BIBLIOGRAPHY

DEBSO, HAIRETTIN DANGLIWAN. March 2012. Effect of fermented plant extracts in controlling elm leaf beetle (*Xanthogaleruca luteola* Muller) on strawberry plant (*Fragaria chiloensis* Duch). Benguet State University, La Trinidad Benguet.

Adviser: Bonie S. Ligat

ABSTRACT

Universal plant garlicand ginger with five specialized herbs were use in the study. Randomized Complete Block Design with factorial arrangement was used to compare the effecacy of each treatment. All qualitative data was analyzed using the Analysis of Variance (ANOVA) for RCBD factorial with four replications. The significant differences among the treatments means were tested using the Duncan's Multiple Range Test (DMRT). The study was conducted at BSU Malachi Farm, Balili, and La Trinidad Benguet from December 2010 to May 2011. The study aims to record the population of alive elm leaf beetle after the application of specialized herb extracts; to observe the degree of injury caused by elm leaf beetle on leaves and flowers of strawberry plant; to determine yield produce from each treatment; and to identify the phytotoxicity caused by specialized herb extracts on plant.

Strawberry plants applied with fermented garlic had less population of elm leaf beetle, less injured leaves and, flowers and had the highest weight of marketable fruit.

The concoctions of becket and madre de cacao were the most effective in reducing the population of elm leaf beetle in strawberr less injury of leaves and flowers of strawberry

and had the highest yield of marketable fruit. While cassava and hot pepper were the less effective and sepal was the least effective.

The combinations of the following concoctions, garlic with becket and ginger with becket were the most effective concoction in reducing the population of elm leaf beetle resulting to less injured leaves and flowers thereby obtaining highest yield of marketable fruit. Garlic with madre de cacao, ginger with madre de cacao and garlic with cassava, and ginger with cassava were more effective. Garlic with sepal, ginger with sepal, garlic with hotpepper, and ginger with hotpepper were the least effective.

The fermented universal plants, specialized herbs and its combinations had no phytotoxic effect on strawberry plants.

RESULTS AND DISCUSSIONS

This chapter presents the result of each treatment in controlling elm leaf beetle. All qualitative data were analyzed using the Analysis of Variance (ANOVA) for RCBD in 6 treatments with four replications. The significance of differences among the treatments means were tested using the Duncan's Multiple Test (DMRT). It also presents the population of insect; degree of injury, yield, and phytotoxicity of the fermented OHI on strawberry plants.

Population of alive elm leaf beetle after treatment

There is a significant difference between the universal plant extract in decreasing the population of living elm leaf beetle after treating with universal plant extracts as presented in Table1. Based on the result, garlic extracts is more effective in decreasing population of elm beetle with a mean of 10.083 and ginger with a mean of 11.625. This is to confirm with the work Cavallito *et al,* .1994 that garlic has a deterrent effect to insects. As to ginger, extracts of this plant has a good repelling action.

Table1. Effect of universal plants to the population of elm leaf beetle

TREATMENTS	MEAN
Garlic	10.083 [a]
Ginger	11.625[b]

Study shows that specialized herbs are highly significant in controlling elm leaf beetle population; however each treatment's potency varies individually. Specialized herb with the most efficient action was Becket followed by madre de cacao and cassava having mean of 1.875, 5.500 and 6.625. The efficiency of bekket must be due to its active chemical component coriamyrtin and tutin. Coriamyrtin and tutin are both compound that exhibit an inhibitory neurotransmitter in the central nervous system and it usually causes death by hyper excitability (Chinese Medical Journal, 2000). In affirmation with the work of Flores *et al* 1993, that the toxic substance coumarin in madre de cacao kills almost all kind of insects pests. The volatile linimarine in cassava also protects the plant from being destroyed by the pests.Base on thedat gathered the poulation of elm leaf beetle decreasing its number after treated with OHI.

Table 2. Effect of specialized herbs to the population of alive elm leaf beetle

TREATMENTS	MEAN
Untreated	33.00[d]
Cassava	6.625[b]
Bekket	1.875[a]
Sepal	8.125[bc]
Hot Pepper	10.000[c]
Madre de cacao	5.500[b]

Table 3 shows the mean number of living elm leaf beetle after treating with the different OHI extracts. Result of the analysis of each treatment employed regardless of its effectivity, treatment combinations were not significant. Treatments mixed with the two universal plant were same effect to control the population of elmleaf beetle. Based from the result of the study becket were found the most effective to lessen the population. As shown in the Table 3 becket mixed with universal plant were the most effective with a mean of 1.250 and 2.500 followed by madre de cacao 5.000 and 6.000 and cassava with a mean of 6.000 and 7.250.Becket was the most effective as it acts as a contact pesticide once sprayed unlike madre de cacao that it may repel or it can kill once it induce.

The mean of cassava plus garlic as universal plant is almost the same with the mean of madre de cacao plus ginger as universal plant; however the rank order is different. The result implies that garlic extract plus cassava with a mean of 6.000^{c} has lesser potency than ginger extracts plus madre de cacao with a mean of 6.000^{b}. This analysis could prove that ginger has a good synergistic effect which means that when mix with other compounds, it makes the reaction stronger and effective.

Table 3 Mean number of elm leaf beetle alive after treating with combination of specialize herbs and universal plants

SPECIALIZED HERBS	UNIVERSAL PLANTS	
	GARLIC	GINGER
	Mean	Mean
Untreated	32.000[f]	34.000[f]
Cassava	6.000[c]	7.250[c]
Bekket	1.250[a]	2.500[a]
Sepal	6.750[d]	9.500[d]
Hot Pepper	9.500[e]	10.500[e]
Madre de cacao	5.000[b]	6.000[b]

Degree of Injury of Damaged Strawberry Leaves

The effect of universal plant to the degree of damaged strawberry leaves has significant differences as presented Table 4. In relation with population, the universal plant extracts that has the lowest mean recorded has caused lesser injury to strawberry leaves see Appendix B, plate 3 which means that the different formulation has varying dgrees of effecacy.

Table 4. Effect of universal plants to the degree of injury of damaged strawberry plant leaves

UNIVERSAL PLANTS	MEAN
Garlic	14.542 [a]
Ginger	15.500[b]

Specialized herbs have a high significance of differences as shown in Table 5. There are two treatment found to be the same in rank order which are the most effective, this are the Bekket with a mean of 1.875[a] and Madre de cacao with a mean of 5.500[a] . Results show that this treatmeants differs on the effecacy and to the extent of control to prevent elm beetle on foraging the strawberry leaves. However, both treatments are generally effective

Table 5. Effect of specialized herbs to the degree of injury of damaged strawberry leaves

TREATMENTS	MEAN
Untreated	21.625[d]
Cassava	6.625[b]
Bekket	1.875[a]
Sepal	8.125[c]
Hot Pepper	10.000[c]
Madre de cacao	5.500[a]

As shown in Table 6 treatments have highly significance differences on the means of damage strawberry leaves caused by elm leaf beetle. Severities of injury were determined by ranking the treatments. A treatment with the highest mean indicates that the damaged strawberry leaves were also high in number (see Appendix B, Plate 5 &6). Generally, treatments with garlic as the universal plant has lower mean than that of those treatment with ginger as the universal plant. This figure shows that specialized herbs plus garlic is more efficient.

Table 6. Mean of strawberry leaves damaged by elm leaf beetle

SPECIALIZED HERBS	UNIVERSAL PLANTS	
	GARLIC	GINGER
	Mean	Mean
Untreated	20.000^{g}	23.250^{h}
Cassava	13.250^{bc}	14.750^{edc}
Bekket	8.500^{a}	12.500^{b}
Sepal	15.000^{cda}	16.250^{fe}
Hot Pepper	17.250^{f}	15.750^{fed}
Madre de cacao	10.000^{a}	13.750^{bcd}

Degree of Injury of Damaged Strawberry Flowers

Table 7 elucidates the universal plants' effect to the degree of injury of damaged strawberry flowers. Fomulations has a significant differences, between the two treatments, garlic extracts has a lower mean which means that damaged strawberry flowers was lesser than that of strawberry plant applied with ginger extracts.

Table 7. Effect of universal plants to the degree of injury of damaged strawberry flowers

TREATMENTS	MEAN
Garlic	8.917 [a]
Ginger	9.875[b]

Table 8 discusses the effect of specialized herbs to the degree of injury of damaged strawberry flowers. Treatments has highly significant differences, higher mean indicates more number of flowers damaged, Bekket extracts is the most efficient treatment with a mean of 7.250 which means that comparing to the other formulations, it has the potency to control elm leaf beetle by increasing its mortality rate and protecting or controlling the strawberry plant from being infested.

Table 8. Effect of specialized herbs to the degree of injury of damaged strawberry flowers

TREATMENTS	MEAN
Untreated	14.875[c]
Cassava	9.000[b]
Bekket	7.250[a]
Sepal	8.625[ab]
Hot Pepper	8.750[ab]
Madre de cacao	8.250[ab]

Result shows that there is no significant difference to the mean of strawberry flowers damaged by elm leaf beetle as shown in Table 10, it implies that the damaged caused by elm leaf beetle is almost the same between garlic extrats plus specialized herbs and ginger extracts plus specialized herbs.

Table 9. Mean of strawberry flowers damaged by elm leaf beetle

SPECIALIZED HERBS	UNIVERSAL PLANTS	
	GARLIC	GINGER
	Mean	Mean
Untreated	13.500[f]	16.250[d]
Cassava	9.000[e]	9.000[c]
Bekket	6.750[a]	7.750[a]
Sepal	8.250[c]	9.000[c]
Hot Pepper	8.500[d]	9.000[c]
Madre de cacao	7.500[b]	8.250[b]

Yield (Marketable)

Table 10 shows the effect of universal plants to the yield of marketable strawberry fruit in grams.Treatments has highly significant differences, data collated presents that strawberry plant applied with garlic extracts has yield more marketable fruit with a mean of 199.98 than that of strawberry plant treated with ginger extracts .

Table 10 Effect of universal plants to the yield of marketable strawberry fruit in grams

TREATMENTS	MEAN
Garlic	199.958[a]
Ginger	168.917[b]

Results of mean weight of marketable yield produce per treatment were presented in table 11. Treatments differences were highly significant. From the table, becket has the highest weight of marketable yield with a mean of 28.125. Madre de cacao is the second marketable fruit harvested with a mean of 244.500. Followed by these treatments, cassava and hot pepper with a mean of 183.125 and 180.750 and Sepal with a mean of 153.000.Untreated had the lowest weight of marketable fruit harvested with a mean of 64.125.

Table 11. Effect of specialized herbs to the yield of marketable strawberry fruit in grams

TREATMENTS	MEAN
Untreated	64.125[e]
Cassava	183.125[c]
Bekket	281.125[a]
Sepal	153.000[d]
Hot Pepper	180.750[c]
Madre de cacao	244.500[b]

Mean of treatments that were used in controlling elm leaf beetle to strawberry plant were presented in table 12, differences of treatments were highly significant. Treatments with higher means signifies that marketable strawberry fruit harvested from the corresponding strawberry plants treated with specialized herbs in terms of yield is high.

Marketable strawberries are weighed in grams and ranked it according to the treatment at which has the highest yield produced. In the table, strawberry plant applied with bekket extracts plus garlic extract has the highest yield of strawberry fruit, followed by madre de cacao plus garlic, cassava plus garlic, bekket plus ginger and madre de cacao plus ginger respectively.

Table 12. Mean of marketable strawberry fruit in grams

SPECIALIZED HERBS	UNIVERSAL PLANTS	
	GARLIC	GINGER
	Mean	Mean
Untreated	74.250[f]	54.000[f]
Cassava	235.000[b]	131.250[e]
Bekket	308.750[a]	253.250[b]
Sepal	161.750[cde]	136.750[de]
Hot Pepper	188.000[c]	173.500[cd]
Madre de cacao	232.000[b]	257.000[b]

Yield (Non-marketable)

Result of the treatments has higly significant differences, as shown in the table. Strawberry plant applied with garlic extract has the least weight of non marketable berries harvested with a mean of 79.333 followed by ginger which mean is 86.750.

Table 13. Effect of universal plants to the yield of non-marketable strawberry fruit in grams

TREATMENTS	MEAN
Garlic	79.333[a]
Ginger	86.750[b]

Effect of specialized herbs to the non marketable strawberry fruit is shown in Table 14. Differences of treatments were highly significant; becket has the least non-marketable strawberry fruit harvested with a mean of 62.125 followed by madre de cacao with a mean of 70.250. These were followed by cassava with a mean of 75.250, hot pepper with a mean of 88.125 and sepal with a mean of 90.00. Untreated were the last with a high weight of non-marketable with a mean of 112.500.

Table 14. Effect of specialized herbs to the yield of non-marketable strawberry fruit in grams

TREATMENTS	MEAN
Untreated	112.500[d]
Cassava	75.250[b]
Bekket	62.125[a]
Sepal	90.000[c]
Hot Pepper	88.125[c]
Madre de cacao	70.250[b]

Table 15 shows that there is no significant difference with the mean of non-marketable strawberry fruit in grams. Treatment which has the lowest mean elucidates that it has the least weighed damage fruit. Bekket plus garlic has the least weight of non marketable stawberry fruit gathered, followed by madre de cacao plus garlic, bekket plus ginger, cassava plus garlic, cassava plus ginger and madre de cacao plus ginger respectively.

Table 15. Mean of non-marketable strawberry fruit in grams

SPECIALIZED HERBS	UNIVERSAL PLANTS	
	GARLIC	GINGER
	Mean	Mean
Untreated	110.250[f]	114.750[f]
Cassava	73.750[c]	76.750[b]
Bekket	54.000[a]	70.250[a]
Sepal	82.250[d]	92.750[e]
Hot Pepper	88.000[e]	88.250[d]
Madre de cacao	62.750[b]	77.750[c]

Phytotoxicity of Treatments

The study shows that the formulated treatments has no burning effect, discoloration of plant, stunted growth and even death of strawberry plant observed as long as proper dosage of plant extract were followed (See Appendix A, Appendix Table 12)

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

Elm leaf beetle was another kind of insect that is destructive to strawberry plants among other identified. The study was conducted to evaluate the effects of different fermented plant extracts in controlling elm leaf beetle on strawberry plant. The study aims to identify number of alive elm leaf beetle after the treatment; to identify the degree of injury on leaves and flowers of strawberry plant caused by elm leaf beetle; to identify yield produce from each treatment; and to identify phytotoxicity on the plant.

Based on the results, treatment that has the highest probability in controlling the population of this insect was Becket + Garlic (B3+A1) with a mean of 1.250 and Becket + Ginger (B3+A2) with a mean of 2.500. For the degree of injury, treatments that has the lowest damage leaves are Becket + Garlic (B3+A1) and Becket + Ginger (B3+A2) with a mean of 8.500 and 12.500; for the flower, Becket + Garlic (B3+A1) with a mean of 6.750 and Becket + Ginger (B3+A2) with a mean of 7.750 are found to be still the most effective. For the marketable fruit, treatments that has the highest yield harvested was from Becket + Garlic (B3+A1) with a mean of 308.750 and Madre de cacao (B6+A2) with a mean of 257.000; treatments that has the lowest yield of non-marketable strawberries are Becket + Garlic (B3+A1) and Becket + Ginger (B3+A2) with a mean of 54.000 and 70.250. Of the stated figures, all have a rank order of A in which they are the treatments that are generally most efficient.

Conclusion

Based on the results and analyzation of treatments, it is therefore concluded that each treatment is highly significant in controlling elm leaf beetle. Nevertheless, the extent of effectiveness and efficiency varies.

Recommendation

A study to determine the market acceptability through market testing, trials on the different potential of each treatment, research and evaluation is needed, furthermore, it is recommended to study more on elm leaf beetle especially its life cycle on strawberry plant so that it will be known when or how to apply natural insecticide or botanopestecides, and to look for more natural ways of controlling elm leaf beetle especially during summer because this insect pest are most likely to be abundant and active foraging during this season.

LITERATURE CITED

ANONYMOUS. 2010. Potential Uses of Indigenious Medicinal Plants in Benguet in Farming Industry.

ANONYMOUS.1992. Reregistration of Eligibility Decision (RED) Capsaicin, Case 4018; U.S. Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances,Office of Pesticide Programs,U.S.Government Printing Office: Washington, DC.Retrieved September 20, 2010 http://en.wikipedia.org/wiki/Capsaicin#Pest_deterrent.

AREGHEORE E. M. and O. O. AGUNBIADE 1991. "The Toxic Effects of Cassava (Manihot Esculenta Grantz) Diets on Humans: A Review". *Vet. Hum. Toxicoogyl.* Retrieved September 20, 2010 http://en.wikipedia.org/wiki/Cassava.

AUGUSTINE, N. B., D. SCOTT, C.R. LEE, J.T.GORMAN, J.W. MCNERNEY, JR., J. RODGERS, J.F.SMITH, JR., K. COOK, L. LAFLEY, and L.M, MARTIN. Joy Dishwashing liquid is good surfactant and emulsifier.

BALAKI, E.T. 1992. Crop Protection and Cultural Management Studies on Strawberry. Benguet State University, La Trinidad, Benguet.

CAVALLITO, CHESTER J., J.H. BAILEY. 1944. Journal of the American Chemical Society 66 (11): 1950. Retrieved August 20, 2010 http://en.wikipedia.org/wiki/Allicin

CEREDA, M.P., M.C.Y. MATOS.1996. Linamarin- The Toxic Compound of Cassava. Journal of Venomous Animals and Toxins,vol. 2 no. 1. Center of Tropical Roots, CERAT-UNESP, São Paulo State University, Botucatu (SP), Brazil. Retrieved September 20, 2010. http//www.researchnews.osu.edu/archive/cassava.htm

Chinese Medical Journal. 2000. Recent development in NMDA receptors. Retrieved March 2012. http://en.wikipedia.org/wiki/Glycine#As_a_neurotransmitter

COLLINS, C.2007. Implementing Phytoremediation of Petroleum Hydrocarbons, Methods of Biotechnology.

COPPING, L. G. 2001. The BioPesticide Manual, 2nd ed.British Crop Protection Council: Farnham, UK, 2001; pp 171-172. Retrieved August 20, 2010 from http://npic.orst.edu/factsheets/Capsaicintech.pdf

CORONEL, R.E. 1983. Promising fruits of the Phililppines. Pp.325-350.

DAHLSTEN, D. L, A. B. LAWSON, and D. L. ROWNEY. 1998. IPM Helps Control Elm Leaf Beetle. University of California; IPM Education and Publications.

FLORES, H. and A. RABENA. 1993. Insectecidal, Nematicidal and Antibacterial of Gliricidia Sepium. Pp. 2625-2629.

HERMANO, F. G. 1999. Strawberry Production Management and Technology. Benguet State University, La Trinidad, Benguet.

PEREZ, N. 2005. School of Holistic aromatherapy. Retrieved June 21, 2010 from http//www.holisticgroma.co.uk/articles/essential oil of ginger.htm

UMALI, GODOFREDO. 2010. Baket, *Coriaria intermedia* Matsum, Japanese false blueberry - Herbal Medicine - An illustrated compilation of Philippine medicinal plants. Retrieved September, 2010 from http://en.wikipilipinas.org/index.php?title=Coriaria_intermedia

WAGNER, H.2003. "Cassava's Cyanide-Producing Abilities Can Cause Neuropathy". Retrieved June 21, 2010 from. http://Www.Cidpusa.Org/Cassava.htm

WAWRZYNSKI, R. P. 2010. Leaf Beetles in Urban Landscapes Regents of the of University Minnesota.

WHITE W. L. B, and R. T. SAYRE. 1998."Cyanogenesis in Cassava, The Role of Hydroxynitrile Lyase in Root Cyanide Production". Plant Physiology. Retrieved September 20, 2010 from http://en.wikipedia.org/wiki/Cassava.