INSECTICIDAL EFFICACY OF SMOKE VINEGAR AGAINST RICE BUGS

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ABSTRACT

The study was conducted under greenhouse condition at the Guimaras State College-Baterna Campus, Constancia, San Lorenzo, Guimaras from June to October 2017 to determine the insecticidal efficacy of smoke vinegar against rice bugs. Rice plants were used as culture media for rice bugs. Each of potted rice was enclosed in white fine mesh net where the rice bugs were introduced and cultured. There were four (4) treatments replicated five (5) times arranged in Complete Randomized Design (CRD). Treatments used were the following: Treatment A (0% concentration of smoke vinegar (CSV), Treatment B (10% CSV), Treatment C (20% CSV), Treatment D (30% CSV). Each experimental treatment had ten (10) cultured rice bugs for testing where each rice bug was treated independently. Results showed that the smoke vinegar was effective in controlling rice bugs. Fifty (50%) mortality was observed 10 minutes after the treatment was introduced particularly at the 30% level of concentration. The probability of initiation (Probit) analysis showed that the smoke vinegar has a lethal dose 50 (LD50) at 8.5% concentration within 10 minutes after application. The results further showed that smoke vinegar can be used as alternative organic insecticide against rice bugs. The 10% concentration of smoke vinegar was highly recommended.

Keywords: insecticidal, smoke vinegar, rice bugs

INTRODUCTION

Background of the study

Rice (Oryza sativa) production is very significant to the economic development of many countries. Any crises reducing the production of this commodity will negatively affect these countries. Most rice-producing countries in the world considered insect pests and crop diseases as the major factors contributing to a decrease in rice production (Fahad, et al, 2015). Every year, more than 200 million tonnes of rice are lost due to biotic and abiotic factors (Khan et al, 1991). Farmers lose an estimated average of 37% of their rice crop to pests and diseases every year (Rice Knowledge Bank, n.d.). According to Arida (2009) common problems encountered by rice farmers included high cost of inputs, low price of palay, lack of capital, labor problem, lack of postharvest facilities, pest and diseases and irrigation system. It also reported that lack of capital and pests and diseases significantly affects rice productivity during wet season.

The use of chemical pesticides play an important role in the management of crop diseases and pests. It effectively control the target pests or diseases once used judiciously. However, its excessive and irrational use contributed to environmental pollution thus causing obstacles to sustainable agriculture. Due to its excessive use, the quality and security of agricultural produce are reduced, and the ecological and environmental integrities are threatened. Due to the adverse effects of chemical pesticide use, ecological pest management measures had been introduced, promoted and adopted to manage rice insect pests and reduce the use of insecticides (Hong-xing, et al, 2017).

Recently, there were alternative organic pesticides that are being explored to provide environmentally-sound management techniques on the management of pests and diseases that exclude the use chemical pesticides. Among the alternative pesticides are the use of different natural farming concoctions, bio-pesticides, bio-agents, smoke vinegar, etc. Among the different alternatives, the use of smoke vinegar is seen to be one the cheapest pest and disease management techniques that can easily be adopted and produced by ordinary farmers. Wood or smoke vinegar is a by-product from charcoal production. It is a liquid generated from the partial burning of plant biomass. The liquid improves soil quality, eliminates pests and controls plant

growth, but is slightly toxic to fish and very toxic to plants if too much is applied (Food and Fertilizer Technology Center, n.d.). Based on this premise, the smoke vinegar has pesticidal properties hence, can control pest particularly insect pests.

Insect pests had been reported to considerably reduce yield. Once this factor is not managed well, this will eventually reduce the income particularly those of the poor farmers. To address this problem, the effectiveness of the smoke vinegar to control pest population was conducted using Rice Bugs as the insect specimen. Rice bugs are the most common insect pest attacking rice plants during flowering to milking stage. They damage rice by sucking out the contents of developing grains from pre-flowering spikelets to soft dough stage, therefore causing unfilled or empty grains and discoloration. Both immature and adult rice bugs feed on rice grains (Rice Knowledge Bank, n.d.). Rice bugs were used as test insects as smoke vinegar application would be very beneficial to rice production once treatment application becomes successful to control these prevalent pests. Hence, the study hypothesized that application of smoke vinegar is effective in controlling rice bugs.

Objectives of the Study

This study was conducted to determine the insecticidal efficacy of smoke vinegar against rice bugs. Specifically, it aimed to (a) Evaluate the efficacy of smoke vinegar against rice bugs and (b) Determine the lethal dose 50 (LD_{50}) of the smoke vinegar against rice bugs.

METHODOLOGY

The materials used in the study were rice plants (PSB Rc 10) as culture plants, polyethylene pots (12x12x15 inches), fine mesh net, catching nets, hand trigger spray, water and smoke vinegar concentrate.

Rice bugs were used as experimental insects. The experiment research design used was laid out in a Complete Randomized Design (CRD) with four (4) treatments replicated five (5) times. Each treatment has a total of five (5) plants with 10 rice bugs per plant. Treatment A was the control (applied only with pure water), Treatment B was added with 10% wood vinegar, Treatment C was added with 20% wood vinegar and Treatment D was added with 30% wood vinegar.

Preliminary activities

Preparation of Smoke Vinegar. The smoke vinegar was prepared by partially burning the rice hull using an open-type carbonizer. To collect the liquid smoke from the burning rice hulls, a bamboo pole (with internal nodes removed) was attached to the chimney of the carbonizer. An opening was made after the first node of the pole starting from the chimney. A container was then hanged opposite to the opening to collect the smoke vinegar. The pole was tied to another post with tip higher than the base (directly attached to the chimney). An inclined position of the pole was followed to collect the condensed smoke. The smoke vinegar collected inside the container was transferred to bigger containers for storage.

Trial application. A trial application of smoke vinegar was conducted three (3) months before the conduct of the study to determine the effectiveness of smoke vinegar concentrate. This was conducted by using three (3) potted rice plants (PSB Rc10). Each potted plant were enclosed in a fine mesh net. Collected rice bugs were introduced to the enclosed plants at a rate of 10 rice bugs per plant during the flowering to milking stage of the plant. Rice bugs were allowed to acclimatize inside the new microenvironment for 1 week. After a week, 100% smoke vinegar concentrate was sprayed to the plant at a rate of 100 ml per plant using hand trigger spray. Based on the trial application, the bugs were killed using the 100% smoke vinegar concentration.

Implementation of the study

Setting up of cultured plants. Before the rice bugs were introduced to the treatment plants, they were first cultured or pre-conditioned inside the enclosed area with potted rice plants grown from seedling stage. The area was enclosed with fine mesh net to avoid the non-target insect pests from entering the area. Rice seeds (PSB Rc10 variety) were sown inside the seed boxes utilizing the soil taken from the near-by rice field. A combination of 3 parts soil and 1 part vermicompost served as soil media for the seedlings. At 21 days after sowing, the seedlings were transplanted into the polyethylene pots filled with soil taken from the nearby ricefield with a planting density of one plant per pot. A total of 100 potted rice plants were used in the study. The potted plants used for culture or pre-conditioning of rice bugs were enclosed inside a fine mesh net. The fine mesh net were installed by establishing a 1.5-meter high frame with a width and length of 25 cm were the fine mesh net is attached to enclose the area. The culture rice plants were raised until the end of the study.

Establishment of potted treatment plants. The treatment plants were established by transplant-ing each seedling at the age of 21 days to the pot with soil taken from the nearby rice field. Each pot was enclosed with a fine mesh net attached to a 1.5-meter high frame, with a width and length of 25 cm. There were five (5) potted rice plants per treatment. The treatment plants were used as host of the rice bugs during the treatment application period.

Collection of rice bugs. Rice bugs were collected from the nearby rice field using catching nets at flowering to milking stage. Collection was conducted in the field were there were evident number of rice bugs. The bugs were collected by quickly sweeping the catching net on the surface of the field. The collect-ed rice bugs were then transferred to bigger fine mesh net container. This container was used as tempo-rary storage of the insect bugs while still on the field. Collection was conducted until the desired number of insect specimen for the study were collected and completed.

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Introduction and culture/pre-conditioning of rice bugs. The rice bugs collected from the field were carefully introduced to the culture area by slowly releasing them from the fine mesh net container. This was undertaken to pre-condition or acclimatize the bugs before subjecting them to the different treatments. The bugs were acclimatized in the culture area for one (1) week before it was released to the treatment plants.

Treatment application. After the insects were acclimatized for one (1) week in the culture area, they were carefully transferred to the treatment plants and were treated with the following treatments (combined with water to form a smoke vinegar solution) two days after they were introduced:

Treatment A – control (pure water application)
Treatment B – 10% smoke vinegar
Treatment C – 20% smoke vinegar
Treatment D – 30% smoke vinegar

After two days, the solutions were applied to the target pest using a 1-L capacity hand trigger spray at a rate of 100 ml solution per plant. The solution was sprayed at approximately the same angle and distance to ensure the homogeneity of spray applications.

Twenty four (24) hours after the application of smoke vinegar, the treatments were inspected for mortality. The insects were considered killed when they were found on the ground not moving. They were further tested by gently touching them using a stick to check if they are still alive. Once not moving upon or after touching, the insects were considered to be totally killed.

Data gathered

The data collected in this study was observed frequency of mortality of the target insect. Mortality rate of rice bug was determined by getting the total number of killed insects per treatment divided by the total number of insects per treatment multiplied by 100..
% mortality = (number of killed insects/total number of insects) x 100

Data Analysis

The mean percentage and Probit Analysis was used to analyzed the data. The Probit analysis was used to determine the effective dose of the treatment applied based on the observed responses of the subject treated.

RESULTS AND DISCUSSIONS

The results showed that the smoke vinegar was effective in controlling rice bugs. It was observed that the application of a solution containing 30% smoke vinegar in one liter of water resulted to 96% mortality after the treatment was introduced (Table 1). The application of pure water into rice bugs did not kill the insect, while 10% of smoke vinegar mixed in water killed 70% of the sampled rice bugs, then 20% concentration killed about 86%. The probability of initiation (Probit) analysis showed that the smoke vinegar has a lethal dose 50 (LD50) at 8.5% concentration within 24 hours after application. The results further showed that smoke vinegar can be used as alternative organic pesticides against rice bugs and was effective and efficient organic material to control a specific pest.

Table 1. Observed mortality rate and lethal dose 50 (LD50) of smoke vinegar

Treatments	# of samples	Observed mortality	Mortality rate
A (0%)	50	0	0.00%
B (10%)	50	35	70.00%
C (20%)	50	43	86.00%
D (30%)	50	48	96.00%

LD_{50} at 8.5% concentration of smoke vinegar and water

CONCLUSIONS

Smoke vinegar can be used as alternative organic insecticide against rice bugs. The 10% or 1:10 ratio of utilizing smoke vinegar was highly recommended. It is also recommended that further study on the insecticidal efficacy of smoke vinegar to other type of insect pests should also explored. Furthermore, the effect of smoke vinegar on the vegetative stage of rice and other crops must be consider and properly observed.

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