The presence of refugia and population of insect pest in rice field

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Abstract. Refugia is a type of plant playing the role as a food source and shelter for natural enemies in extreme environmental conditions. Legumes, food plants and flowering plants are used as refugia. The purpose of the research is to study the dominant pest population in the embankment of rice fields planted with refugia. The research was conducted in Tanasitolo village, South Sulawesi from June to November 2017. The study used a Randomized Block Design of five treatments and repeated it four times. The research was started by planting several different plants as refugia in the embankment of rice fields, namely: P0 = embankment without plant (control); P1 = maize and soybean in embankment; P2 = flowering plants in embankment; P3 = taro and banana in embankment; and P4 = long beans in embankment. The results showed that rice fields used various plants as refugia, the insect population was in the lowest number. The results showed that Valanga sp. were not found in P1 when the rice was 56 and 63 days after planting. The number of Nephotettix virescens (0.5 individuals) when the rice was 42 days after planting. Leptocorisa acuta has the lowest population at P1 and P3 in the age 84 days after planting (10.5 individuals). The conclusion of the experiment is the lowest population of grasshopper L. migratoria in rice age 56 and 63 days after planting was showed P1 (maize and soybean). The lowest population of green leafhopper N. virescens in the rice age 42 days after planting showed in the treatment P1 (maize and soybean). In the rice age in the 84 days after planting with treatment P1 (maize and soybean) and P3 (taro and bananas) showed a very low population.

1. Introduction

Rice (Oryza sativa L.) is an important Graminae in worldwide. According to [1, 2] reported rice an important agricultural commodity and more giving a contribution to increasing national income. In South Sulawesi Sulawesi Selatan, the rice productivity in 2015 reached 52.41 quintals per hectare and production about 5,471,806 tons with a total harvest of 1,044,030 hectare. In 2004 – 2005, the average rice productivity in South Sulawesi only 50.73 quintals per hectare. The effort to increase rice productivity always an obstacle because of abiotic and biotic stress. Abiotic stress comes from drought and flooding, biotic stressed including the presence of plant pests and diseases [3]. The one group attacking rice is pests from arthropods. According to [4] state that the common pest around rice fields such as stem borer, stink bug, grasshopper and green leafhoppers.

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According to [5, 6] reported stink bug *Leptocorisa acuta* (Hemiptera: Alydidae) is the destructive pest insect in the rice panicle formation phase. *L. acuta* sucking the panicle caused empty or filling process not perfect. The spreading of insect is wide. In Indonesia, *L. acuta* as occasional pests and caused 50% yield losses. The presence of *L. acuta* affected increasing grain discoloration. *Grain discoloration.* Injury of *L. acuta* caused decreased production and quality of grains. On the other hand, the destructive rice pest is green leafhoppers. In Indonesia, planthopper populations often found in high numbers, caused the death of rice plants. One of the planthoppers that commonly attacking rice in many areas in Indonesia is the green leafhopper. In addition to direct damage, green leafhoppers playing a role as a vector of tungro diseases. Their attack on rice resulting in a reduction in rice productivity in endemic areas [6]. The grasshoppers that are commonly found attacking rice plants are *Locusta migratoria*. The body of *L. migratoria* is brown, the hind wings are dark and yellow stripes. During the day, the grasshoppers hide in the leaves or dark places. Commonly they attacked rice plants at night. The feeding habit of grasshoppers cut off the leaves and remains leaf bones [7].

Majority of the control of insect pests of rice plants in several regions in Indonesia using synthetic insecticides. The application of insecticides containing dangerous chemicals in the process of the control of rice pests has a negative impact in the form of insect resistance and the death of non-target organisms that act as natural enemies. In general, many natural enemies living in refugia that grow surrounding rice fields. Botanical pesticides are the one safety method for natural enemies [8, 9]. The embankment is the boundary between one rice field and another, not used by farmers. The embankment is commonly called invisible sleeping land. Using embankment planting agricultural crops very useful for farmers increasing the diversity of production and income for the family. Besides the source of income, another benefit embankment planting agricultural plants used as a medium for breeding natural enemies that have the potential to control the population of insect pests, interfere with main crops in the rice fields. As said earlier, plants planting in embankments such as legumes, maize, bananas, taro and flowering plants around rice become refugia for natural enemies. Refugia not only provides nectar but also preparing leaves to protect natural enemies from sun exposure. The existence of refugia can be a hiding place for natural enemies when the land is fallow. Natural enemies such as predators and parasitoids play a very important role in suppressing insect pest populations [10,11,12]. The purpose of research is to study the dominant pest population in the embankment of rice fields planted with refugia.

2. Methodology

2.1. Site of research

The research was conducted in Tanasitolo District, Wajo Regency, South Sulawesi was held from June until November 2017. The research used 20 plots of farmers' rice fields (five treatments and four replication). The planting of different plants in the embankment (length 30 m). The treatment used P0 = without planting on embankment; P1 = maize and soybean; P2 = taro and banana; P3 = flowering plant and P4 = long bean.

2.2. Observation of rice pests

The observation of research was started 14 days after planting used D-vac with intervals of seven days. Collection processed pest insects in one plot were held in four sites suction-based randomly. The position of D-vac suction is two suction-based distances from plant embankment and suction around embankment; two suction in the center of the rice field. Result of D-vac collection put on the labeling bottle with 70% alcohol. Counting of insects collected used microscopes. Data analysis used Randomized Block Design in five treatments and four replication. The observation focused on key pests on rice in the planting season.
3. Results and discussion

3.1. Key pest of rice

Rice as a staple food for Indonesian and many people in different countries. The observation of grasshopper (L. migratoria), green leafhopper (N. virescens) and stink bug (L. acuta) has potential caused yield losses. The averages of L. migratoria in the rice (O. sativa) were showed in table 1.

Table 1. The averages of L. migratoria in the rice (O. sativa).

| Rice ages (days after planting) | P0   | P1   | P2   | P3   | P4   |
|----------------------------------|------|------|------|------|------|
| 21                               | 0a   | 0a   | 0a   | 1b   | 0.25a|
| 28                               | 0a   | 0a   | 0.5ab| 1b   | 0a   |
| 35                               | 0a   | 0a   | 1b   | 0a   | 0a   |
| 42                               | 0a   | 0.25a| 0.5a | 0.25a| 0a   |
| 49                               | 0.5a | 0.25a| 0a   | 0.25a| 0a   |
| 56                               | 0.25ab| 0a   | 0.25ab| 0.75b| 0a   |
| 63                               | 0.25a| 0a   | 0.5a | 2b   | 0.25a|
| 70                               | 0.75a| 1.75a| 1a   | 0.75a| 0.5a |
| 77                               | 1.25a| 1a   | 0.5a | 2a   | 0.25a|
| 84                               | 0.75a| 0.75a| 0.75a| 0.5a | 0.25a|

Numbers in the same column followed by same letters are not significantly different at Duncan Multiple Range Test α = 0.05. P0 = without plant (control); P1 = mayze and soybean; P2 = flowering plant; P3 = taro and bananas; P4 = long beans.

The results in table 1 showed that rice fields used various plants as refugia, the insect population was in the lowest number. The results showed that L. migratoria were not found in P1 (control) when the rice was 56 and 63 days after planting. Rice age 56 days after planting, the L. migratoria population in P1 (maize and soybean) and P4 (long beans) lower than P2 (flowering plants). This treatment non-significant with P3 (flowering plant) and P0 (control). Once rice age 63 days after planting, L. migratoria at P0 (control), P1 (maize and soybean), P3 (taro and bananas) and P4 (long beans) are lower than P2 (flowering plants).

The population of L. migratoria seems lowest in few treatments because plant age caused fluctuation of the pest insect population in the rice field. In the vegetative phase, L. migratoria more actively attacked the plant because the plant grows actively in stem and leaves. This condition supporting of L. migratoria because of preparing more nutritious food. In general, L. migratoria prefers to eat the cereal plant part in the vegetative phase because they are succulent and contain more water. According to [4] state L. migratoria prefer host plant from Graminae such as rice, maize, sorghum, sugarcane, reeds, and many species of grass. Grasshopper also attacked coconut leaves, bamboo, peanut and young cabbages. Some of the less preferred plants are mung bean, soybean, long bean, cassava, tomato, yam and cotton. According to [6] state change of solitary phase of L. migratoria to gregarious in the beginning of the wet season after the long dry season. In the bad condition, increasing population of solitary grasshopper from a different location to another location that suitable based ecology for their development.

In general, the habitat that suitable for L. migratoria development such as open land or contain many grasses, soil contain more sand, near the source of water (river, lake, ponds). After development about 3 – 4 generation transfer, transient phase to gregarious depends on habitat condition. The specific location of L. migratoria is known as the initial breeding site. The average of N. virescens in the rice (O. sativa) was showed in table 2.
When rice age in 21 and 28 days after planting, *N. virescens* not attacked plant in P0 (control) and P1 (maize and soybean). The lowest number of *N. virescens* about 0.5 individuals when rice 42 days after planting in treatment P1 (maize and soybean). They had a fluctuation and increasing to the highest population at 63 days after planting in P4 (long beans) about 32.5 individuals and P1 (maize and soybean) about 22.25 individuals. The lowest population of *N. virescens* at P3 (taro and bananas) about 0 individual/zero and P4 (long beans) showed at 84 days after planting.

Findings the lowest population of *N. virescens* find at 28 days after planting in P1 (maize and soybean) and P0 (control). Green leafhoppers *N. virescens* playing important roles caused significant injury in the rice. This is a very destructive and vector of tungro diseases. They are capable of adapting very fast in new habitats [10]. The average of *L. acuta* in the rice (*O. sativa*) was showed in table 3.

**Table 3. The averages of *L. acuta* in the rice (*O. sativa*)**

| Rice age (days after planting) | P0  | P1   | P2   | P3   | P4   |
|-------------------------------|-----|------|------|------|------|
| 21                            | 0a  | 0a   | 0a   | 0a   | 12b  |
| 28                            | 0a  | 0a   | 0a   | 0a   | 2.25b |
| 35                            | 3.25a | 0.5ab | 1.5ab | 0a   | 0.75ab |
| 42                            | 3.25a | 4.25a | 1a   | 0.5a | 7a   |
| 49                            | 3a  | 1.75a | 2.75a | 0a   | 0.5a  |
| 56                            | 0a  | 1.5a | 4a   | 0.75a | 0.25a |
| 63                            | 9.25a | 6.25a | 10.75a | 10a  | 3a   |
| 70                            | 13.5a | 16.75a | 19a   | 18.75a | 22.25a |
| 77                            | 11.75a | 11.5a | 15.35 | 11a  | 15.25a |
| 84                            | 17a | 10.5a | 13.5a | 10.25a | 13.75a |

Numbers in the same column followed by the same letters are not significantly different at Duncan Multiple Range Test α = 0.05. P0 = without plant (control); P1 = maize and soybean; P2 = flowering plant; P3 = taro and bananas; P4 = long beans.

The population of *L. acuta* in the rice age 21 and 28 days after planting, not find in P0 (control), P1 (maize and soybean) and P2 (flowering plant). Rice age at 56 days after planting, *L. acuta* has the highest population in P2 (flowering plant) about 4 individual. The lowest population of *L. acuta* in P4 (long beans) about 0.25 individuals. The highest population at P1 (maize and soybean) about 10.5 individuals and P3 about 10.2 individuals at the age 84 days after planting. Then the lowest population of *L. acuta* in P0 (control), P1 (maize and soybean), P2 (flowering plant), P3 (taro and bananas) find in the rice age 21 days after planting. This condition because *L. acuta* prefers sucking rice panicle...
forming like milk. When the young rice in the vegetative phase, *L. acuta* makes the plant in embankment as an alternative host before rice produces panicles. According to [5] reported a population of *L. acuta* increasing because available and support for their development. Adult and nymphs of *L. acuta* sucking the soft rice panicle used the stylet. This behavior makes yield losses.

In general, the population of *L. acuta* develop faster in the rice planting is not simultaneously. The specific cases caused the living habitat of *L. acuta* not supported food for their development. This triggers the movement of *L. acuta* to another rice field that less natural enemies and many food sources [11, 12]. According to [5, 13], *L. acuta* still living in the rice field and waiting for the vegetative phase of rice panicle as their food source. Impact of plant in the embankment as refugia as protection site and food source. Refugia can be playing roles as alternatives hosts in extreme land conditions.

### 4. Conclusions

The lowest population of grasshopper *L. migratoria* in rice age 56 and 63 days after planting was showed P1 (maize and soybean). The lowest population of green leafhopper *N. virescens* in the rice age 42 days after planting showed in the treatment P1 (maize and soybean). In the rice age in the 84 days after planting with treatment P1 (maize and soybean) and P3 (taro and bananas) showed a very low population.

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