

**EFFECT OF DIFFERENT FERMENTED PLANT EXTRACT AGAINST
INSECT PESTS OF TRANSPLANTED RICE
UNDER ORGANIC FARMING**

LYLAC C. VILLANUEVA

An Undergraduate Thesis Submitted to the Faculty of the Department of Environmental
Science, College of Arts and Sciences, Central Luzon State University,
Science City of Muñoz, Nueva Ecija, Philippines
in Partial Fulfillment of the Requirements
for the Degree of

**BACHELOR OF SCIENCE IN ENVIRONMENTAL SCIENCE
(Sustainable Agriculture)**

FEBRUARY 2020

ACCEPTANCE SHEET

This undergraduate thesis entitled "**EFFECT OF DIFFERENT FERMENTED PLANT EXTRACT AGAINST INSECT PESTS OF TRANSPLANTED RICE,**" prepared by **LYLAC C. VILLANUEVA** in partial fulfillment of the requirements for the degree of **BACHELOR OF SCIENCE IN ENVIRONMENTAL SCIENCE (SUSTAINABLE AGRICULTURE)**, is hereby accepted:


JONATHAN L. GALINDEZ, Ph.D.

Adviser

01-22-20

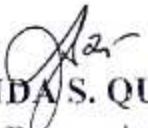
Date Signed


CESAR V. ORTINERO, Ph.D.

Critic

1-22-2020

Date Signed


LUZVIMINDA S. QUITO, Ph.D.

Department Research Coordinator

1-22-2020

Date Signed

Accepted as partial fulfillment of the requirements for the degree of **BACHELOR OF SCIENCE IN ENVIRONMENTAL SCIENCE (SUSTAINABLE AGRICULTURE)**:


SHARON E. LAZARO, Ph.D.

Chair, Department of Environmental Science

22 January 2020

Date Signed


KRISTINE GRACE D. WANG, M.Sc.

College Research Coordinator

1/22/2020

Date Signed


EVARISTO A. ABELLA, Ph.D.

Dean, College of Arts and Sciences

01-22-20

Date Signed

BIOGRAPHICAL SKETCH

The author was born in Bagong Sikat, Science City of Muñoz, Nueva Ecija on July 24,1999, She has a younger brother and she is the only daughter of Mr. Ariel E.Villanueva and Mrs. Maribel C. Villanueva. She finished her elementary education at Bagong Sikat Elementary School with awards. She took his secondary education at San Sebastian School Science City of Muñoz, Nueva Ecija.

At present she is studying at Central Luzon State University taking up Bachelor of Science in Environmental Science major in Sustainable Agriculture.

As a student at Central Luzon State University, she was a member and scholar of Gintong Ani Philippines-Rondalla during her first year (2015-2016). She experienced the Gintong Ani Philippines free admission concert entitled "Katubanya" at CLSU Auditorium. She was also a scholar of CHED Tulong Dunong- SUC from 2016-2018 and first and second semester of 2017-2018.She attended the 24th Psychology Student Research Congress held at Central Luzon State University Auditorium on April 29, 2016. She also attended symposium entitled "Role of Biologist in the Environmental Impact Assessment and Projects" on November 22, 2016 and symposium entitled "Philippine Biodiversity and the National Museum" on March 22, 2016. She attended a seminar on Environmental Awareness with the theme " Kilos Para sa Kalikasan: Building Resilience Philippines" held at the College of Arts and Sciences Little Theatre, Central Luzon State University on November 15, 2017.

ACKNOWLEDGMENT

The author believes on the saying "Doing my best is more important than being the best". It was a world that happenings are play and make believed. As she grows, her simple world became complicated. She finds herself down, yet she works hard and wishing so hard that by the next count, she could conquer. And finally, she won, she work her best with the help of numerous people that without them she cannot achieve her goal.

She wants to express her sincerest thanks and love to God, the one who always give strength and holy spirit. The one who always give motivation to her life and her studies.

A heartfelt thanks to her very supportive parents Mr. Ariel E. Villanueva and Mrs. Maribel C. Villanueva who give advises, and moral support. A special thanks to her grandmother Prescilla L. Candelario who always give inspiring messages and motivation throughout her studies, as well as financial support. She also wants to express her sincerest thanks to her friends and relatives who give jokes and helping hands during her studies. Without them she cannot pursued her studies.

This piece of work was not come into reality if her very hard-working adviser is not present. So, a very deep appreciation and thankfulness to Dr. Jonathan L. Galindez, the one who give advises and suggestions on her study. He's the one the author depends on during her studies.

Thanks, is also due to her critic Dr. Cesar V. Ortinero, Ph.D. who willingly criticized her work and gave kind words about her study. Also, deep appreciation to the Department Research Coordinator Prof. Luzviminda S. Quito, Ph.D. who gave unmeasurable help. To those people who always there, they left something to love and to value.

TABLE OF CONTENTS

	PAGE
LIST OF TABLES	vii
LIST OF APPENDICES	ix
LIST OF APPENDIX TABLES	x
LIST OF APPENDIX FIGURES	xvi
ABSTRACT	xviii
INTRODUCTION	1
Background of the Study	1
Importance of the Study	2
Objectives of the Study	3
Significance of the Study	3
Statement of the Problem	4
Scope and Limitation of the Study	4
Time and Place of The Study	4
REVIEW OF RELATED LITERATURE	5
Botanical Extracts	5
Characteristics of Botanical Pesticide	5
Advantage and Disadvantage of Plant Extract	6
Pests	7
Harmful Insect	7
Beneficial Insect	8
Impacts of Pests	8
Methods of Controlling Pests	9
Status of Present Pests Control	10
Advantage of Using Botanical Extract	11
Chemical Compound	12
Kakawate	12
Yellow Ginger	12
Coronitas (Lantana)	13
Oregano	14

METHODOLOGY	15
Collection of Kakawate Leaves, Yellow Ginger, Coronitas and Oregano Leaves	15
Preparation of Extracts	15
Preparation of Fermented Extract	15
Establishment of Experimental/Test Crop	16
Field Preparation and Field Layout	16
Seedbed Preparation	16
Transplanting	17
Water Management	17
Organic Fertilizer Application	17
Insect Pests Management	18
Weed Management	18
Harvesting, Threshing and Cleaning	19
Statistical Analysis	19
Data Gathered	20
RESULTS AND DISCUSSION	23
Preparation of Fermented Plant Extract	23
Plant Height at 30 DAT	24
Plant Height at Harvest	25
Number of Productive Tillers Per Hill	26
Number of Unproductive Tillers Per Hill	27
Green Leafhoppers	33
Brown Planthoppers	34
Rice Whorl Maggot	37
Damaged leaves	40
Dead Hearts	43
White Heads	44
SUMMARY, CONCLUSION AND RECCOMENDATION	45
LITERATURE CITED	46
APPENDICES	51

LIST OF TABLES

TABLE		PAGE
1	Calculated Dose/Rate of Treatment will be Applied on Rice	19
2	Average amount of strained liquid from the fermented plant materials	24
3	Average Plant height at 30 DAT of Basmati (CL-1) as affected by the application of different treatments	25
4	Average Plant height at harvest of Basmati (CL-1) as affected by the application of different treatments	26
5	Average number of productive tillers per hill at harvest	27
6	Average number of unproductive tillers per hill	29
7	Percent decrease of green leafhopper population one day after treatment application at different time of application	33
8	Percent decrease of brown planthopper population observed per plot after treatment application at different time of application	36
9	Percent decrease of green leafhopper population one day after treatment application at different time of application	39
10	Damaged leaves at 14 DAT, 21 DAT and 28 DAT	41
11	Damaged leaves at 35 DAT, 42 DAT and 49 DAT	42
12	Mean of Dead Heart of Basmati (CL-1) as Affected by The Application of Different Treatment	43
13	Mean of White Head of Basmati (CL-1) as Affected by the Application of Different Treatment	44

LIST OF EQUATION

EQUATION

1	Percent Decrease/Increase of Insect Pest One Day After Treatment Application	20
---	--	----

LIST OF APPENDICES

APPENDIX

1	Raw Data and ANOVA Tables	52
2	Documentary	77

LIST OF APPENDIX TABLE

APPENDIX TABLE		PAGE
1	Plant height at 30 DAT of Basmati (CL-1) as affected by the application of different treatments	52
2	Analysis of variance on the plant height at maturity of transplanted rice (cm)	52
3	Pairwise Mean Comparison of Treatment on the plant height at maturity	52
4	Plant height at harvest of Basmati CL-1 as affected by the application of different treatments	53
5	Analysis of variance on the plant height at harvest of transplanted rice (cm)	53
6	Pairwise Mean Comparison of Treatment on the plant height at harvest	53
7	Number of unproductive tillers per hill at harvest	54
8	Analysis of variance on the unproductive tillers of transplanted rice	54
9	Pairwise Mean Comparison of Treatment on the unproductive tillers	54
10	Number of productive tillers of transplanted rice	54
11	Pairwise Mean Comparison of Treatment on the productive tillers	55
12	Analysis of variance on the productive tillers of transplanted rice	55
13	Mean population of green leafhopper at 14 DAT	55
14	Analysis of variance on the green leafhopper population at 14 DAT	55

15	Pairwise Mean Comparison of Treatment on the green leafhopper population at 14 DAT before treatment application	56
16	Pairwise Mean Comparison of Treatment on the green leafhopper population at 14 DAT after treatment application	56
17	Mean population of green leafhopper at 21 DAT	56
18	Analysis of variance on the green leafhopper population at 21 DAT	56
19	Pairwise Mean Comparison of Treatment on the green leafhopper population at 21 DAT before treatment application	57
20	Pairwise Mean Comparison of Treatment on the green leafhopper population at 21 DAT after treatment application	57
21	Mean population of green leafhopper at 28 DAT	57
22	Analysis of variance on the green leafhopper population at 28 DAT	57
23	Pairwise Mean Comparison of Treatment on the green leafhopper population at 28 DAT before treatment application	58
24	Pairwise Mean Comparison of Treatment on the green leafhopper population at 28 DAT after treatment application	58
25	Mean population of green leafhopper at 35 DAT	58
26	Analysis of variance on the green leafhopper population at 35 DAT	58
27	Pairwise Mean Comparison of Treatment on the green leafhopper population at 35 DAT before treatment application	59
28	Pairwise Mean Comparison of Treatment on the green leafhopper population at 35 DAT after treatment application	59

29	Mean population of green leafhopper at 42 DAT	59
30	Analysis of variance on the green leafhopper population at 42 DAT	59
31	Pairwise Mean Comparison of Treatment on the green leafhopper population at 42 DAT before treatment application	60
32	Pairwise Mean Comparison of Treatment on the green leafhopper population at 42 DAT after treatment application	60
33	Mean population of green leafhopper at 49 DAT	60
34	Analysis of variance on the green leafhopper population at 49 DAT	60
35	Pairwise Mean Comparison of Treatment on the green leafhopper population at 49 DAT before treatment application	61
36	Pairwise Mean Comparison of Treatment on the green leafhopper population at 49 DAT after treatment application	61
37	Mean population of brown planthopper at 14 DAT	61
38	Analysis of variance on the brown planthopper population at 14 DAT	61
39	Pairwise Mean Comparison of Treatment on the brown planthopper at 14 DAT before treatment application	62
40	Pairwise Mean Comparison of Treatment on the brown planthopper at 14 DAT after treatment application	62
41	Mean population of brown planthopper at 21 DAT	62
42	Analysis of variance on the brown planthopper population at 21 DAT	62
43	Pairwise Mean Comparison of Treatment on the brown planthopper at 21 DAT before treatment application	63

44	Pairwise Mean Comparison of Treatment on the brown planthopper at 21 DAT after treatment application	63
45	Mean population of brown planthopper at 28 DAT	63
46	Analysis of variance on the brown planthopper population at 28 DAT	63
47	Pairwise Mean Comparison of Treatment on the brown planthopper at 28 DAT before treatment application	64
48	Pairwise Mean Comparison of Treatment on the brown planthopper at 28 DAT after treatment application	64
49	Mean population of brown planthopper at 35 DAT	64
50	Analysis of variance on the brown planthopper population at 35 DAT	64
51	Pairwise Mean Comparison of Treatment on the brown planthopper at 35 DAT before treatment application	65
52	Pairwise Mean Comparison of Treatment on the brown planthopper at 35 DAT after treatment application	65
53	Mean population of rice whorl maggot at 14 DAT	65
54	Analysis of variance on the rice whorl maggot population at 14 DAT	65
55	Pairwise Mean Comparison of Treatment on the rice whorl maggot at 14 DAT before treatment application	66
56	Pairwise Mean Comparison of Treatment on the rice whorl maggot at 14 DAT after treatment application	66
57	Mean population of rice whorl maggot at 21 DAT	66
58	Analysis of variance on the rice whorl maggot population at 21 DAT	66
59	Pairwise Mean Comparison of Treatment on the rice whorl maggot at 21 DAT before treatment application	67
60	Pairwise Mean Comparison of Treatment on the rice whorl maggot at 21 DAT after treatment application	67

61	Mean population of rice whorl maggot at 28 DAT	67
62	Analysis of variance on the rice whorl maggot population at 28 DAT	67
63	Pairwise Mean Comparison of Treatment on the rice whorl maggot at 28 DAT before treatment application	68
64	Pairwise Mean Comparison of Treatment on the rice whorl maggot at 28 DAT after treatment application	68
65	Mean population of rice whorl maggot at 35 DAT	68
66	Analysis of variance on the rice whorl maggot population at 35 DAT	68
67	Pairwise Mean Comparison of Treatment on the rice whorl maggot at 35 DAT before treatment application	69
68	Pairwise Mean Comparison of Treatment on the rice whorl maggot at 35 DAT after treatment application	69
69	Mean population of rice whorl maggot at 42 DAT	69
70	Analysis of variance on the rice whorl maggot population at 42 DAT	69
71	Pairwise Mean Comparison of Treatment on the rice whorl maggot at 42 DAT before treatment application	70
72	Pairwise Mean Comparison of Treatment on the rice whorl maggot at 42 DAT after treatment application	70
73	Number of damaged leaves at 14 DAT	70
74	Analysis of variance on the damaged leaves at 14 DAT	70
75	Pairwise Mean Comparison of Treatment on the damaged leaves at 14 DAT	71
76	Number of damaged leaves at 21 DAT	71
77	Analysis of variance on the damaged leaves at 21 DAT	71
78	Number of damaged leaves at 28 DAT	72

79	Analysis of variance on the damaged leaves at 28 DAT	72
80	Pairwise Mean Comparison of Treatment on the damaged leaves at 28 DAT	72
81	Number of damaged leaves at 35 DAT	73
82	Analysis of variance on the damaged leaves at 35 DAT	73
83	Pairwise Mean Comparison of Treatment on the damaged leaves at 35 DAT	73
84	Number of damaged leaves at 42 DAT	74
85	Analysis of variance on the damaged leaves at 42 DAT	74
86	Pairwise Mean Comparison of Treatment on the damaged leaves at 42 DAT	74
87	Number of damaged leaves at 49 DAT	75
88	Analysis of variance on the damaged leaves at 49 DAT	75
89	Pairwise Mean Comparison of Treatment on the damaged leaves at 49 DAT	75
90	Number of Dead Hearts	75
91	Analysis of variance on the dead heart	76
92	Number of White Heads	76
93	Analysis of variance on the white head	76
94	Pairwise Mean Comparison of Treatment on the white heads	76

LIST OF APPENDIX FIGURES

APPENDIX FIGURE		PAGE
1	Kakawate leaves	77
2	Coronitas Leaves	77
3	Yellow ginger	77
4	Oregano Leaves	77
5	Chopped Plant Materials	78
6	Kakawate leaves Extract	78
7	Coronitas Leaves Extract	78
8	Yellow Ginger Corm Extract	78
9	Oregano Leaves Extract	79
10	Combination of all Plant Material	79
11	Fermented Kakawate leaves	79
12	Fermented Coronitas Leaves	79
13	Fermented Yellow Ginger Corm	80
14	Fermented Oregano Leaves	80
15	Combination of all Fermented Plant Material	80
16	Strained Liquid	80
17	Brown Bottle	81
18	Measuring of Blocks	81
19	Pulling of 21 Days old seedling.	81
20	Transplanting of rice	81
21	Application of organic fertilizer	82

22	Collection of insects at 14 DAT (Before and After)	82
23	Collection of insects at 21 DAT (Before and After)	82
24	Collection of insects at 28 DAT (Before and After)	83
25	Collection of insects at 35 DAT (Before and After)	83
26	Collection of insects at 42 DAT (Before and After)	84
27	Collection of insects at 49 DAT (Before and After)	84
28	Application of treatments at 14 DAT	85
29	Application of treatments at 21 DAT	85
30	Application of treatments at 28 DAT	85
31	Application of treatments at 35 DAT	86
32	Application of treatments at 42 DAT	86
33	Application of treatments at 49 DAT	86
34	Measuring of plant height	86
35	Counting of damaged leaves	87
36	Counting of Dead Heart	87
37	Counting White Head	87
38	Green Leafhopper	88
39	Brown Planthopper	88
40	Rice Whorl Maggot	88
41	Experimental Field Layout (RCBD)	89

ABSTRACT

VILANUEVA, LYLAC C., Department of Environmental Science, College of Arts and Sciences, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines, **February 2020, EFFECT OF DIFFERENT FERMENTED PLANT EXTRACT AGAINST INSECT PESTS OF TRANSPLANTED RICE**

Adviser: **JONATHAN L. GALINDEZ, Ph.D.**

One of the most important global problems is protecting rice crops from being attacked by insect pests. Synthetic chemicals are the most commonly used to combat these insect pests. However, using chemicals would threaten the environment, health of farm operators, animals, and consumers. The negative effects of these chemicals leads to the interest in biopesticides due to their minimal costs and ecological safety. In this study, fermented kakawate leaves extract, fermented coronitas leaves extract, fermented oregano leaves extract, fermented yellow ginger corms extract and the combination of all fermented plant extract were tested against insect pests of rice. Result showed that the application of combination of all fermented plant extract was found the most effective against insect pests of rice. Biopesticides affect only the population of rice insect pests. Utilization of biopesticides ensure the integrity of the environment and the production of safe quality food.

Keywords: fermented; biopesticide; environment; extract; insect

LITERATURE CITED

- Abteu, A., Subramanian, S., & Martin, T. (2015). Repellency of plant extracts against the legume flower thrips *Megalurothrips sjostedti* (Thysanoptera:Thripidae). *Journal of Agricultural Research*, 13, 12-25.
- Addisu, S., Mohamed, D., & Waktole, S. (2014). Efficacy of botanical extracts against termites, *Macrotermes* spp., (Isoptera: Termitidae) under laboratory conditions. *International Journal of Agricultural Research*, 9, 60-73. doi:10.3923/ijar.2014.60.73
- Aeschbach, R., Loliger, J., Scott, B. C., Murcia, A., Halliwell, B., & Aruoma O. I. (1994). Antioxidant actions of thymol, carvacrol, [6]-gingerol, zingerone and hydroxytyrosol. *Food Chemical Toxicology*, 32(1), 31-6.
- Aktar, W. M., Sengupta, D., & Chowdhury, C. (2009). Impact of pesticides use in agriculture: their benefits and hazards. *Interdisciplinary Toxicology*, 2(1), 1-12.
- Alam, S. (2017). Checklist of rice insect pests of Bangladesh. In: Literature review of insect pests and diseases of rice in Bangladesh. *Bangladesh Journal of Botany*, 46(1), 405-412.
- Altemimi, A., Lakhssassi, N., Baharlouei, A., Watson, D. G., & Lightfoot, D. A. (2017). Phytochemicals: Extraction, isolation and identification of bioactive compounds from plant extracts. *Plants-Basel*, 6(4), 42-45.
- Alzohairy, M. A. (2016). Therapeutics role of *Azadirachta Indica* (neem) and their active constituents in diseases prevention and treatment. *Journal on Evidence Based Complementary and Alternative Medicine*, 42, 1583-1594.
- Ansari, M. A., Vasudevan, P., Tandon, M., & Razdan, R. K. (2011). Larvicidal and mosquito repellent action of peppermint (*Mentha piperata*) oil. *Bioresource Technology*, 71, 267.
- Barakat, D. A. (2011). Insecticidal and antifeedant activities and chemical composition of casimiroa edulis leaf extract and its fractions against (*Spodoptera Littoralis*) larvae. *Journal of Basic Medical Sciences*, 5(9), 693-703.
- Block, G., Patterson, B., & Subar, A. (1992). Fruit, vegetables, and cancer prevention: A review of the epidemiological evidence. *Pesticides in the Diets of Infants and Children*, 18, 1-29.
- Calumpang, S. M. F., Navasero, M. M., Burgonio, G. A. S., & Navasero, M. V. (2014). Repellency of Volatile Organic Chemicals of Kakawate (*Gliricidia sepium*) (Jacq.) Walp., to Rice Green Leafhopper, *Nephotettix virescens* (Distant) (Hemiptera: Cicadellidae). *Philippine Agriculture Scientist*, 97(2), 148-154.

- Carroll, J. F., Demirci, B., Kramer, M., Bernier, U. R., Baser, H. C., & Tabanca, N. (2017). Repellency of the *origanum onites* L. essential oil and constituents to the lone star tick and yellow fever mosquito. *Journal on Natural Product Research*, 31(18), 2192-2197.
- Chatterjee, S., & Mondal, P. (2014). Management of rice yellow stem borer, (*Scirpophaga incertulas*) Walker using some bio rational insecticides. *Journal of Biopesticide*, 7, 143-147.
- Cranshaw, W. S., (2009). Beneficial insects and other arthropods. *Bio agricultural Sciences and Pest Management*, 1, 5-550.
- Culver, M., Fonvel, T. & Chiteka, A. Z. (2012). Effect of oringa extract on growth and yield of tomato. *Greener Journal of Agricultural Sciences*, 2(5), 207-2011.
- Duraipandiyan, V., Ayyanar, M., & Ignacimuthu, S. (2006). Antimicrobial activity of some ethnomedicinal plants used by paliyar tribe from Tamil Nadu, India. *BMC Complementary and Alternative Medicine*, 6, 35-41.
- Ertani, A., Sambo, D., Nicolletto, C., Santagana, S., Schiavon, M., & Nord, S. (2015). The use of biostimulants in hot pepper plants to help low inputs sustainable agriculture. *Chemical and Biological Technologies in Agriculture*, 2(11), 1-11.
- Evans, H. C., & Ellison, C. A. (1990). Classical biological control of weeds with micro-organisms: past, present, prospects. *Aspects of Applied Biology*, 24, 39-49.
- Flint, M. L., & Bosch, R. (1977). Introduction to integrated pest management. *Biointensive Integrated Pest Management*, 18(2), 173-174.
- Ghahfarokhi, S. M., Pirali, Y., & Samani, D. A. (2018). The insecticidal and repellent activity of ginger (*zingiber officinale*) and eucalyptus (*ucalyptus globus*) essential ils Agaainst *culex theileri* theobald, 1903 (Diptera:Culicidae). *Annals of Parasitology*, 64(4), 351-360.
- Gopalakrishnan, R., & Chander, S. (2007). A degree-day simulation model for the population dynamics of the rice bug, *Leptocorisa acuta* (Thunb.). *Journal of Applied Entomology*, 132, 646-653.
- Gross, B. L., & Zhao, Z. (2014). Archaeological and genetic insights into the origins of domesticated rice. *Proceedings of the National Academy of Sciences*, 111(17), 6190-6197.
- Heinrichs, E. A., & Barrion, A. T., (1983). Rice feeding insects and selected natural enemies of west africa. *Biology and Ecology*, 12, 21-33.

- Inostrosa, S. I., & Fournier, O. L. A. (1982). Allelopathic substances found in vegetative and reproductive structures of Kakawate (*Gliricidia sepium*). *International Journal of Tropical Biology and Conservation*, 34, 223-229.
- Javier, A. M. V., Ocampo, V. R., & Ceballo, F.A. (2017). Insecticidal activity of selected essential oil extracts against common cutworm, (*Spodoptera litura* Fabricius) (Lepidoptera: Noctuidae). *Philippine Journal of Science*, 146(3), 247-256.
- Kar, R. K. (1991). The fossil floras of Kachchh. IV- Tertiary Palynostratigraphy; A critique on dinoflagellate cysts. *The Palaeobotanist*, 39(1), 57-85.
- Kayedi, M. H., Haghdoost, A. A., Salehnia A., & Khamisabadi, K. (2014). Evaluation of repellency effect of essential oils of *Satureja Khuzestanica* (Carvacrol), *Myrtus Communis* (Myrtle), *lavendula officinalis* and *salvia sclarea* using standard repellency tests. *Journal on Anthropod Borne Diseases*, 8(1), 60-68.
- Khan, M. H., Sarwar, M., Farid, A., & Syed, F. (2010). Compatibility of pyrethroid and different concentrations of neem seed extract on parasitoid *Trichogramma chilonis* (Ishii) (Hymenoptera: Trichogrammatidae) under laboratory conditions. *The Nucleus*, 47(4), 327-331.
- Laxmishree, C., & Nandita, S. (2017). Botanical Pesticides A Major Alternative to Chemical Pesticides. *A review International Journal of Life Sciences*, 5(4), 722-729.
- Lucas, M. B., Salacup, C. E., Simo, S. R. (2018). Efficacy of rose bangle (*Lantana Camara L.*) leaf extract in controlling corn borer (*Ostrinia Furnacalis*) and corn earthworm (*Helicoverpa Zea*) of sweet corn (*Zea Mays Var. Saccharata*). *Asia Pacific Journal of Multidisciplinary Research*, 6(2), 18-22.
- Morton, J. F. (1994). Lantana, or red sedge (*Lantana camara L.*), notorious weed and popular garden flower; some cases of poisoning in Florida. *Economic Botany*, 48, 259-270.
- Nawaz, M., Mabubu, J. I., & Hua, H. (2016). Current status and advancement of biopesticides: Microbial and botanical pesticides. *Journal of Entomology and Zoology Studies*, 4(2), 241-246.
- Negahban, M., Moharramipour, S., & Sefidkon, F. (2007). Insecticidal activity of essential oil from *Artemisia sieberi* Beser against three stored-product insects. *Journal of Stored Products Research*. 43, 123-128.

- Padmanabhan, S. Y. (1973). The great Bengal famine. *Annual Review of Phytopathology*, 11, 11-24.
- Pretty, J., & Bharucha, Z. (2015). The sustainable intensification of agricultural system. *Analysis of Botany*, 114(8), 1571–1596. doi:10.1093/aob/mcu205
- Rajashekar, Y., Ravindra, K. V., & Bakthavatsalam, N. (2014). Leaves of lantana camara linn. (*Verbenaceae*) as a potential insecticide for the anagement of hree species of stored grain insect pests. *Journal of Food Sciences and Technology*, 51(11), 3494-3499.
- Rana, V. S., Prasad, D., & Blazquez, M. A. (2002). Chemical composition of the leaf oil of lantana camara. *Journal of Essential Oil Research*, 17, 198-200.
- Rizvi, S. A., Hussain, S., Rehman, S. U., & Jaffar, S. (2016). Efficacy of ecofriendly botanical extracts of ginger, garlic, and tobacco for the control of cabbage looper under agro-ecological conditions of Pershawar, Pakistan. *Journal of Entomology and Zoology Studies*, 4(1), 88-90.
- Sasidharan, S., Chen, Y., & Latha, L., Y. (2011). Extraction, isolation and chracterization of bioactive compounds from plants extracts. *African Journal of Traditional, Complementary and Alternative Medicines*, 8(1), 1-10.
- Sharififard, M., Safdari, F., Siahpoush, A., & Kassiri, H. (2016). Evaluation of some plant essential oils against the brown-banded cockroach, (*Supella longipalpa*) (Blattaria:Ectobiidae):A mechanical vector of human pathogens. *Journal on Arthropod Borne Diseases*, 10(4), 528–537.
- Sharma, V. P., Ansari, M. A., & Razdan, R. K. (1993). The effectiveness of botanical extracts as repellents against aedes aegypti mosquitoes. *Journal of the American Mosquito Control Association*, 9, 359-360.
- Silva, G., A., Lagunes, J. C., & Rodríguez, D. (2012). Control of (*Sitophilus zeamais*) (Coleoptera: Curculionidae) with vegetable powders used singly and mixed with calcium carbonate in stored corn, *Vegetable Insecticides: A New-Old Option in Pest Management*, 28, (2) 139-148.
- Smith, A. H., & Capinera, J. L. (2000). Natural enemies and biological control. *Khon Kaen Agriculture Journal*, 34(1), 1-11.
- Stern, V. M., Smith, R. F., Bosch, R., & Hagen, K. S. (1985). The integration of chemical and biological control of the spotted alfalfa aphid. *The integrated control concept Hilgardia*, 29, 81–101.

- Tagoe, D. N. A., Baidoo, S. E., Dadzie, I., & Kangah I. (2010). A comparison of the antimicrobial (antifungal) properties of garlic, ginger and lime on *aspergillus flavus*, *aspergillus niger* and *cladosporium herbarum* using organic and water base extraction methods. *Internet Journal of Tropical Medicine*, 7(1), 122-130.
- Teixeira, B. (2013). Chemical composition and bioactivity of different oregano (*Coleus aromaticus Benth*) extracts and essential oil. *US National Library of Medicine National Institutes of Health*, 93(11), 7-14.
- Torres, L. M. (2018). Madre de cacao and sinta leaves extract as botanical animal lies and tick's remover. *Journal of Fundamental and Applied Sciences*, 10, 1112-9867.
- Tripathi, A. K., Upadhyay, S., Bhuiyan, M., & Bhattacharya, P. (2014). A review on prospects of essential oils as biopesticide in insect pest management. *Journal of Pharmacology and Phytotherapy*, 2(3), 52-63.
- Ullah, M. I., Cagatay, N. S., Abdullah, A., Dikmen, F., Kaya, C., & Khan, R. R. (2019). Field evaluation of water plant extracts on sucking insect pests and their associated predators in transgenic. *Egyptian Journal of Biological Pest Control*, 49(2), 623-627.
- Villegas, P. G. (2010). Kakawate (*Gliricidia Sepium*) as a Soil amendment and biological control of soil-borne pathogens. *The Philippines Experience Acta Horti*. 883, 309-315. doi:10.17660/ActaHortic.2010.883.38
- Wollenweber, B., Porter, J. R., & Lubberstedt, T. (2005). Need for multidisciplinary research towards a second green revolution. *Current Opinion in Plant Biology*, 8, 337-341.
- Yadav, S. K., & Patel, S. (2017). Insecticidal and repellent activity of some lant extracts against (*Myzus Persicae*) sulzer and (*Brevicoryne Brassicae*) linnaeus. *Journal of Entomology and Zoology Studies*, 5(2), 1434-1439.