Utilization of botanical pesticide as rice pests control of in Soporaru Village, North of Tapanuli, Indonesia

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Abstract. Peoples in Soporaru village grows local specific brown rice ‘Kasumbo’ as a source of staple food in North of Tapanuli, Indonesia. The productivity is mostly disturbed by dominant pests, white back leafhoppers, planthopper, stemborer, and stinkbugs. The importance use of plant materials of botanical pesticide can control pests food crops. The method used was purposive random sampling using Yellow Sticky Trap (YST) and applied botanical pesticide, consist of \textit{Cosmos caudatus}, \textit{Tagetes erecta}, and \textit{Clitoria ternatea} at the paddy plantation during May-August 2020 in Soporaru village, North of Tapanuli. The fertilizers used farmer recorded Phosphate, ZA, SP36, and NPK. These results were recorded applied the variance of three botanical pesticide influence the mean population of \textit{Sogatella furcipera}. Variety pests, such as: \textit{S. furciper}, \textit{Leptocorisa oratorius}, \textit{Orseolia oryzae} and \textit{Nephotettix virescens} were identified are quite diverse. Species \textit{S. furciper} can detected used by botanical pesticides, \textit{C.caudatus}/kenikir flower (4-11 individuals), \textit{Tagetes erecta} L./marigold flower (5-10 individuals) and \textit{Clitoria ternatea}/butterfly pea flowers (6-13 individuals). Status insects in paddy were three categorized, such 12 species were pests, 7 predators, and only \textit{Gryllotalpa orientalis} into insect.

1. Introduction

The need for rice continues to increase because the increase in the number of consumers is not matched by sufficient production. According to CBS [1], Indonesia's rice production in 2019 was 54.50 million tons of Milled Dried Grain, but too high rice consumption meant that the food diversification program had not been achieved. Based on these conditions, the opportunity can still be done to increase production is intensification, one of which is doing agricultural business by applying technology, including seed technology [2].

Rice plant (\textit{Oryza sativa} L.) with variety Kasumbo is a brown rice plant which is a source of carbohydrates for some of the world's population. Almost 95% of Indonesia's population consumes rice as a staple food, so that every year the demand for rice needs increases along with the increase in population. According to data from the [2,3], rice consumption in Indonesia during 2019 is higher, such as 31.31 million tons. The need for the rice Manurung commodity itself plays an important role for the life of the Indonesian nation in general and for the people of North Tapanuli Regency in particular. The need for paddy and rice greatly affects areas of community life such as health,
education, sports, economics, and others. Therefore, [3] said the need for rice commodity is very interesting to study further, especially about pests of paddy effected to food security in the future.

Geographically, North Tapanuli Regency is located at the coordinates of 1º20’00” - 2º4’10” North Latitude (LU) and 98º05’99”16’ East Longitude (BT). With an area of ± 3,800.31 km², with a land area distribution of 3,793.71 km² and an area of waters of Lake Toba of 6.60 km². Of the 15 Districts in North Tapanuli Regency, Garoga District is the one with the largest area of about 567.58 km² and the sub-district which has the smallest area is Muara District, which is about 79.75 km² [4].

As for the existing rice planting problems, new problems arise due to instant problem solving. Farmers often use chemicals as a first step to eradicate pests and diseases on their rice fields. However, the impact of the use of these chemicals has only recently been seen, resulting in the explosion of pests in rice fields. The rice pest in Soporaru village dominantly by Sogatella furcicera, Leptocorisa oratorius, Orseolia oryzae and Nephotettix virescenc. According to Mahfuddin [5] stated that under these conditions, insect pests would increase in population if pesticides were not used as recommended. Therefore it needs to be done. The principles of Integrated Pests Management (IPM) include the use of natural enemies, cultivation of healthy plants, regular observation and expert farmers used methods of IPM.

One of the IPM activities that farmers can do quite simply is using botanical pesticides. These botanical pesticides are obtained through the process of grinding plant material which contains substances that pest insects do not like and dissolving it with water. There are many types of plants that can be used as botanical pesticides, such as Cosmos caudatus/kenikir flower, Tagetes erecta/marigolds flowers, and Clitoria ternatea/butterfly pea flower. Objective the study to determined effected of variance of flowers (kenikir, marigold and butterfly pea) as botanical pesticides to control dominance rice pests of S. furcicera in Soporaru paddy plantation.

2. Materials and methods
The materials used in this research were paddy plantation, C. caudatus/kenikir, T. erecta/marigold, C. ternatea/butterfly pea, water, liquid soap. The tools used in this study were a handsprayer, drum, alcohol 70%, collection bottles, meters, insect net, plastic bags, ropes, plastic, label paper, bamboo, stakes scissors, knife, camera, filter, mixer and other supporting tools.

The research method used was purposive sampling method. Observations were made on rice planting land which was divided into 4 plots with the application of vegetable pesticides as follows such as:
Plot 1: Control (BP0) (without application)
Plot 2: Botanical pesticide 1 (BP1) application by kenikir flower
Plot 3: Botanical pesticide 2 (BP2) application by marigold flower
Plot 4: Botanical pesticide 3 (BP3) application by butterfly pea flower

The plants used as botanical pesticides were obtained directly in the field which were grew around agricultural areas, including kenikir, marigold, and butterfly pea flowers. Six kg of each of samples plants were grounded finely using a mixer, then 20 g detergent/soap were added until it reached 1000 ml. Kenikir flower, marigold flower, leaves and butterfly pea flower were mashed. All ingredients were stirred evenly in 20 L of water, then were soaked for 24 hours. The next day the ingredients were filtered using a mesh net 50mm. The filtered solution was diluted again with 60 L of water. This amount of solution can be applied for 1 ha rice field.

Botanical pesticides have been left for 24 hours were taken from the drum and then filtered. After that, the pesticide could be sprayed using a hand sprayer applied in paddy plantation. The application of botanical pesticides was carried out 7 times during the sampling interval of around 14 days using a predetermined trap.

Then the yellow Sticky Trap (YST) was made of yellow paper measuring 30 cm x 20 cm which was smeared with adhesive glue and attached by using bamboo poles with a height adjusted to the height of the plant leaf canopy. Yellow traps are used to catch insects that are attracted to certain
colors in rice fields please insert a reference here. The insects found in these traps were collected, identified and counted.

The insects caught from the field that can be identified directly and some that cannot be identified directly. Insects that were not been directly identified were then taken to the Pest Laboratory, Faculty of Agriculture, Universitas Sumatera Utara for identification. Identification was carried out at the family level using identification references [6-9]. The captured insects were then photographed and made for a collection. After being separated larva and imago insects, counted the number of imago, and entered into the boxes insects. The data obtained were analyzed using data analysis descriptive quantitative.

3. Results and discussion
The results showed he use of botanical pesticides used by kenikir leaves, marigold flowers, butterfly pea flowers against control of the pest, white leafhoppers S.furcifera has been found in rice plantations in the Soporaru village, North Tapanuli as shown in Table 1. below.

Table 1. The average population of S.furcifera on paddy fields in Soporaru.

| Plot | Treatment | Total individuals/ 16 m² |
|------|-----------|--------------------------|
|      |           | O1 | O2 | O3 | O4 | O5 | O6 | O7 | O8 |
| 1    | BP-0      | 6  | 6  | 7  | 8  | 9  | 11 | 12 | 14 |
| 2    | BP-1      | 4  | 5  | 5  | 6  | 7  | 7  | 8  | 9  |
| 3    | BP-2      | 5  | 7  | 6  | 7  | 8  | 9  | 8  | 9  |
| 4    | BP-3      | 6  | 6  | 7  | 8  | 9  | 10 | 11 | 11 |

| Plot | Treatment | Total individuals/ 16 m² |
|------|-----------|--------------------------|
|      |           | O9 | O10 | O11 | O12 | O13 | O14 | O15 | O16 |
| 1    | BP-0      | 15 | 16  | 17  | 18  | 19  | 20  | 19  | 18 |
| 2    | BP-1      | 10 | 9   | 8   | 8   | 7   | 8   | 7   | 8  |
| 3    | BP-2      | 10 | 9   | 8   | 9   | 7   | 7   | 6   | 5  |
| 4    | BP-3      | 12 | 12  | 10  | 11  | 10  | 9   | 9   | 8  |

Noted: O=observation, BP0=control (without application); BP1= botanical pesticide with application kenikir flower; BP2= botanical pesticide with application marigold flower and BP3=botanical pesticide with application butterfly pea flower.

Figure 1. The land ready to be processed and planted with brown rice ‘Kasumbo’.

Figure 1 described processing the land ready to processed and planted with brown rice ‘Kasumbo’. While after a month, the women farmers makes botanical pesticides from kenikir flower, marigold flower, and butterfly pea flower used hand sprayer applied it to the paddy plantation (Figure 2).
Meanwhile Figure 3 showed the morphology and characteristics of *S. furcifera* detected at brown rice Kasumbo plantation.

![Figure 2. Activities women farmers in Soporaru villages during paddy phases plantation.](image1)

![Figure 3. *Sogatella furcifera* detected in the paddy plantation.](image2)

The population of *S. furcifera* in rice plants in the Soporaru village has decreased every week. The decline in the population of *S. furcifera* every week, due to increasing plant age. According to [9,10], white-back leafhoppers usually attack young rice plants and rarely attack old rice plants. The highest population of *S.furcifera* occurred in the first week of observations, when the paddy field was one month old (30 Day After Planting=DAP), while the lowest population of *S. furcifera* was in the last observation when the plants were 51 DAP.

According to [11,12], paddy plantation can be done simultaneously shorten the existence and breeding time of leafhoppers white back *S.furcifera* in lowland rice cultivation. In addition, the spacing of lowland rice plants also affects the development of the white back planthopper population. According to [13,14], spacing affects the physical environment of the plants themselves. Spacing that is too tight will reduce the space for the plants to develop so that the plants cannot grow healthy and become susceptible to pests and diseases. In lowland rice cultivation in Soporaru Village, farmers use rice spacing of 25 x 25 and 20 x 20 cm.

Generally, farmers use fertilizers, such as urea, SP36, NPK, and so on with different doses for each farmer. Fertilization time that is done by the farmers is three times fertilization, the first fertilization at the plant two weeks after planting, the second fertilization is four weeks after planting, and the third fertilization is seven weeks after planting. However, from the types of fertilizers used, Urea is the fertilizer with the highest dose used by farmers, so this is thought to be one of the factors in the development of the white-back planthopper population in rice cultivation in the Soporaru village, supported by Baehaki's statement of [11].
Other factors that influence the development of pest populations are insects as natural enemies, both predators and parasites, which can suppress the population of pests that exist on rice plants. In Soporaru village, farmers have started to develop integrated control techniques such as biological control, mechanical control, namely the use of light trap, YST, botanical pesticide and control techniques other.

Types of insects obtained recorded as pest, predator and insects recorded 20 species. Almost seven species (Tetragrantha sp, Coccinella septempunctata, Paederus sp, Atractomopha crenulata, Agrocnemis pygmaea, Ischnura senegalensis, Pantala flavescens), only Gryllotalpa orientalis insectsand twelve species insects were categorized into pests.

The status function of insects consists of pest, predator and insect. Then, the quite diverse assumed the development and reproduction of insects are strongly influenced by various abiotic factors, one of which is climate, this factor affects insects directly or indirectly, especially the orientation of insects when looking for food, and causes changes in insect physiology in anticipation of adverse climatic conditions. Climate has a direct effect on birth and mortality rates, indirectly, climate affects insect abundance [12,15].

| Order      | Family      | Species                  | Status         |
|------------|-------------|--------------------------|----------------|
| Aranea     | Lycosidae   | Tetragrantha sp          | Predator       |
| Coleoptera | Belostomatidae | Lepthocerus indicus  | Pest           |
| Coleoptera | Coccinellidae | Coccinella septempunctata | Predator     |
| Coleoptera | Staphylinidae | Paederus sp            | Predator       |
| Diptera    | Ephydridae  | Hydrellia sp              | Pest           |
| Diptera    | Cecidomyiidae | Orseolia oryzae     | Pest           |
| Hemiptera  | Chrysomelidae | Nephotettix virescens  | Pest           |
| Hemiptera  | Coreidae    | Leptocoridae oratorius   | Pest           |
| Hemiptera  | Coreidae    | Riptortus linearis       | Pest           |
| Hemiptera  | Delphacidae | Sogatella furciperia     | Pest           |
| Hemiptera  | Pentatomidae | Nezara viridula       | Pest           |
| Hymenoptera| Formicidae  | Gryllotalpa orientalis   | Insect         |
| Hymenoptera| Gryllotalpidae | Componotus sp          | Pest           |
| Lepidoptera| Crambidae   | Scirpophaga incertulas   | Pest           |
| Lepidoptera| Pyralidae   | Chilo suppressalis       | Pest           |
| Lepidoptera| Pyralidae   | Sesamia inferens         | Pest           |
| Orthoptera | Tettigonidae | Atractomopha crenulata   | Predator       |
| Odonata    | Coenagrionidae | Agrocnemis pygmaea   | Predator       |
| Odonata    | Coenagrionidae | Ischnura senegalensis  | Predator       |
| Odonata    | Libellulidae | Pantala flavescens      | Predator       |

The calculation of Evenness Index value of insect species in Soporaru paddy plantation were $E' = 0.78$, is which indicates the evenness of insect species in this area supported by environmental factors causes the score is high ($E' > 0.6$). Accordance to [14,15] states the evenness value ($E$) ranges between 0 and 1, which means that if the evenness value gets closer to 1, it describes a state where all species are quite abundant. The recorded no family type dominates in the paddy sites. This is in accordance with [14] which states that the evenness value will tend to be high if the number of populations in a family does not dominate the population of other families, otherwise evenness tends to be low if a family has a population that dominates the number of other populations.

Otherwise, usable plant parts can be in the form of leaves, twigs, seeds and, roots/rhizomes, depending on the type of plant, usually the most toxic part is seeds [16], supported research by [17] concluded raw materials of the botanical insecticide are abundantly available in rainfed rice.
agroecology, i.e. neem leaves/seeds, mahogany seeds, and ageratum (Ageratum zonycoides). Botanical pesticides are suitable for prevention before the attack of pests and diseases (preventive) in plants [11]. Biological pesticides (botanical pesticides and microbial pesticides) are potential components of the concept IPM apply in the future for environmentally friendly.

4. Conclusions
The dominance pests resistant white-back leafhoppers (S. furcipera) can control used by botanical pesticides are used Cosmos caudatus Kunth/kenikir flower (4-11 individuals), Tagetes erecta L./marigold flower (5-10 individuals) and Chitoria ternatea/butterfly pea flowers (6-13 individuals). Species Sogatella furcipera, Leptocorisa oratorius, Oroselia oryzae and Nephotettix virescen were identified are quite pests diverse. Then the status insects in paddy were 4 categorized, such 12 species were pests, 7 predators, and only Gryllotalpa orientalis into insect.

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