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Test The Effectiveness Botanical Insecticide of Citronella Leaf Extract (*Cymbopogon nardus* L.) to Control Stink Bug (*Leptocorisa oratorius* Fabricius) on Upland Rice

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Abstract

Leptocorisa oratorius F. is one of the factors causing the decline in rice production. Appropriate and safe control measures for the environment need to be taken, considering that the use of chemical pesticides can have a negative impact on the environment. The treatment solution that can be used to deal with the stink bug pest (*Leptocorisa oratorius* F.) is by using plant-based pesticides which are known to be relatively safe because they do not pollute the environment and are easy to obtain. A plant that has the potential to be used as a botanical insectiside is citronella (*Cymbopogon nardus* L). The research aims to obtain a concentration of citronella leaf extract (*Cymbopogon nardus* L) that is effective in controlling the stink bug pest (*Leptocorisa oratorius* F.) on rice plants. The research was carried out at the Plant Pest Laboratory and Greenhouse, Faculty of Agriculture, Riau University, which was carried out for three months from Januari to Maret 2023. The research was carried out experimentally using a completely randomized design (CRD) consisting of five treatments and four replications so that 20 experimental units were obtained with various concentrations, namely 0 g.l-1 water, 25 g.l-1 water, 50 g.l-1 water, 75 g.l-1 water, 100 g.l-1 water. The results showed that the application of the stems and citronella leaves extract concentration of 75 gl-1 water is an effective concentration for controlling L. oratorius because it can cause a mortality of 85% with an initial time of death of 17.75 hours after application and a lethal time of 50 at 61.25 hours after application. The exact concentration of peper elder extract to control 50% of Leptocorisa oratorius is 4.31% or the equivalent of 43.1 g.l-1 water.

Keywords: Botanical insecticide, *Cymbopogon nardus* L., *Leptocorisa oratorius* F., Mortality, Rice plants

1. Introduction

Rice is one of the food commodities that is the largest source of calorie and nutrient providers for the people of Indonesia, rice is a commodity that is prioritized and plays an important role in agricultural development in Indonesia (Lena et al., 2020). Broadly speaking, rice production in Indonesia and the world has increased (Khanal et al., 2016). As the population increases, the need for rice also increases (Rusda and Syahni, 2016), so efforts to increase production and maintain the productivity of rice plants must continue to be pursued in order to prevent food shortages in Indonesia

BPS Riau (2023) reported that rice production in 2021 was 217,458 tons of milled dry grain (MDG) with a harvest area of 53,062 ha. Rice production in 2022 was estimated at 213,557 tons of milled dry grain (MDG) with a harvest area of 51,054 ha. The data shows that from 2021 to 2022 there was a decrease in production. Constraints in rice cultivation that hinder the increase in domestic production causing low rice production include pest attacks. The attack of *Leptocorisa oratorius* F. is one of the factors causing the decline in rice production.

Leptocorisa oratorius F. attacks rice plants during the flowering phase until milk maturity, damaging them by sucking plant fluids from flower stalks (paniculae), causing plants to lack nutrients and turn yellow (chlorosis), and die. This pest can not only reduce yield but also reduce grain quality such as brown spots in the grain due to the suction

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of liquid from the pest, causing a decrease in grain quality (BBPTP, 2015).

The *Leptocorisa oratorius* F. is an important pest of rice plants that causes damage to rice plants. It can reduce yields by 10-40%, but in severe attacks due to high populations it can reduce yields by up to 100% or loss of life (BBPTP, 2015). The results showed that a population of 5 moths per 9 clumps of rice plants would reduce the yield by 15%. From the attack of *Leptocorisa oratorius* F. and the decrease in yield, it shows that the attack of one *Leptocorisa oratorius* F. per panicle in one week can reduce the yield of 27% (Agricultural Training Center, 2021). The high attack of *Leptocorisa oratorius* pests on rice plants cannot be controlled with effective and efficient control where until now farmers still use synthetic insecticides (Salbiah and Harefa, 2018). Appropriate and environmentally safe control measures need to be taken, considering the use of chemical pesticides can have a negative impact on the environment.

Plants that have the potential to be utilized as vegetable pesticides are citronella (*Cymbopogon nardus* L). (Plantation Research and Development Center, 2012). According to Hidana and Novia (2015) lemongrass leaves contain phytochemicals, namely saponins, tannins, and steroids. Citronella plants also have citronella compounds that work as contact poisons that cause dehydration in insects, so that insects will experience death due to fluid loss.

According to research by Kojongian et al., (2022), citronella extract with a concentration of 1% can provide mortality of Spodoptera litura larvae by 80%. According to Dadang and Prijono (2008), botanical insecticides are said to be effective if they are able to kill large insect pests of or equal to 80% with a water solvent of not more than 10% and an organic solvent of not more than 1%. So far, information on the use of citronella (*Cymbopogon nardus* L) in controlling L. oratorius pests has not been widely reported, especially in Riau.

Based on this description, the authors have carried out research with the title "Test the Effectiveness of Leaf Extract *Cymbopogon nardus* L. to Control Pests *Leptocorisa oratorius* F.

2. Material and Methods

2.1. Place and Time

The research was conducted at the Plant Pest Laboratory of the Faculty of Agriculture, Riau University and the Experimental Garden of the Faculty of Agriculture, Riau University, Bina Widya Campus, KM 12.5, located at 0°27′20″N 101°23′17″E, Pekanbaru, Riau Province. The research was conducted forthree months from January to March 2023.

2.2. Materials and Tools

The materials used in this study were citronella leaves, imago and nymphs of walang sangit instar II, rice seeds of Pb-42 variety, water, distilled water, topsoil, manure, Urea fertilizer, KCL, TSP, and cream soap.

The tools used in this research are machetes, hoes, paddles, knives, filters, gauze, rubber bands, cotton, tissue, wire, basins, scissors, stirrers, stirring rods, plant hoods, insect nets, polybags measuring 30 cm x 40 cm, blenders, hand sprayers, measuring cups, beakers, thermohygrometers, analytical scales, cellphone cameras, label paper and stationery.

2.3. Research Methods

This study was conducted using an experimental method with a complete randomized design (CRD), which consisted of several concentrations of citronella leaf extract applied during the nymphal stadia. The treatments tested were several types of citronella leaf extract concentrations consisting of 5 treatments, with 4 replications so that 20 experimental units were obtained, each experimental unit consisted of 10 nymphs of the second instar grasshopper. The treatments used were citronella leaf extract concentrations of 0 g.l-1 water, 25 g.l-1 water, 50 g.l-1 water, 75 g.l(-1) water and 100 g.l(-1) water.

2.4. Data Analysis

The data obtained were analyzed statistically using the results of variance that significantly influenced were further tested with the Honest Real Differences (BNJ) test at the 5% level. The program used was SAS System Version 9.12.

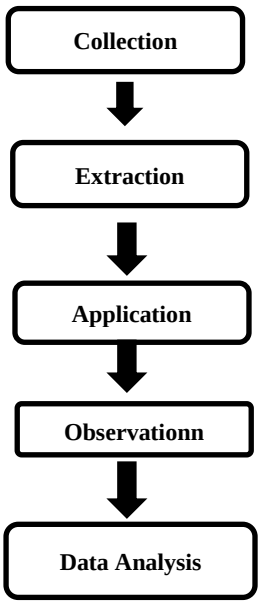

Figure 1. Research flow diagram

3. Results and Discussion

3.1. Initial time of death (hours)

The results of variance showed that different concentrations of citronella leaf extract (*C. nardus*. L) significantly affected the early death time of L. oratorius

nymphs can be seen in Table 1.

Table 1. Average initial time of death *Leptocorisa oratorius* nymphs after application of several concentrations of citronella extracts

Citronella extract concentration g.l^{-1} water	Time of onset of death (hours)
0	96,00±0,00 a
25	42,00±1,25b
50	40,75±0,95 b
75	17,75±0,80 c
100	15,00±0,65 c

Description: The numbers in the columns followed by unequal lowercase letters are significantly different according to the BNJ further test at the 5% level after being transformed with y□

The concentration of citronella leaf extract caused significant differences in the initial time of death of *Leptocorisa oratorius* with a range of 15.00 - 96.00 hours after application. Giving the concentration of citronella leaf extract 100 g.l -1 water causes the initial time of death which is 15.00 hours after application and is not significantly different from the concentration of 75 g.l -1 which is 17.75 hours after application but significantly different from other treatments. The results obtained prove that the higher the concentration of citronella leaf extract, the faster the time needed to kill *Leptocorisa oratorius*. In accordance with the opinion of Mulyana (2002), that the provision of high concentrations causes an increase in toxic compounds so that the ability to kill pests is faster.

Giving a concentration of 50 g.l-1 water causes an early death time of 40.75 hours after application and is not significantly different from the concentration of 25 g.l-1 water which is 42.00 hours after application and significantly different from other treatments. The length of the initial time of death of *Leptocorisa oratorius* nymphs is due to the low concentration of citronella leaf extract, so that the active ingredients in it are also small. Rizal et al. (2010) stated that the lower the concentration given, the longer it takes to kill the pest because the less active ingredients enter the pest's body.

3.2. Lethal Time 50

The results of the LT50 observation after analyzing variance showed that the treatment of several concentrations of citronella leaf extract had a significant effect on the LT(50) of *Leptocorisa oratorius* nymphs. The average results of LT50 after the BNJ test at the 5% level can be seen in Table 2.

Table 2 shows that the application of several concentrations of citronella extract caused a lethal time of 50 nymphs of *Leptocorisa oratorius* with a range of 49.75 - 96 hours after application. Giving the concentration of citronella extract 100 g.l -1 water in killing 50% of *Leptocorisa oratorius* nymphs is 49.75 hours after application, not significantly different from the concentration of citronella extract 75 g.l -1 water in killing 50% of *Leptocorisa oratorius* nymphs which is 61.25 hours. It is suspected that the higher the concentration given, the higher the content of active ingredients in citronella extract so that the faster the time required in killing 50% of *Leptocorisa oratorius* nymphs. This opinion is supported by Hasyim et al. (2019) that the higher the concentration of the extract and the type of plant extract used, the faster the initial time of death and the LT50.

Table 2. Average Lethal time 50 of *Leptocorisa oratorius* nymphs after application of several concentrations of citronella extracts.

Citronella extract concentration (g.l^{-1} water)	*Lethal Time* 50 (hours)
0	96,00±0,00 a
25	79.75±1,75 ab
50	75.00 ±1,50ab
75	61.25±1,25 bc
100	49,75±0,90 c

Description: The numbers in the columns followed by unequal lowercase letters are significantly different according to the BNJ test at the 5% level after being transformed with y□

The concentration of citronella extract 75 g.l-1 water the time required to kill 50% of *Leptocorisa oratorius* nymphs is 61.25 hours, not significantly different from the concentration of citronella extract 50 g.l-1 water the time required to kill 50% of *Leptocorisa oratorius* nymphs is 75.00 hours. It is different in the initial time of death (Table 1) shows that the concentration of citronella extract 75 g.l -1 water with the initial time of death required is 17.75 hours, but significantly different from the concentration of citronella extract 50 g.l -1 water with the initial time of death required is 40.75 hours. It is suspected that at LT 50 citronella compounds in citronella extract in addition to entering as a contact poison also enter as a stomach poison, both of these poisons work optimally in killing 50% nymphs of *Leptocorisa oratorius*. so that there is a significant difference between the concentration of citronella extract 50 g.l -1 water and the concentration of citronella extract 75 g.l -1 water. Citronella compounds enter the insect body in a contact poison through natural holes such as the mouth, anus, and spiracles. The poison will attack the nervous system, thus disrupting nymph activity (Mumba & Rante, 2020). Citronella compounds can also act as stomach poisons. The compound enters the insect's body as a stomach poison that enters through extracts eaten by nymphs resulting in disruption of eating activity so that the nymphs will weaken and eventually die (Arimurti et al., 2017).

3.3. Lethal Concentration (LC50 and LC95) (%)

The results of probit analysis using the POLO-PC program, citronella extract concentration showed LC 50 and LC 95 of 4.31% and 53.06%, respectively. The results of probit analysis can be seen in Table 3.

Table 3 shows that the appropriate concentration of citronella extract to kill 50% of *Leptocorisa oratorius* nymphs is 4.31% or equivalent to 43.1 g.l-1 water with a

confidence interval in the range of 1.87% - 7.69%. This means that a concentration of 43.1 g.l-1 water of citronella extract is needed to be able to kill 50% of *Leptocorisa oratorius* nymphs, which is close to a concentration of 50 g.l-1 water. According to Hasyim et al. (2019) that the smaller the lethal concentration value, the more toxic the vegetable insecticide will be.

Table 3. Lethal Concentration (LC50 and LC95) of *Leptocorisa oratorius* nymphs after application of concentrations of citronella extract.

Lethal concentration **(LC)**	**Concentration (%)**	**95% SK range (%)**
LC_{50}	4,31	1,87 - 7,69
LC_{95}	53,06	19,05 - 7044,26

SK= Confidence Interval

The correct concentration to kill 95% of *Leptocorisa oratorius* nymphs is 53.06% or equivalent to 530.6 g.l-1 water with a confidence interval in the range of 19.05% - 7044.26%. Munandar and Halim (2020) stated that the narrower the confidence interval, the higher the level of accuracy and the wider the confidence interval, the lower the level of accuracy.

3.4. Total Mortality (%)

The results of variance indicated that different concentrations of leaf extract (*C. nardus*. L) significantly affected the total mortality of *Leptocorisa oratorius* can be seen in Table 4.

Table 4. Total mortality of *Leptocorisa oratorius* nymphs after application of several concentrations of citronella extracts.

Concentration Citronella extract (g.l^{-1} water)	**Total Mortality (%)**
0	0,00±0,00 d
25	55,00±2,30 b
50	55,00±2,10 b
75	85,00±1,90 a
100	87,50±1,75 a

Description: The numbers in the column followed by the same lowercase letter are not significantly different according to the BNJ test at the 5% level after being transformed with arcsin y+0.5

Giving several concentrations of citronella extract gave a significant difference to the total mortality of *Leptocorisa oratorius* nymphs with a range of 55.0% - 87.50%. The concentration of citronella extract 100 g.l-1 water and the concentration of 75 g.l-1 water caused total mortality of *Leptocorisa oratorius* nymphs, namely 87.50% and 85.00%, significantly different from other concentration treatments, but the concentration of 100 g.l-1 water was not significantly different from the concentration of 75 g.l-1 water. This indicates that the concentration of citronella extract in high concentrations can increase the percentage of total mortality in controlling *Leptocorisa oratorius* nymphs. Mulyana (2002) states that the provision of high concentrations causes insects to die quickly, this is due to the large number of chemical compounds that enter the insect's body.

Citronella compounds enter the insect body as a contact poison through natural openings such as the mouth, anus, and inter-abdominal segments. The poison will attack the nervous system thus disrupting nymphal activity (Mumba & Rante, 2020). Citronella compounds can also act as respiratory toxins, citronella inhibits respiratory function through the spiracles. The main mechanism of action of citronella involves the inhibition of the enzyme acetylcholinesterase, which causes the accumulation of acetylcholine, triggering nervous disorders, paralysis, and death. (Rustam and Tarigan, 2021)

The concentration of citronella extract 75 g.l-1 water was significantly different from the concentration of 50 g.l(-1)water and 25 g.l-1 water. This indicates that the increase in concentration is able to provide a significant difference to the total mortality of *Leptocorisa oratorius* nymphs. Giving citronella extract concentration of 25 g.l-1 water caused the lowest total mortality of *Leptocorisa oratorius* nymphs, which was 55%. This is due to the lack of citronella compounds contained in citronella extract concentration of 25 g.l-1 water. Yunianti (2016) states that the lower the concentration of pesticides, the lower the toxic compounds contained, so that the few active ingredients enter the insect's body.

The application of citronella extract vegetable insecticide is effective in controlling *Leptocorisa oratorius* nymphs at a concentration of 75 g.l-1 water with total mortality reaching 85.00%. Dadang and Prijono (2008), said that vegetable insecticides can be said to be effective if they are able to kill test pests equal to or greater than 80% by using water solvents not more than 10%.

3.5. Morphological and Behavioral Changes of Leptocorisa oratorius Nymphs

Changes in the behavior of *Leptocorisa oratorius* nymphs after giving concentrations of citronella leaf extract showed symptoms of death characterized by *Leptocorisa oratorius* nymphs not actively moving, decreased appetite due to toxins that enter the nymph's body. Morphological changes are characterized by changes in the color of the nymph's body which is initially green and over time becomes wrinkled, secretes yellow liquid, and finally blackens.

According to Rustam and Tarigan (2021), the mechanism of action of citronella poison is by inhibiting the enzyme acetylcholinesterase so that amino acid phosphorylation or acetylcholine accumulation occurs which causes nervous system disorders, respiratory paralysis, and death. Morphological changes of *Leptocorisa oratorius* nymphs after treatment can be seen in Figure 2.

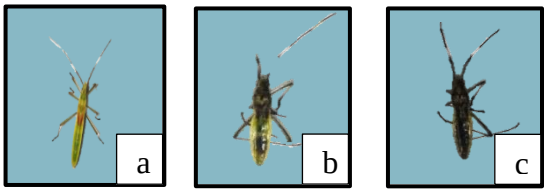

Figure 2. Color change of *Leptocorisa oratorius* nymphs after citronella extract application (2a) *Leptocorisa oratorius* nymphs are active, (2b) the color of *Leptocorisa oratorius* nymphs turns brown (42 hours after application), (2c) the color of *Leptocorisa oratorius* nymphs turns black (96 hours after application) (Research Documentation, 2023).

4. Conclusion

Based on the results of giving several concentrations of citronella leaf extract to *Leptocorisa oratorius*, it was concluded that the concentration of citronella extract with a concentration of 75 g/l water was an effective concentration for controlling *Leptocorisa oratorius* pests because this concentration was able to cause total mortality of 85% with an initial time of death of 17.75 hours after application and lethal time 50 at 61.25 hours after application.

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