RESEARCH ARTICLE

DIFFERENT AMOUNTS OF KANTUTAY *(Lantana camara)* LEAF EXTRACT AS BOTANICAL INSECTICIDE AGAINST POD BORER *(Helicoverpa armigera)* OF MUNGBEAN *(Vigna radiata)*

Monica G. Rivas[1], Marlon L. Vargas[1], Mac Gener D. Babas[1], Rochelle V. Soriano[2]
[1]Student Researcher – Bachelor of Science in Agriculture, College of Agriculture
[2]Instructor I, College of Agriculture
acinomsavir@gmail.com

ABSTRACT

This study was conducted to determine the effect of different amounts of *Kantutay* (*Lantana camara)* leaf extract as botanical insecticide against pod borer (*Helicoverpa armigera*) in mungbean (*Vigna radiata).* It was conducted at Vegetable Production, OMSC-Murtha San Jose, Occidental Mindoro from October 14 to December 5, 2022.

A total of 20 mungbean plants were randomly assigned to five treatments with four replications, each replication has 1 plant. Plants were given the same care and management practices for $1^{1}/_{2}$ months. The Completely Randomized Design (CRD) experiment was utilized and had the following treatments, T0= Control; T1 – 250g *Kantutay* + 750 ml distilled water; T2 - 500g *Kantutay* + 500 ml distilled water; T3 -750g *Kantutay* + 250 ml distilled water. While the control group was provided with recommended chemical insecticide.

A total of 200 pod borer larvae were collected from the field and introduced to 20 experimental plants with net cover to prevent pod borer larvae to getting out from experimental sites. Spraying of *Kantutay* leaf extracts begun two hours after the introduction of pod borer with the frequency of three applications at one day intervals. Mortality rates, percentage damaged leaves and percentage damaged pods were the parameters considered in the study.

Result revealed that the highest mortality rate of pod borer obtained on Treatment 3 and also registered as effective in reducing damaged leaves and damaged pods. However, this is not comparable in treatment 0 and treatment 4. The treatment with higher concentration of *Kantutay* leaf extract show higher number of mortality rate, lesser percentage of damaged leaves, and lesser percentage of damaged pods.

Keywords: *Kantutay, botanical insecticide, leaf extract, mungbean, pod borer*

INTRODUCTION

Green mungbean (*Vigna radiata L.*) is an important pulse consumed all over the world, about 8.5% of the global pulse area grown and consumed by most households in Asia, including the Philippines. Also known as an excellent source of protein, dietary fiber, minerals, vitamins, and becoming a popular functional food in promoting good health (Hou et al., 2019). In the Philippines, it is locally known as "munggo" and considered as high value crops that represents a good opportunity for farmers to earn additional income. Mungbean production requires minimal inputs and it is a short duration crop which can contribute millions of pesos to the local economy (Yap, 2018). However, production can be affected by several constraints such as erratic weather, poor management practices, use of inferior or low yielding varieties insect pest and diseases (Department of Agriculture, 2019).

On the other hand, among biotic stresses, pod borer has been reported to be one of widest spread and destructive pests of mungbean (Joshi et al., 2018). Pod borer (*Helicoverpa armigera*) is a major mungbean pest that attack at any stage from seedlings to late pod fill and become most attractive from budding onwards (Australian Mungbean Association, 2019). According to Riaz et al. (2021) it has wide and diverse host range and causing estimated global economic losses of over 3 billion US dollars annually and possess the ability to enter diapause in order to survive adverse climatic conditions. On the other hand, Barmukh et al. (2021) stated that management of pod borer is mostly dependent on insecticide applications. However, the indiscriminate use of synthetic insecticide has led to the problem of environmental pollution, health problems, pest resurgence, insecticidal resistance in insects, and increased in cost for pest controls (Usman, et al., 2018).

Kantutay (*Lantana camara*) is a perennial shrub and considered to be one of the most invasive plant species worldwide. Leaves extract showed more potent effect having many phytoconstituents of medicinal value which can be exploited as eco-friendly biocontrol agents against harmful insects (Alghamdi & Basher, 2020). It is also a valuable source of biologically active compounds, and phytochemical studies including terpenoids, saponins, phenylethanoid, glycosides, and flavonoids (Elumalai et al, 2017). The pesticidal components of the triterpenes and saponins provide protection against pathogens and pests. The presence of glycosides, tannins, and sterols that wild sage contains affects only the target insects excluding the beneficial natural enemies. Alkaloids act as protective substances against the animal or insect attacks (Gonzales, 2020). This shrub is commonly found throughout the Philippines and widely grows in many parts of San Jose, Occidental Mindoro.

MATERIALS AND METHODS

Research Design

This study used the experimental method of research following layout in Complete Randomized Design (CRD).

Experimental Layout

There were five treatments and each treatment were replicated four times. The CRD is appropriate in the experiment, since; the researchers, employed a controlled environment

condition in the field by constructing an improvised greenhouse and provided net cover in each plot. This was to prevent other insects from infesting the experimental plants and to avoid pod borer larvae crossing over to different plot. The treatments and the corresponding replications were randomly assigned in the experimental unit using draw lots.

T_1R_4	T_0R_3	T_2R_4	T_4R_4	T_4R_2
T_3R_2	T_0R_2	T_1R_3	T_3R_3	T_1R_2
T_2R_1	T_2R_2	T_0R_1	T_0R_4	T_4R_1
T_1R_1	T_2R_3	T_3R_1	T_4R_3	T_3R_4

Preparation of Treatment Application

Kantutay leaves were collected at Sitio Yaw Yawi 1, Barangay Murtha, San Jose, Occidental Mindoro. Extraction was done to obtain the plant's necessary component for the production of plant based. Different concentrations were used for each of the treatment, namely; treatment 1- 250g of *Kantutay* leaves boiled in 750ml distilled water; treatment 2- 500g of *Kantutay* leaves boiled in 500ml distilled water; and treatment 3- 750g of *Kantutay* leaves boiled in 250ml distilled water. The distilled water was boiled for 20 minutes. Ten mL per plant was the application rate used in all of the *Kantutay* treatments

The boiled materials were squeezed out through a clean cloth to separate the extract from the solid materials. Subsequently, the extract was placed in a basin and prepared to be applied in the treatment. On the other hand, chemical insecticide was 10mL of diluted and applied in treatment 4.

Construction of Improvised Greenhouse

An improvised greenhouse was constructed with an area of 56 sq. m. It was made of round posts, bamboo slots and net screen. Seventeen posts were arranged inside the greenhouse following the experimental lay-out in Complete Randomized Design (CRD).

Cultural Practices

- **Potting Media Preparation:** Soil medium was collected and dried under the sunlight. Potting media was a mixture of garden soil and carabao manure at 2:1 ratio.
- **Drilling of Mungbean Seeds:** Two pieces of mungbean seeds were sowed on each sack at 4cm deep and watered to provide preliminary moisture for germination. There were two sacks on every treatment.
- **Water Management:** After sowing of mungbean seeds, adequate water was supplied to give the water requirements for growth and development of experimental plants. Watering was done twice times a week or as needed.
- **Installation of Net Enclosure:** Net screen served as a confinement of the pod borers in vivo. Each treatment was covered with garden net screen, containing two hills of mungbean in each. Low-cost materials like bamboo stick were used to serve as framework for the screen. Net screen was installed after one-week seed emergence to protect the mungbean from insect. Top of the screen can be opened and closed for the data gathering.

- **Collection and Introduction of Pod Borer:** Pod borers were collected in mungbean farms around San Jose and Rizal, Occidental Mindoro. Two hundred pod borers were collected carefully. The collected pod borers were attached to the leaves of mungbean plants to avoid stressing them. The collected pod borers were placed in a rectangular transparent container. Ten pod borers were introduced per treatment at 6:00 pm on the afternoon and was acclimatized in vivo for 2 hours. This was done at 51 days after sowing of mungbean plants.
- **Application of Kantutay Leaf Extract:** Various amounts of leaf extracts were applied in all treatments except for the T_0- Control and T_4- Chemical insecticide. These were applied late in the afternoon at 9:00 pm. After application, close monitoring for 2 hours was done to see the response of the pod borer on the insecticides applied at 51 DAS, 2nd application at 52 DAS and 3rd application at 53 DAS.

Data Collection

The following parameters were measured taken from the experimental set-up:

a. **Mortality Rate:** Dead larvae were counted and recorded every two hours after application of botanical insecticides. Larva that was not moving and changed its color to black was counted as dead. Observation and counting begun a day after application of botanical insecticides. Mortality rate was calculated using the following formula: total number of dead pod borer / total number of pod borer x 10
b. **Percentage of Damaged Leaves:** This was obtained by getting all the damaged leaves caused by pod borer using graphing paper to get the percentage of damage per leaves. Percentage leaves damaged was calculated using the following formula: damaged parts per leaves / total area per leaves x 100
c. **Percentage of Damaged pods:** This was measured by getting all the damaged pods using graphing paper to get the percentage of damaged per pods. Percentage of pods was calculated using the following formula: damaged parts per pods/ total area per pods x 100

Data Analysis

Various data gathered were processed using the Analysis of Variance in Completely Randomized Design (CRD) at 5% and 1% levels of significance. The Least Significant Difference (LSD) test was used to identify the significant difference between treatments means. All of the data were processed using Statistical Tool for Agricultural Research (STAR) which was developed by the International Rice Research Institute (IRRI).

RESULTS

The results demonstrate that the use of chemical insecticide (T4) was the most effective treatment in reducing mortality, the percentage of damaged leaves, and the percentage of damaged pods in kantutay plants. This treatment significantly outperformed the other treatments. Treatments involving varying concentrations of Kantutay extracts also showed positive effects, with higher concentrations generally leading to better outcomes. These findings provide valuable insights into pest control strategies for kantutay plants and may have implications for broader agricultural practices.

Table 1. Effect of different amounts of *Kantutay* leaf extract as botanical insecticide against pod borer in mungbean.

Treatments	Mortality	Percent damaged leaves	Percent damaged pods
T0 - Control	7.5^{d}	26.07^{a}	57.20^{a}
T1 – 250g *Kantutay* + 750ml distilled water	25.00^{c}	17.25^{b}	38.20^{b}
T2 - 500g *Kantutay* + 500ml distilled water	35.00^{bc}	13.02^{c}	35.13^{bc}
T3 -750g *Kantutay* + 250ml distilled water	45.00^{b}	10.41^{c}	23.43^{c}
T4 - Chemical insecticide	70.00^{a}	4.89^{d}	7.21^{d}
F-value	18.34	49.64	15.11
P-value	0.000	0.000	0.000
Coefficient of Variation	29.80%	15.75%	29.55%

DISCUSSIONS

Mortality Rate

Result revealed that the highest mortality rate of pod borer was observed in T4 (chemical insecticide) with a mean of 70.00 percent. Superiority of T4 in terms of killing effect could be attributed to its highly concentrated toxic substance. Thus, the pod borer in the treatment 4 was controlled.

On the other hand, different amounts of *Kantutay* leaf extract could also control pod borer but of lesser efficacy as compared with chemical insecticide. Treatment 3 with 750g *Kantutay* + 250ml distilled water obtained a mean of 45.00% percent mortality rate. This was followed by T2 with 500g *Kantutay* + 500ml distilled water with a mean of 35.00 percent and T1 with 250g *Kantutay* + 750ml distilled water with a mean of 25.00 percent mortality rate of pod borer. This result indicates that as the amount of *Kantutay* leaf extract increases, its efficacy to kill pod borer also increases due to higher concentration of its toxic substance. This is supported by Murugesan et al. (2016) that *Lantana camara* leaves extract had a presence of triterpenoids, steroids, alkaloids, flavonoids and tannins, which expressed potent insecticidal

behavior. On the other hand, T0 (Control) got the lowest mortality rate with mean of 7.50% for having no application of *Kantutay* leaf extracts and chemical insecticides. Having no application of leaf extract, the mortality is attributed to external factors such as presence of ants as biological control agent.

Statistically, there is a significant difference between the treatment means. T 1 and 2 have comparable effect and similar result was observed between T2 and T3. On the other hand, T0 and T4 have significant difference among all treatment means. Moreover, treated plants with *Kantutay* leaf extract have higher in effect compared to control but lesser to chemical insecticide.

The result shows that the computed F-value of 18.34 is higher than critical value of 4.89 at 1% level of significance. Therefore, the null hypothesis is rejected. Indicating that there is a significant difference in the effect of different amounts of *Kantutay* leaf extract against pod borer. These findings support the study of Dusane et al. (2018) that *Kantutay* leaf extracts at their highest doses and longer exposure time shows very high mortality rate.

Percent Damaged Leaves

The percentage of damaged leaves by pod borer larvae three days after application of *Kantutay* leaf extract shows that T4 (chemical insecticide) obtained the less damaged leaves with a mean of 4.89% due to its highly concentrated toxic substance. On the other hand, different amounts of *Kantutay* leaf extract could also control pod borer but of lesser efficacy as statistically compared with chemical insecticide. T3 obtained a mean of 10.41 percent damaged leaves, followed by T2, with a mean of 13.02 percent damaged leaves, while T1 got a mean of 17.25 percent. As gleaned in the table, the highest percentage of damaged leaves was observed in T0 (control) with a mean of 26.07 percent, since there is no application of either chemical or *Kantutay* leaf extract in this treatment. Statistically, there are significant difference among treatment means. The effects of *Kantutay* leaf extract on pod borer resulted in the interruption in their feeding activity. As amounts of botanical insecticide increase, the lesser is the percentage of damaged leaves. This was supported by the findings of Gonzales (2020) that *Kantutay* leaves have chemical constituents contributed to the insecticidal property.

Statistical analysis revealed that there is a highly significant difference among the treatments in terms of effect in reducing the percentage of damaged leaves. The computed F-value of 49.64 is higher than critical value of 4.89 at 1% level of significance. This implies that the analysis of variance detects that there is a significant difference between and among the treatment means. This indicates that the null hypothesis on the effect of different amounts of *Kantutay* leaf extract against pod borer in terms of percent damaged leaves is rejected. Based on the observation, pod borer was inactive and immobile when sprayed with *Kantutay* leaf extract. This finding corroborates to the study of Melanie et al. (2020) that antifeedant effect of *Kantutay* extract can deter the larval feeding activity.

Percent Damaged Pods

Percentage damaged pods in the control Treatment got the highest mean of 57.20 since there is no application of either chemical insecticide or *Kantutay* leaf extract. On the other

hand, the percentage damaged pods were reduced in Treatment 1 with a mean of 38.20 percent, Treatment 2 with a mean of 35.13 percent and Treatment 3 with a mean of 23.43 percent.

As expected, Treatment 4 (chemical insecticide) obtained the lowest percentage damaged pods with a mean of 7.21 percent. Furthermore, the comparison of treatment means using LSD revealed that those treated with *Kantutay* leaf extract, Treatments 1 and 2 had a comparable effect in percent damaged pods. Treatments 2 and 3 had also a comparable effect. The reduction in damaged pods was highly significant in contrast to the damaged pods in the control.

As revealed by the analysis of variance using complete randomized design, there is a highly significant difference among treatment means in terms of percentage damaged pods as affected by different amounts of *Kantutay* leaf extract. This is supported by the calculated F-value of 15.11 which is higher than the critical value of 4.89 at 1% level of significance. Thus, the null hypothesis is rejected. This is supported by Melanie et. al (2019) the phytochemical constituents of *L. camara* leaf extract are potentially good antifeedant activity. They also claim on their other study that antifeedant can reduce the attack of pest insects on host plants Melanie et. al (2020).

CONCLUSIONS

Effects of different amounts of *Kantutay* leaf extracts as botanical insecticide against pod borer in mungbean are found highly significant in mortality rate, percentage of damaged leaves, and percentage of damaged pods. Furthermore, the treatment with higher concentration of *Kantutay* leaf extract show higher number of mortality rate, lesser percentage of damaged leaves, and lesser percentage of damaged pods.

Treatment 3 containing the mixture of 750g *Kantutay* + 250ml of distilled water effectively control pod borer on mungbean.

Application of different amounts of *Kantutay* leaf extract have significant difference in the effect from the control and chemical insecticide in terms of mortality rate, percentage of damaged leaves, and percentage of damaged pods.

Based on the highly significant findings of this study, it is recommended that Kantutay leaf extracts be considered for practical implementation in pest management strategies for mungbean cultivation. Specifically, the use of 750g Kantutay leaf extract mixed with 250ml of distilled water, as demonstrated in Treatment 3, is encouraged for effective pod borer control. Further research and field trials should be conducted to validate the practical application of Kantutay leaf extracts on a larger scale and in different geographical regions to assess their efficacy under diverse environmental conditions. Additionally, studies on the long-term effects of Kantutay leaf extracts and their potential impact on non-target organisms and the ecosystem should be conducted to ensure sustainable and environmentally responsible pest management practices. Finally, farmers and agricultural practitioners are encouraged to explore the adoption of Kantutay leaf extracts as a safer and more ecologically sound alternative to chemical insecticides in mungbean cultivation.

REFERENCES

Alghamdi, A. A., & Basher, N. S. (2020). Efficacy of leaves and flowers ethanol extracts of the invasive species Lantana camara Linn as a Mosquito larvicidal. *Int J MosqRes*, *7*(5), 43-7. https://www.dipterajournal.com/archives/2020/7/5/A/7-5-4

Australian Mungbean Association. (2019). Managing insect pests in mungbean. http://www.mungbean.org.au/pests.html#helicoverpa

Barmukh, R., Roorkiwal, M., Jaba, J., Chitikineni, A., Mishra, S. P., Sagurthi, S. R., Munghate, R., Sharma, H. C., & Varshney, R. K. (2020). Development of a dense genetic map and QTL analysis for pod borer Helicoverpa armigera (Hübner) resistance component traits in chickpea (Cicer arietinum L.). The plant genome, e20071. Advance online publication. https://doi.org/10.1002/tpg2.20071

Department of Agriculture (2019). Investment Guide for Mung bean C November 12, 2020 from https://www.gov.ph/wp-content/uploads/2021/04/Investment-guide-for-mung-bean.pdf

Dusane, A., Dusane, S., Dongre, S., & Bhosale, R. (2018) Effect of Biopesticide-Lantana Camara (L.) On Allosobruchus Macullatus (Pulse Beetle). International Journal of Researches in Biosciences, Agriculture and Technology 6(2). 56-58.

Elumalai, D., Hemalatha, P., & Kaleena, P. (2017). Larvicidal activity and GC–MS analysis of Leucas aspera against Aedes aegypti Anopheles stephensi and Culex quinquefasciatus. Journal of the Saudi Society of Agricultural Sciences, 16(4), 306–313. https://doi.org/10.1016/j.jssas.2015.10.003

Joshi, N., Shera, P. S., Sangha, K. S., & Sharma, S. (2019). Bioformulations for Management of Pod Borer, Helicoverpa armigera (Hubner) in Mungbean (Vigna radiata L.). *Journal of Biological Control*, *33*(1), 76-79. https://doi.org/10.18311/jbc/2019/16280

Gonzales, J.A (2020). Effectiveness of *Kantutay* (Lantana camara Linn.) extract against rice stem borer. https://mjst.ustp.edu.ph/index.php/mjst/article/download/532/164/

Hou, D., Yousaf, L., Xue, Y., Hu, J., Wu, J., Hu, X., Feng, N. & Shen, Q. (2019). Mung Bean (Vigna radiata L.): Bioactive Polyphenols, Polysaccharides, Peptides, and Health Benefits. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6627095/

Joshi, N., Shera, P. S., Sangha, K. S., & Sharma, S. (2018). Bioformulations for management of pod borer, Helicoverpa armigera (Hubner) in Mungbean (Vigna radiata L.). Journal of Biological Control. https://doi.org/10.18311/jbc/2019/16280

Melanie, M., Hermawan, W., Kasmara, H., Kholifa, A.H., Rozi, A.F., and Panatarani, C. (2020). Antifeedant Activity of Ethanolic Leaf Extract of Lantana camara Against Crocidolomia pavonana and Spodoptera litura. https://journal.jptranstech.or.id/index.php/jptafm/article/view/27

Murugesan, S., Senthilkumar, N., Suresh, B. D., & Rajasugunasekar, D. (2016). Chemical constituents and toxicity assessment of the leaf oil of Lantana camara Linn from Tamilnadu regions. *Asian Journal of Plant Science and Research*, *6*(3), 32-42.

Riaz, S., Johnson, J. B., Ahmad, M., Fitt, G. P., & Naiker, M. (2021). A review on biological interactions and management of the cotton bollworm, Helicoverpa armigera (Lepidoptera:

Noctuidae). *Journal of Applied Entomology*, *145*(6), 467 498. https://doi.org/10.1111/jen.12880

Usman, A., Ali, M. I., Shah, M., e Amin, F., & Sarwar, J. (2018). Comparative efficacy of indigenous plant extracts and a synthetic insecticide for the management of tomato fruit worm (Helicoverpa armigera Hub.) and their effect on natural enemies in tomato crop. *Pure and Applied Biology (PAB)*, *7*(3), 1014-1020.

Yap, J. (2018). Technology can Boost Mungbean Production. https://www.agriculture.com.ph/2018/12/10/technology-can-boost-mungbean-production