ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Abundance of Paederus Sp, Micraspis Sp, Austrogomphus Sp, And Orthetrum Sp. In Paddy Field Using Cowpea and Mung Beans As Shelter At Paddy Dikes.

Tamrin Abdullah*

Department of Plant Protection, Faculty of Agriculture, Hasanuddin University, Makassar (90245) Indonesia

ABSTRACT

Paederus sp., Micraspis sp., Austrogomphus sp. and Orthetrum sp. is the important biological agents. The presence of them attractive by cowpea and mung beans as shelter. The study was conducted in village of Mappadaelo, sub-districts Tanasitolo, Wajo Regency South Sulawesi, Indonesia, aims impact of cowpea and mung beans as shelter in paddy dikes and their relationship with abundance of predatory insects in rice field. The experiment was arranged in Randomized Block Design, consisting of five treatments with two replication. All of predatory insects were collected with a 12-volt dust vacuum. Predatory insects keep in the glass bottle contain 70% alcohol. Results showed highest population of predatory insects in cowpea at 38 days after rice transplanting is Paederus sp. with average 16.5 individual; Austrogomphus sp. (11.5 individual) and Micraspis sp. (9.0 individual), respectively. The lowest number of Orthetrum sp. in similar plant and age (1.5 individual). Mung beans at 38 days after rice transplanting showed highest population of Micraspis sp. (11.5 individual) and lowest population in Orthetrum sp. on same age (0.0 individual). Our results suggested cowpea played important role as shelter and food source of predatory insects in rice field.

Keywords: predatory insects, paddy dikes, rice, cowpea, mung beans

Corresponding author

ISSN: 0975-8585

INTRODUCTION

Rice (Oryza sativa L.) is the staple food in majority of Asia region and another part of worldwide, thus their availability must be preserved. Indonesian food security has experienced stagnation and is not yet adequate to fulfill the food needs of the country. In efforts to increase the rice production, influence of various biotic and abiotic factors plays a determining role.

One of the major reason and responsible to low level production of rice is the pest problem associated with the crops as their host. More than hundred insect pests have been known to attack rice crop during its growth stages, out of which about twenty have major significance on crops worldwide [3,7,17].

Biotic factor is plant-destroying organisms such as rice white stemborers, green and brown planthoppers, rice bug and the attacks of new pests like the rice grain bug, Paraeuscosmetus pallicomis Dallas and Pachybrachius pacificus Stal (Hemiptera: Lygaeidae) in Sulawesi [1,16]. They are a main part of complexity pests problem in Indonesia. Also synthetic insecticides application in rice reducing food security value, negative effect in environment, consumers and farmers as user. These need more attention and solution for new control strategy for pest insects and sustainability of natural resource.

Sulawesi island is the one from six planning economic strategy with development of agricultural productivity in future. The main problem from pests and plant diseases will decreased agricultural production and farmers income. Utilization of biological agents in the control of plant pests is one of priority application of IPM including predatory insects as active biological agents keep environmental balance. Effective predators will suppress pest insects population in low level and not harmful. Predator conservation efforts can be taken to increase populations in the crop and sustainable around planting [2,13,15]. For example, optimizing the role of ant predator Solenopsis sp. (Hymenoptera: Formicidae) for controlling Asian corn stemborer Ostrinia furnacalis Guenee (Lepidoptera: Pyralidae) on maize [12].

Rice cultivation has several types of insects as potential predators to control pests of rice. In rice field, Coleopteran families such as Paederus sp., and Micraspis sp., also Odonata such as Austrogomphus sp. and Orthetrum sp. is the potential predatory insects and playing important role controlled pest insects [8,9,11]. The presence of them in rice field with cowpea and mung beans as a shelter in paddy dikes affect their activity suppressed of their target.

One important factor decreasing efficiency of predators in low population because applied chemical insecticides in field. Use of insecticides has thus far proven to be the fastest and most effective means of suppressing the population of rice grain bug, however precautions must be taken to prevent excessive use of such chemicals to avoid economic drawbacks and environmental pollution [2,22]. In case improving role of predators in rice field, need conservation efforts such as paddy dykes were covered with mung bean and cowpea. Result of rice harvest with mung bean in dikes more higher because their function as shelter and food source for predators in rice field [1,12]. On the other hand, cowpea has important role as supplementary food for beneficial insects in field [21]. The aims of research is to study impact of cowpea and mung beans as a shelter in paddy dikes and their relationship with abundance of predatory insects in rice field.

MATERIAL AND METHODS

The research conducted in the village of Mappadaelo, in the sub-districts Tanasitolo, Wajo Regency in South Sulawesi. The treatments were arranged in a Randomized Block Design with two replication. The treatments were : (1) cowpea were planted in paddy dykes at 20 days after rice transplanting; (2) mung beans were planted in dykes at 20 days after rice transplanting; (3) without plant on paddy dykes; (4) cowpea were planted in dykes at 38 days after rice transplanting and (5) mung beans were planted in dykes at 38 days after rice transplanting.

Preparation of Rice Plants :

The fields for rice were tilled using a hoe and hand tractor (two-wheeled tractor). We used seedling of rice Mekongga were transplanted from the nursery when the seedling were 20 days old, with a planting space of 20 x 20 cm. Dead seedling were replaced with rice seedling of the similar variety one week after

transplanting. Compound fertilizer such as NPK with a dose of urea 300 kg/ha; SP36 100 kg/ha and KCl 100 kg/ha was distributed evenly throughout the paddy fields. We used botanical insecticides such as neem seed extract with concentration 50 mL added water 15 L mixed together in sprayer.

Preparation Cowpea and Mung Beans :

The paddy dykes as a space for legume crops (cowpea and mung beans) were cleaning from weedy plant. Seedling of cowpea and mung bean planting in paddy dykes with a planting space 30 x 30 cm. Dead seedling were replaced with cowpea and mung bean seedling from the same variety. Weeds eradication two weeks after planting in paddy dikes. Compound fertilizer used (NPK) 100 grams of fertilizer mixed with water and distributed using sprayer. During the study, we used botanical insecticides such as neem seed extract with concentration 50 mL added water 15 L mixed together in sprayer.

Preparing Botanical Insecticide :

We used neem seeds extract as botanical insecticide that safety for beneficial insects. One kg neem seeds soaked for 12 hours and grinding with added 100 mL of distilled water. Then, extract put in the bucket contain alcohol and 5 gram of soap, stir and bucket sealed. Neem seeds extract is deposited for ± 24 hours. After opened bucket sealed, we stir the extract, filtered and put into the glass bottle. The waste is disposed on safety bags.

Observation and Sampling :

Observation and sampling of predatory insects divided into two rectangular box model with measurement 1m x 1m x 1m, respectively. Each rectangular box model contains 20 rice plants. All of sample observation has a distance 1 m from paddy dikes. First observations of predatory insects once week when the crops reached vegetative stage. Second observation started when rice plant reached the generative stage. Observation for cowpea and mung bean in paddy dikes were made at interval of 3 days.

All of predatory insects were collected with a 12-volt dust vacuum. To avoid flying insects, we used containment was made from 0.5m x 1m x 1.5m PVC pipe framework wrapped in gauze. Vacuuming was performed on the leaves and stem of the rice. Predatory insects keep in the glass bottle contain 70% alcohol. All collected predatory insects were brought to Pest Laboratory for identification using insect identification references by [8,9,11].

Data Analysis :

Data collected were analyzed using ANOVA. Before analysis, the data transform into log (x + 1). The significant difference among treatments was detected then the treatment means were separated using a Duncan's multiple range test at 0.05.

RESULTS AND DISCUSSION

Predatory Insects in Rice Field

Based our observation in rice field, we find more insects than arachnid. Predatory insects including Paederus sp. (Coleoptera: Staphylinidae), Austrogomphus sp. (Odonata: Gomphidae), Orthetrum sp. (Odonata: Libellulidae) and Micraspis sp. (Coleoptera: Coccinellidae). They are common predatory insects in rice field.

Paederus sp. (Coleoptera: Staphylinidae)

Paederus sp. population in rice field were significantly different when age of cowpea and mung bean is 52 and 56 days, respectively. In contrast, the ages of another plant in paddy dikes were not significantly different between treatments (Table 1).

ISSN: 0975-8585

Table 1: Population average of Paederus sp. (Coleoptera: Staphylinidae) in rice field

Treatments	Cowpea and mung beans ages and number of Paederus sp. (days/individual/m^2)		Total average (individual/m^2)
	52	56	
Cowpea in paddy dykes at 20 days after rice transplanting	2	9.5	11.5^{ab}
Mung beans in paddy dykes at 20 days after rice transplanting	1	5.5	6.5^{ab}
Paddy dykes without cowpea and mung beans	2.5	0	2.5^{a}
Cowpea in paddy dikes at 38 days after rice transplanting	5	11.5	16.5^{b}
Mung beans in paddy dikes at 38 days after rice transplanting	1	8	9.0^{ab}

Numbers followed by the same letter at the same column were significantly different (P= 0.05, Duncan's multiple range test).
*Number of predators per 2 m^2

When legume crops on paddy dikes at 52 days, the average of Paederus sp. in rice field were highest in cowpea at 38 days after rice transplanting (5 individual). The lowest total average of Paederus sp. in paddy dykes without plant (2.5 individual).

When legume crops on paddy dikes at 56 days, the average of Paederus sp. in rice field still were highest in cowpea at 38 days after rice transplanting (11.5 individual) than number of Paederus sp. in paddy dykes without plant (0.0 individual). Total average Paederus sp. in cowpea at 38 days after rice transplanting from 52 and 56 days (16.5 individual), more higher than 20 days after rice transplanting (11.5 individual).

Austrogomphus sp. (Odonata: Gomphidae)

Austrogomphus sp. population in rice field were significantly different when age of legumes in paddy dykes at 22 days. In contrast, the ages of another plant in paddy dikes were not significantly different between all of treatments (Table 2).

Table 2: Population average of Austrogomphus sp. (Odonata: Gomphidae) in rice field

Treatments	Total average Austrogomphus sp. at cowpea and mung bean on 22 days (individual/m^2)
Cowpea in paddy dykes at 20 days after rice transplanting	6.5^{a}
Mung beans in paddy dykes at 20 days after rice transplanting	10.0^{ab}
Paddy dykes without cowpea and mung beans	6.0^{ab}
Cowpea in paddy dikes at 38 days after rice transplanting	11.5^{b}
Mung beans in paddy dikes at 38 days after rice transplanting	11.0^{ab}

Numbers followed by the same letter at the same column were significantly different (P= 0.05, Duncan's multiple range test).
*Number of predators per 2 m^2

When cowpea and mung beans on paddy dikes in 22 days, the average of Austrogomphus sp. in rice field were highest in cowpea at 38 days after rice transplanting (11.5 individual) than number of Austrogomphus sp. in paddy dikes without cowpea and mung beans (6.0 individual).

Orthetrum sp. (Odonata: Libellulidae)

Orthetrum sp. population in rice field were significantly different when age of legumes in paddy dykes at 15 days. In contrast, the ages of another plant in paddy dikes were not significantly different between all of treatments (Table 3).

Table 3: Population average of Orthetrum sp. (Odonata: Libellulidae) in rice field

Treatments	Total average Orthetrum sp. at cowpea and mung bean on 15 days (individual/m^2)
Cowpea in paddy dykes at 20 days after rice transplanting	0.0^a
Mung beans in paddy dykes at 20 days after rice transplanting	3.0^a
Paddy dykes without cowpea and mung beans	0.0^a
Cowpea in paddy dykes at 38 days after rice transplanting	1.5^b
Mung beans in paddy dykes at 38 days after rice transplanting	0.0^a

Numbers followed by the same letter at the same column were significantly different (P= 0.05, Duncan's multiple range test).
*Number of predators per 2 m^2

When cowpea and mung beans on paddy dikes at 15 days, the average of Orthetrum sp. in rice field were highest in cowpea at 38 days after rice transplanting (1.5 individual) than number of Orthetrum sp. in treatment with paddy dykes without plant (0.0 individual).

Micraspis sp. (Coleoptera: Coccinellidae)

Micraspis sp. population in rice field were significantly different when age of mung beans in paddy dykes at 36 days after rice transplanting (11.5 individual). In contrast, the ages of another plant in paddy dikes were not significantly different between all of treatments (Table 4).

Table 4: Population average of Micraspis sp. (Coleoptera: Coccinellidae) in rice field

Treatments	Total average Micraspis sp. at cowpea and mung bean on 36 days (individual/m^2)
Cowpea in paddy dykes at 20 days after rice transplanting	6.0^{ab}
Mung beans in paddy dykes at 20 days after rice transplanting	6.5^a
Paddy dykes without cowpea and mung beans	7.0^{ab}
Cowpea in paddy dykes at 38 days after rice transplanting	9.0^{ab}
Mung beans in paddy dykes at 38 days after rice transplanting	11.5^b

Numbers followed by the same letter at the same column were significantly different (P= 0.05, Duncan's multiple range test).
*Number of predators per 2 m^2

Population averages of Micraspis sp. in paddy dykes with mung bean at 38 days after rice transplanting more higher (11.5 individual) than population in mung bean at 20 days after rice transplanting (6.5 individual). However, these treatment not significantly with Micraspis sp. population in another treatment.

DISCUSSION

Paederus sp. (Coleoptera: Staphylinidae)

Table 1 showed that population of Paederus sp. more higher at cowpea 38 days after rice transplanting than another treatments. We assumed at the same time, cowpea in full with flowers before forming seed. This is attractive for more arthropods visited flowers as nectar and pollen sources. It is benefit for predatory insects because one of them as a prey. [6] and [14] state that flowers visited by Coleopteran, Dipteran, Lepidopteran (butterflies) and Hymenopteran (including bees and ants). [20] state that Paederus sp. is effective predators for pest insects in soybean. Based our observation, total Paederus sp. approximately 40.6 individual. [10] and [5] state that Paederus sp. prefer to brown planthopper and green planthopper than another insects.

Austrogomphus sp. (Odonata: Gomphidae)

Based on our observation, population of Austrogomphus sp. more higher at cowpea 38 days after rice transplanting (11.5 individual) than another treatments. At the same time, age plant on paddy dikes is 22 days (Table 2). We assumed that in the observation areas contain irrigation canal contain fresh water suitable for Austrogomphus sp. habitat. [18] and [19] state that female damselflies prefer to fresh water before oviposition. Their function as important predatory insects in nature and has responsibility suppress pest insects in low level. It caused damselflies as important indicator of water and environment qualities. Total Astrogomphus sp. adults in our observation is 45 individual.

Orthetrum sp. (Odonata: Libellulidae)

Based on our observation, population of Orthetrum sp. more higher at cowpea 38 days after rice transplanting (1.5 individual) than another treatments. At the same time, age plant on paddy dikes is 15 days (Table 3). Direct observation using magnifying glass in cowpea and mung beans not given clear information about their presence. Total Orthetrum sp. adult during the study is 4.5 individual. [18] state that damselflies playing important roles as potential biological agents in nature as a nymph (inside fresh water) and adult. [2] and [4] state that damselfly especially Orthetrum sp. can suppress population of rice stemborer (Chilo sp.), brown planthopper and rice bugs in rice field.

Micraspis sp. (Coleoptera: Coccinellidae)

Based on our observation, population of Micraspis sp. more higher at mung beans 38 days after rice transplanting (11.5 individual) than another treatments. At the same time, age plant on paddy dikes is 36 days (Table 4). Direct observation using magnifying glass in cowpea and mung beans, a few population of Micraspis sp. during research. Total Micraspis sp. adult in our study is 39.5 individual in 20 sample. [2], [12], [13] and [15] state that lady bird beetle or Micraspis sp. playing important roles as potential biological agents for aphids in vegetable crops. Their habitat in in stem of crops or weedy plants as a shelter and source of food. [19] giving example, Coccinellids Micraspis lineata active in daily and suppressed population of rice stemborer (Chilo sp.), brown planthopper and rice bugs in rice field. Larvae of M. lineata can fed 5 – 10 brown planthopper nymph and adult fed 10 – 12 nymph in 24 hours.

CONCLUSION

The total highest population of predatory insects in cowpea at 38 days after rice transplanting is Paederus sp. with average 16.5 individual; Austrogomphus sp. (11.5 individual) and Micraspis sp. (9.0 individual), respectively. The lowest number of Orthetrum sp. in similar plant with average 1.5 individual. In contrast, mung beans at 38 days after rice transplanting showed the highest population of Micraspis sp. (11.5 individual) and lowest population in Orthetrum sp. on same age (0.0 individual).

ISSN: 0975-8585

ACKNOWLEDGEMENTS

Our sincere appreciation to Dr. Sri Nur Aminah Ngatimin for critically read the early version of the manuscript. We are also grateful to our student Ramlah and farmers in rice field for helped during the research.

REFERENCES

[1] Abdullah T, Ahdin G, Sri NAN, Nurariaty A and Abdul F., 2015. Impact of Different Time Planting in Soybean and Neem Seeds Extracts Application to Insects Population on Rice Field. International Journal of Scientific Research and Technology, 4(10): 62-65.
[2] Bàrberi P. , Burgio G. , Dinelli G. , Moonen A. C. , Otto S. , Vazzana C. and Zanin G., 2010. Functional Biodiversity in The Agricultural Landscape: Relationships Between Weeds and Arthropods Fauna. Weed Research, 50:388-401.
[3] Bhattacharrya B, Basit A and Saikia DK., 2006. Parasitoids and Predators of Rice Insect Pest of Jorhat District of Assam. J. Biol Control 20(1): 37-44.
[4] Capinera JL., 2001. Handbook of Vegetable Pests. San Diego: Academic. 729 p.
[5] Chiu S., 1977. Biological Control of Brown Planthopper, Nilaparvata lugens Stal. Proc. of The International Rice Research Institute. Los Banos, Laguna Philippines.
[6] Gullan PJ and Cranston PS., 2000. The Insects : An Outline of Entomology 2nd Ed. Blackwell Science Ltd., USA.
[7] Heinrich AE, 1994. Biology and Management of Rice Insects. IRRI. Los Banos, Laguna Philippines.
[8] Hill DS., 1994. Agricultural Entomology. 635 p. Timber Press Portland, Oregon USA.
[9] Kalshoven LGE., 1981. The Pests of Crops in Indonesia (Translated and Revised by P.A. van der Laan). PT. Ichtian Baru-van Hoeve, Jakarta, Indonesia. 701 p.
[10] Kartohardjono A and Soejitno J., 1987. Planthopper Natural Enemies. Nilarvata lugens Stal on Rice. Proc. National Seminar Indonesian Ministry of Agriculture, Jakarta.
[11] Kristensen NP, Naumann ID, Carne PB and Lawrence JF., 1991. The Insects of Australia: A Textbook for Students and Research Workers. CSIRO. Melbourne University Press, Carlton-Victoria, Australia.
[12] La Daha, Amin N and Abdullah T., 2016. The Study on The Roles of Predator on Asian Corn Stemborer, Ostrinia furnacalis Guenee (Lepidoptera: Pyralidae). Online Journal of Biological Sciences 16(1): 49-55.
[13] Landis DA, Wratten SD, and Gurr GM., 2000. Habitat Management to Conserve Natural Enemies of Arthropod Pests in Agriculture. Annual Review Entomology 45:175-201.
[14] Lin GT, Tay EB, Pang TC and Pan KY., 1992. Biologi, Ecology and Control of Cocoa Pod Borer, Conopomorpha cramerella (Snellen) and It's Control in Sabah Malaysia. Proc. of The Internasional Conference of Plant Protection in The Tropics, MAPPS Kuala Lumpur. pp. 69-72.
[15] Nentwig W., 1998. Weedy Plant Species and Their Beneficial Arthropods: Potential for Manipulation in Field Crops. In: Enhancing Biological Control: Habitat Management to Promote Natural Enemies of Agricultural Pests" (C.H. Pickett and R.L. Bugg, eds.). pp. 49-67. University of California Press, USA.
[16] Rahayu M, Taufik M, Karimuna L and Khaeruni A., 2015. The Biology of Black Ladybug (Paraeucosmetus pallicornis Dallas): A New Pest on Rice in Southeast Sulawesi. Australian Journal of Basic and Applied Sciences. 9(23): 282-286.
[17] Rauf A., 1996. Ecosystem Analysis in IPM. Proc. National Seminar of Plant Protection.
[18] Susanti, S., 1998. Introduction Odonata. Biologi Research Centre-LIPI Cibinong-Bogor.
[19] Shepard BM, Barrion AT and Litsinger JA., 2000. Beneficial Insects, Arachnids and Pathogens. Los Banos. International Rice Research Institute, Philippines.
[20] Taulu LA, 2001. Paederus fuscipes Curtis Predator on Soybean and Their Roles in Environment. IPB Bogor.
[21] Valenzuela H dan Smith J., 2002. Cowpea. College of Agriculture and Human Resources University of Hawaii, Manoa.
[22] Warouw DT, Sembel D and Watung JW., 1997. Control of Paraeuscosmetus sp. (Hemiptera: Lygaeidae) in Rice (Oryza sativa) at North Sulawesi. Indonesian Entomology Society.