of the Technical panels of the International Journal of Food Engineering and Technology. Educational background: DST Biology in 2009 from the University of the Philippines-Open University in Los Banos Laguna, Doctor of Education major in Educational Management from Palawan State University on March 2003. She conducted her dissertation at Okayama University Graduate School Education in Japan on March to June 2000 as research fellow. She received her Master of Science degree in agricultural education-Plant Science (Agronomy) from the Western Philippines University in Aborlan, Palawan, Philippines on April 1993. She got her Bachelor of Science degree in Agriculture (cum laude), major in Animal science and minor in Plant Science (agronomy) from the Western Philippines University in Aborlan, Palawan Philippines on April 1986. She is an associate professor and the chairperson of the Department of Natural Sciences, College of Arts & Science in San Beda College, Mendiola, Manila, Philippines. Prior to her employment in San Beda College in Manila, she had served as professor for 20 years in Western Philippines University in Puerto Princesa City, Palawan, Philippines. She handled several administrative works aside from teaching profession. She served as assistant dean of Western Philippines University, Puerto-Princesa Campus, Director for Instruction, Department Chairperson of the Education, Department chairperson of the Agribusiness Department & chairperson for the thesis committee. She had 14 publications. Eleven of her publications are international publications and can be found in the data-based system. Four are indexed by EBSCO and PROQUEST and six are indexed by google scholar