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The Effectiveness of Teak Wood-Sawdust Liquid Smoke and Areca-Nut Extract as a Pesticide on *Pomacea canaliculata*

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Abstract: The present study was aimed to evaluate the effectiveness of Liquidsmoke (LS), Areca-nut Extract (AE) and their combination on restriction of golden apple snail (*Pomaceacanaliculata*) activity, which is known as a major pest in Indonesian rice farms. The experiment conducted under laboratory conditions and each experimental unit consisted of aplastic jar 13 cm in diameter and 15 cm high, which was coverd with gauze which kept 20 snails and fed 2 g/day of the fresh taro leaves, respectively. The treatments were arranged in a completely randomized design with three replications. The results showed that the treatment using LSconcentration of 15% showed moluscisidal action. LS treatment at concentrations of 5 and 10%; Areca-nut Extract (AE) treatment at concentrations of 5,10 and 15%; and a mixture of LS and AE at a concentration of 5.10, and 15% proved not to have a significant effect.

Keywords: Areca Extract, Molluscicide, *Pomacea canaliculata*

Introduction

The Golden Apple Snail (GAS) (*Pomacea canaliculata* Lamarck) is an invasive species not only in Indonesia but mostly in Southeast Asia. The snail caused serious damaged on more than a thousand hectares of rice-fields per year in Indonesia (Isnaningsih and dan Marwoto, 2011).

A number of tropical plant species have been recognized as molluscicidal plants and common put at (Barringtonia racemosa) is one of these. The toxic effects of *B. racemose* seed kernel extracts on *Pomacea canaliculata* were evaluated. The lethal concentration at 50% values, in ppm/48 hours, was 94.39 (62.48-142.59), for the extracts withdrawn using methanol. It is assumed that the observed biological effects of the extracts may be due to the sapiens and flavonoids present in the seed (Musman, 2010).

Yunidawati *et al*. (2011) reported that the application of the Areca Extract (AE) at a rate of 40 L of water affected the percentage of infected plants and mortality of golden snail pests, but not to the number of rice tillers per clump. The population of golden snails affects the percentage of infected plants, thereby reducing the number of tillers per clump, thereby reducing the number of plant tillers per clump.

Plant-based pesticides have weaknesses in the supply of mass and continuity, because they require a lot of plant mass and special cultivation. Another case of plant waste-based pesticides, such as Liquid Smoke (LS) made from lignocellulose waste, is available abundantly but has not been utilized maximally.

The effect of Liquid Smoke (LS) on corn seed pest (*Sitophillus zeamis*) turned out to work as an insect repellent not as an insecticide (Rahmat *et al*., 2014). Likewise the effect on armyworm (*Spodoptera litura*) as anti-feed ant was not as a larva ide (Rahmat *et al*., 2015). Therefore, it was necessary to try again the use of liquid smoke in combination with other botanical pesticides. Hopefully, the combination of botanical pesticides will lead to synergistic interactions.

Both of these materials have the potential as an environmentally friendly botanical-pesticide, so further research was needed to obtain application methods or concentrations of LS, AE, independently or in combination, so that satisfactory results can be obtained in controlling GAS. This study aimed to determine the effect of LS and EA, either independently or in combination as moluscicide on golden apple snail (*Pomacea canaliculata*).

Materials and Methods

Preparation of Materials

The tools used in this experiment include a set of pyrolysis kiln; a blender, an electrical analytic balance, various beakers and funnels. Other tools used were: 30 plastic jars, measuring cups and fine gauze.

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The materials used in this experiment were teak sawdust from four sawmills, young Areca seeds taken from community forests in Suk raja Sub-district, Tasikmalaya district and five adult golden apple snail GAS that were ready to lay eggs were taken in the rice fields in Taman sari Sub-district, Tasikmalaya City.

The GAS was maintained intensively to produce healthy and uniform mass of eggs. The mass of eggs hatchas after 14 days after the parent was placed (Fig. 1). Maintenance of snail tillers was done specifically and separately. Every afternoon, fresh feed was provided and water was replaced to maintain oxygen availability. This group of tillers was maintained until the age of 60 days so that they were ready to be used in experiments.

Young taro leaves (*Colocasia esculenta* L.) were used as pre-experimental and experimental feeds. Pre-experimental feeds are provided in rear containers since egg hatching. The feed quantity in the experiment was 2 g per container per day. The plant-based pesticide treatments were applied to Bioassay Method using the leaf dip technique. Fresh taro leaves (2 g) were dipped in each treatment for 2 min, then wind-dried for 10 min. Furthermore, the dried leaves were placed in the rear container, respectively.

This experiment was carried out in an experimental unit in the form of a plastic jar 13 cm in diameter and 15 cm high, which was covered with gauze (1×1 mm) which kept 20 snails and fed 2 g/day of fresh taro leaves, respectively, which will give treatment according to the experimental design.

Areca-nut Extract (AE) was made from young Areca seeds and technical alcohol solvents, which is 30 g Areca seeds mixed with mL alcohol, then blended at medium speed to form a suspension. Then the suspension was filtered to obtain an Areca-nut extract.

Experimental Methods

A treatment solution of 5% concentration was made by mixing 5 mL LS or AE and 95 mL of water. The same way, for a concentration of 10% was made by mixing 90 mL LS or AE. Likewise, for a concentration of 15% it was made by mixing 15 mL of LS or AE and 85 mL of water. While the combination treatment was done by mixing LS and AE according to the treatment needs so that the partial concentration of the components can be calculated.

Fig. 1: (1) Parent of golden snail (*P. canaliculata*) was laying eggs (2) Reared snail tillers (3) Leaf dip technique of pesticide application (4) 20 young snails in each plastic jar as an experimental unit

The LS- producing process was carried out following the procedure of (Rahmat *et al*., 2014). Sawdust waste (1,000 g) with a water content of 20% was used as feedstock per unit of LS produced. The sawdust was heated to 450°C for 45 min, in the absence of air or oxygen, in the airtight kiln, which was connected to a condenser. The crude distillate contained LS, oil and the tar, all collected in the condenser outlet. This distillate was decanted for two weeks to form a separate faction.

The experiment aimed to test the effectiveness of ten treatments on the mortality and feeding intensity of the *P canalilata*. The treatment was varied as *A* (without treatment as a control), B (LS of 5%), C (LS of 10%), D (LS of 15%), E (AE of 5%), F (AE of 10%), G (AE of 15%), H (LS of 5%+AE of 5%), I (LS of 10%+AE of 10%) and J (LS of 15%+AE of 15%), respectively.

The experiment was applied to Bbioassay Method using the leaf dip technique. Fresh taro leaves (2 g) were dipped in each concentration for 2 min, then wind-dried for 10 min. Furthermore, the dried leaves were placed in a plastic jar 13 cm in diameter and 15 cm in height and used to rear 20 snails of *P. canaliculata*, respectively.

This experiment was arranged in a complete randomized design with three repetitions performed. Data from the observations were analyzed using analysis of variance and Duncan test (Gomez and Gomez, 1983).

The measured GAS response was: (i) the number of dead snails, which were taken after 14 days of incubation; (ii) the weight of residual feed leaves obtained after 14 days of incubation; (iii) the decrease in snail weight. The experiment was carried out for 14 days in the laboratory at 25±1°C.

Results

Effect of LS and AE on Mortality of P. canaliculata after 14 Days of Incubation

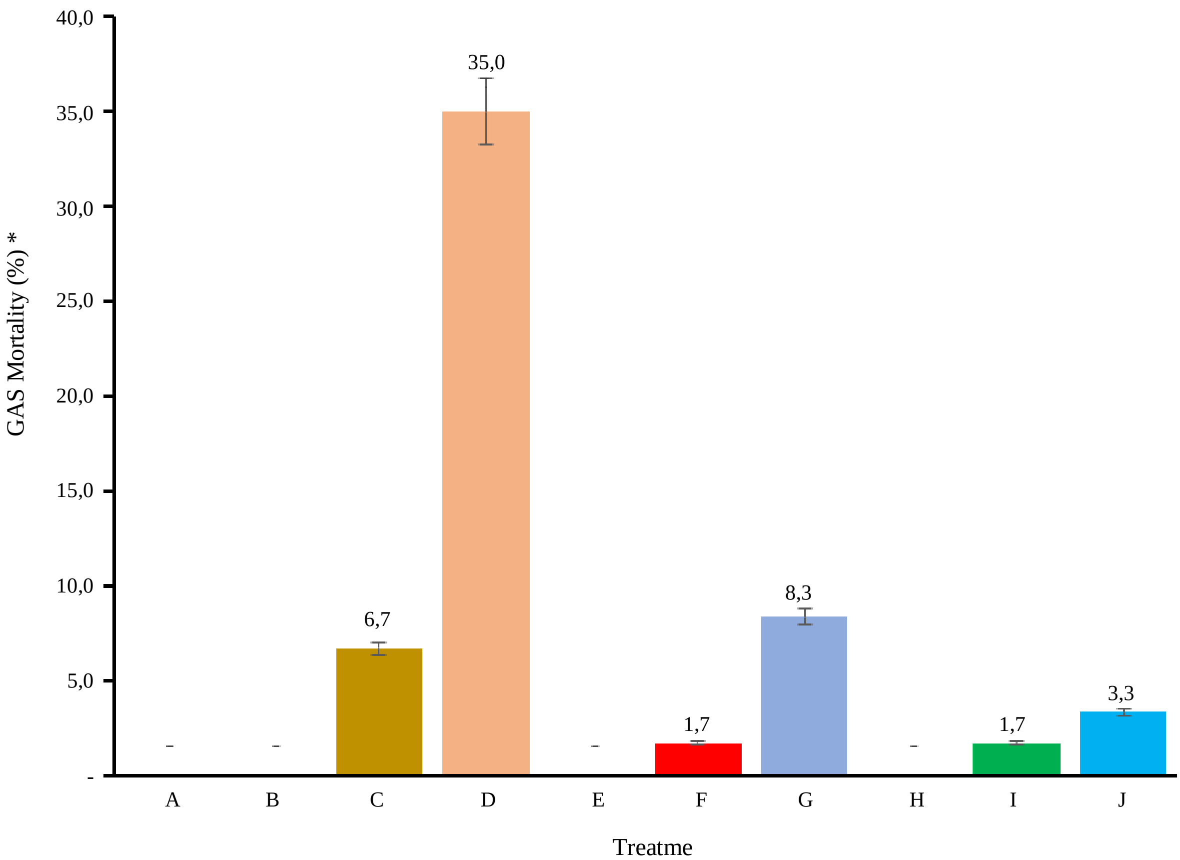

Fig. 2: Effect of LS and AE on mortality of *P. canaliculata* after 14 days of incubation The data after transformed by $\sqrt{X+0.5}$

Effect of LS and AE on Feed Reduction of P. canaliculat weight after 14 Days of Incubation

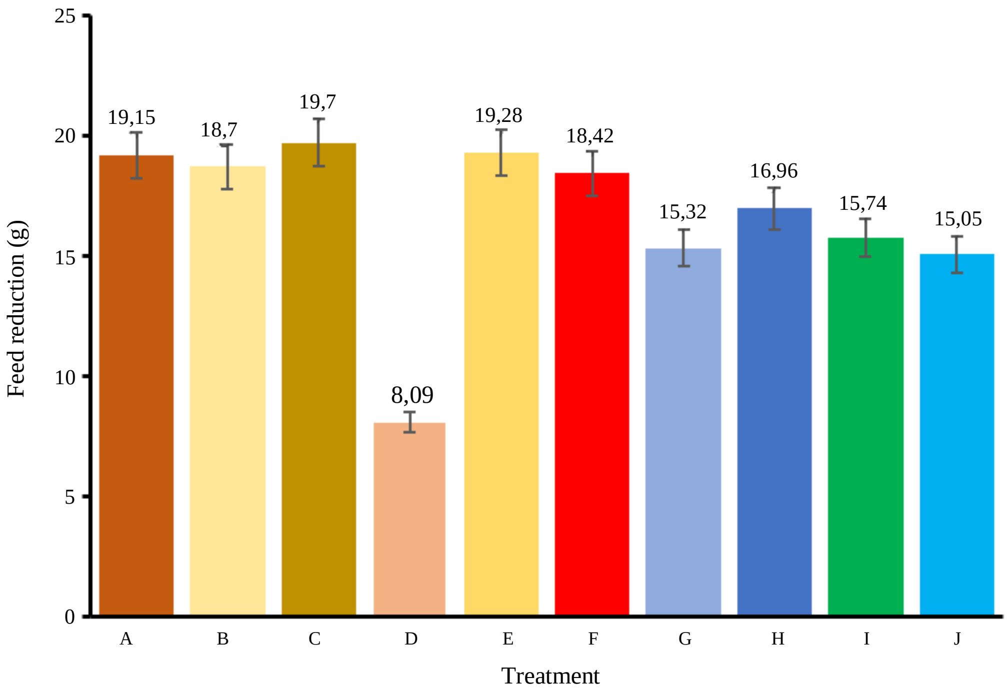

Fig. 3: Effect of LS and AE on Feed Reduction of *P. canaliculata* after 14 Days of incubation

Effect of LS and AE on Decreasing of P. canaliculata weight after 14 Days of Incubation

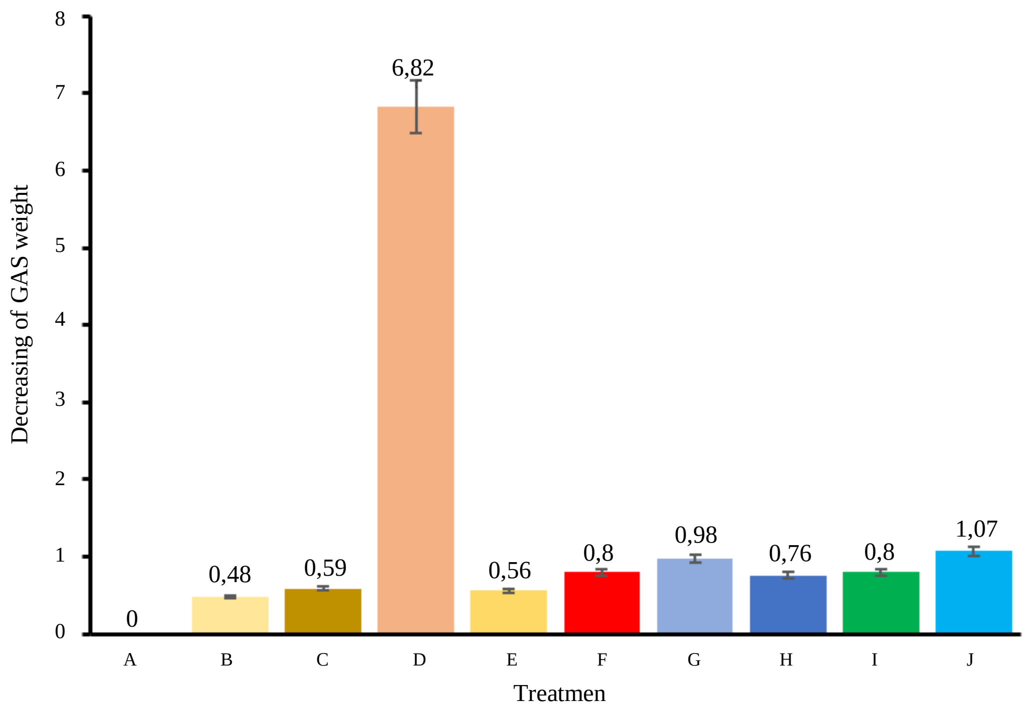

Fig. 4: Effect of LS and AE on decreasing of *P. canaliculata* weight after 14 days of incubation

Discussion

The highest snail mortality was achieved in LS treatment with a concentration of 15%, which was different from all other treatments (Fig. 2). In addition to the 15% LS treatment, all treatments were not different compared to *controls and all treatments were not different from P. canaliculata* mortality.

All treatments, except LS treatment with a concentration of 15%, did not give a difference in the decrease in feed weight compared to the control, also all of the treatments were not different from the decrease in feed weight (Fig. 3). The treatment of LS concentration of 15% has the effect of decreasing feed weights that are different from all other treatments.

The highest decrease in snail weight was achieved in LS treatment with a concentration of 15%, which was different from all other treatments (Fig. 4). Apart from the 15% LS treatment, all treatments were not different from the controls, all of them did not give a difference in the decrease in the weight of *P. canaliculata*.

Terrestrial plants produce a diverse array of secondary metabolites, likely more than 100,000 unique compounds, and there is compelling evidence that at least some of these are important in the defence of plants against herbivores. It should come as no surprise then, that the vast majority of substances documented to deter feeding by insects have been isolated from plants. Antifeedants can be found amongst all the major classes of secondary metabolites-alkaloids, phenolics and terpenoids. But it is in the last-mentioned category that the greatest number and diversity of antifeedants, and the most potent, have been found (Isman, 2002)

Mechanism of action of botanical pesticides on organism-targets are: (i) inhibition of acetylecholinestrase (essential oils from: *Azadirachtina indica*, *Mentha* spp., *Lavendula* spp.); (ii) cholinergic acetylcholine nicotinic receptor antagonist (nicotine from: *Nicotiana* spp., *Haloxylon salicornicum*, *Stemona japonicum*); (iii) GABA-gated chloride channel (thymol, silphinenes from: *Thymus vulgaris*); (iv) sodium and potassium ion exchange disruption (pyrethrin from *Crysanthemum cinerariaefolium*); (v) inhibitor of cellular respiration or Mitochondrial complex Electron Transport Inhibitor (METI) (rotenone from: *Lonchocarpus* spp.); (vi) affect calcium channels (ryanodine from *Ryania* spp.); (vii) affect nerve cell membrane action (sabadilla from: *Schoenocaulon officinale*); (viii) octopaminergic receptors (esssential oils from: *Cedrus* spp., *Pinus* spp., *Citronella* spp., *Eucalyptus* spp); (ix) block octopamine receptors by working through tyramine receptors cascade (thymol from: Thymus vulgaris); and (x) hormonal balance disruption (azadirachtin from : *Azadiractina indica*) (El-Wakeil, 2013).

Increasing the concentration of LS to 15% gave an increase in the effect of mortality on *P. canaliculata*, but not on feed consumption and weight of the snail. According to (Memon *et al*., 2017) that increased concentration correlates with an increase in the active ingredients of a biocytic substance. Thirty (30) second nymhal instar of mealybug were used on three different botanical pesticides need, davi and paneer with 10, 20 and 30 ppm doses to find the mortality of mealybug in different hours (24,48,72,96 and 120/hours). Each replication was repeated three times. Present results revealed that significantly increased mortality was observed in 10 and 20 ppm on devi and paneer, whereas a highly significantly augmented mortality was recorded on neem extract in 30 ppm (Memon *et al*., 2017).

On the other hand, increasing the concentration of areca seed extract to 15% did not give a difference in effect on mortality of *P. canaliculata,* feed consumption and decrease in the weight of the snail, even the effect of all of them was equal to control.

The combination of the treatment of LS concentration and 15% areca seed extract concentration (treatment J), proved that the concentration level of areca nut gave an antagonistic effect on the action of LS concentration at that level. According to the PAN Germany (2009) statement that if two or more pesticides are applied together, the interaction is: (i) In general, combination effects can be predicted on the basis of two models used in pharmacology and toxicology, i.e., ‘concentration addition’ and ‘independent action; (ii) Terms such as ‘synergism’ or ‘antagonism’ are only meaningful with regard to an expected effect; (iii) Combination effects of chemicals are usually additive or independent; (iv) Both additive and independent action of several substances lead to greater effects than of the individual substances: (iv) Substances present at concentrations below their ‘No-Observed Effect Concentration’ (NOEC) also result in combination effects that are relevant; and (vi) It is possible to consider combination effects in chemical risk assessment.

Conclusion

It was concluded that liquid smoke at a rate of 40 mL can significantly restrict the activity of *Pomacea canaliculata* under laboratory conditions as a major pest in rice fields in Indonesia. However, field study is essential to validate the laboratory results.

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Author's Contributions

All the authors mentioned above really have contributed in one or more of these research and publication phase.

Ethics

The authors confirmed that this article is an original research and do not contain any conflict of interest.

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