The Effect of Refugia Block of Long Bean (*Vigna cylindrica*) on the Arthropod Diversity and Composition

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Abstract-Rice pest is being a probem that should be treated effectively and efficiently. Recently, pestiside takes a role in negative impact towards ecosystem, give a reason itself to find a pest controller innovation. Started before entering the era of agricultural intensification, local wisdom of Indonesian farmers have used refugia block as microhabitat which decrease population number of pest insect by increasing insect natural enemies roles in crop field. This research was going to study insect abundant, community strusture, species diversity, and the similarity between refugia plot and non refugia plot of certain crop field in Desa Tunjungtirto, Kecamatan Singosari, Kabupaten Malang. The method used is visual control towards incoming insects in crop field. The data are taken in vegetative and generative phase within trice a day in each plot for 15 minutes in each period. Insects abundants are recorded as much as 672 individuals, contains of 13 orders with 44 families. 5 higher frequencies of families belongs to Alydidae, Culicidae, Anthomyzidae, and Acrididae, with higher importance value index on Alydidae (32.68%). The highest insect diversity is found in the vegetative phase of cowpea plot in medium until 2-3 high category. Avarage similarity of of insect composition shows its low similarity rate. Found insect fuctional status contains from predator (42%), herbivore (40%), pollinator (17%), and parasitoid (1.5%). Decreasing insect pest population on refugia plot indicates a significant role of pest natural enemies. Based on these results, refugia is being recommended as a habitat manipulation.

Keywords- insect, refugia, visual control, community structure, crop field, population

I. INTRODUCTION

The diversity and composition of Arthropods is very important to maintain the balance of the ecosystem, including an agroecosystem [1]. Arthropods have important roles in paddy filed ecosystems as pollinators, natural enemies and decomposers. One of the efforts to preserve the diversity and composition of Arthropods in paddy fields is to permeate refugia blocks. The refugia block is a microhabitat that provides temporary shelters for natural enemies of pests, such as predators and parasitoids, and helps biotic interactions such as predation and pollination [2]. Refugia blocks on farmland are applied by allowing or growing local plants that provide shelter, feeding resources and resources for natural enemies [3]. Refugia blocks may be made either at the edges or within the cultivated area [4]. The presence of natural enemies can suppress pest populations that cause damage to rice cultivation [5].

Refugia is a microhabitat that provides temporary shelter for natural enemies of the pests, like predator and parasite, and help the biotic interaction such as polination [2]. This specific area also can provide an alternative host and additional food for the imago of the parasite when in unsuitable conditions [5]. Good engineered microhabitat is made either on the edge or inside the crop field [4]. The presence of the predator can suppress the population of the pests that caused damage to the rice cultivation [5].

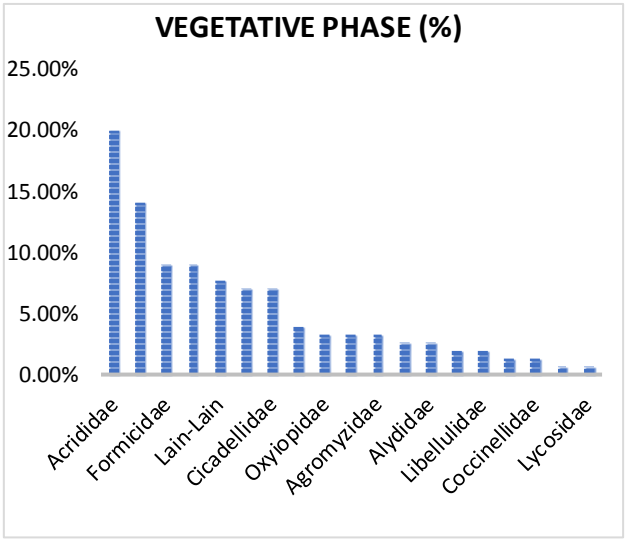

Figure 1 Relative Abundance of visitor insects on control vegetative phase

Research on refugia blocks has been done in Malang [6], apple orchard [7,8,9,10] as well as on paddy fields [12,13,14,15]. Types of plants commonly used are wild plant species such as *Pocota* sp., *Eristalis tenak, Cyperus rotundus, Capsicum frutesens, Bidens pilosa, Mimosa pudica, Vernonia cinera, Marsilea crenata, Pistia startiotes, Commelina difussa, Ageratum conyzoides, Chromolaena odorata, Brachiaria mutica, Panicum repens , Vetiveria zizanioides and Ipomoea crasicaulis*. The use of wild plant species is often less successful because farmers consider wild plants as weeds that compete with main

crops [12, 16]. Recently, study conducted a search for the type of plant that acts as refugia as well as can be utilized by farmers. The plant species ever used is *Zae mays* [17]. Based on this, this study analyze the relative abundance, community structures, diversity, and refugia effects on the pattern of Arthropod visits, on the Long Bean (*Vigna cylindrica*) grown on the edge of paddy fields.

II. MATERIAL AND METHOD

This research was held on June-July 2016 in certain a paddy field in Singosari Sub-district, Malang District, East Java, Indonesia. The Arthropods were observed three times a day (morning, noon and afternoon) using visual encounter survey method on both vegetative and generative phase in each refugia block. The refugia plant used was the long beans (*Vigna unguiculata*). This species was planted along small dike in a side of paddy field. The block size was 0.5 x 2 meter square. Observations of Arthropod visitors were made by observing the blocks recording all Arthropod families and abundances during a 15-minute period. When species identity was not determined at the time of observation, specimens were collected and taken back to the laboratory for identification. Further identification was done in Animal Diversity Laboratory of Biology Department, Brawijaya University.

Arthropod community structure were analyzed with parameter of importance value index, diversity index (Shannon-Wiener Index), and community similarity (Bray Curtis Index) done with PAST program. Comparison of individuals average of each block and insect differences between refugia block and control treatment was observed to analyze refugia block effect. Last, both effects of abiotic factor and insects ecological roles were explained descriptively.

III. RESULT AND DISCUSSION

There were 668 individuals of Arthropod belong to 43 families observed visually consisted of 212 individuals during vegetative phase and 117 individuals during generative phase in Refugia blocks and 339 individuals in grasses (control). There were in control 29 families during vegetative phase (figure 1) and 16 families during generative phase (figure 2); while those in refugia block, there were 19 families during vegetative phase (figure 3) and 21 families during generative phase (figure 4). Culicidae, Alydidae and Acrididae were dominated the sample composing of 12.8 % of total individuals in Refugia blocks and 18.1% individuals in grasses. The other dominant families were Drossophilidae, Cicadelidae, Tipulidae, Formicidea, Agromyzidae, and Tephritidae (Table 1).

Importance Value Index shows the effects of a family of insect towards community structure of an ecosystem. Importance value Index up to 10% indicates a domination. During vegetative phase, the highest IVI in the refugia block was belong to Anthomyzidae (14%), followed by Culicidae (14%) and Acrididae (11.2%); while that in control was belong to Acrididae (26.5%), Drossophilidae (20.8%), Formicidae (15.7%) and Culicidae (15.7%).

During generative phase, the highest result of Arthropod in the refugia block was Alydidae (32.7%). This number was followed by Culicidae (20.7%), and Formicidae (16.4%). That in control was dominated by Drossophilidae (20.8%), Formicidae (15.7%) and Culicidae (15.7%).

Table 1 Important value index in each rice field blocks

NO	FAMILY	RV (%)	RG (%)	CV (%)	CG (%)
1	Cullicidae	14.01	20.71	15.64	19.10
2	Acrididae	11.20	4.34	26.54	13.69
3	Drossophilidae	10.27	13.88	20.77	15.85
4	Cicadelidae	9.80	12.17	13.72	13.69
5	Tipulidae	6.06	6.97	13.72	18.01
6	Formicidae	7.00	16.44	15.64	8.28
7	Agromyzidae	9.80	11.31	7.65	10.99
8	Tephritidae	7.00	13.88	10.51	10.45
9	Alydidae	-	32.68	7.01	24.50
10	Anthomyzidae	14.01	3.49	-	2.58

Diversity Value Index was highest during vegetative phase on refugia block (2.92), while the lowest was during vegetative phase on control block (2.57). All the diversity was fall in medium level (value 2-3).

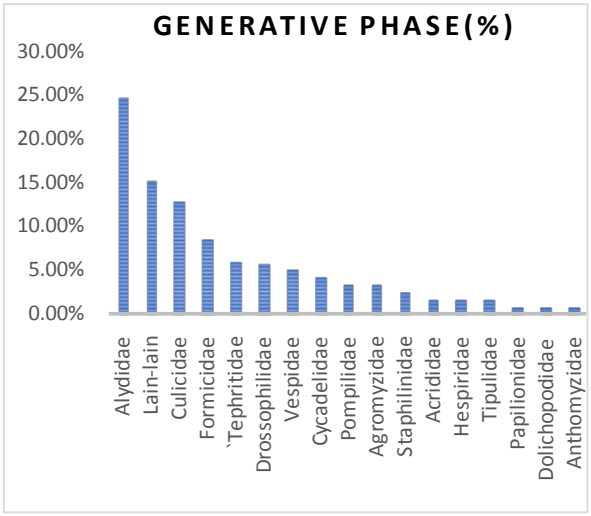

Figure 2. Relative Abundance of visitor insects on control generative phase

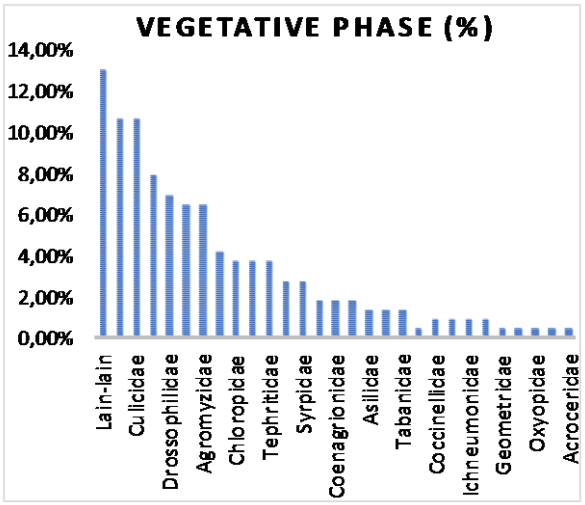

Figure 3. Relative abundance of visitor insects on refugia rice field vegetative phase

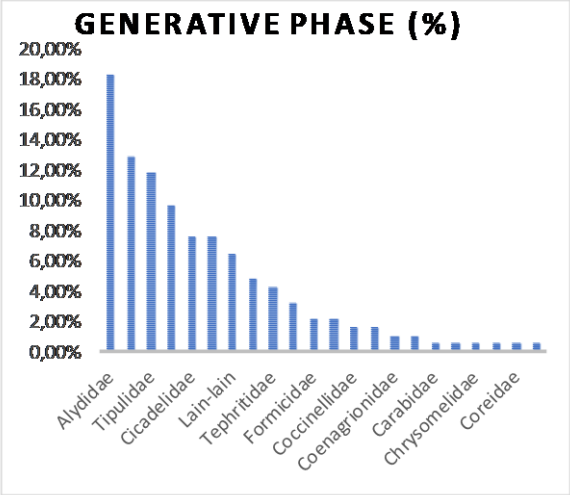

Figure 4. Relative abundance of visitor insects on refugia rice field generative phase

Result of the cluster analysis showed that Arthropod visitors were assemblage according to treatment. Family similarity was greater between the Arthropod visitor compositions in the control. The highest similarity of insects composition is found between generative phase on control field and vegetative phase on control field. It provides subtitutive properties at different time. Composition of predators was slightly dominant in refugia block (42%) compared herbivores (40%); while that in control block was vice versa. It was dominated by herbivores (59.4%), while predators were 20.59%.

Observation results show that Acrididae, Drossophilidae, Formicidae and Culicidae were among the dominant families during vegetative phase. Acrididae showed the highest percentage of relative abundance value in control blocks. Acrididae is common in grassland vegetation [1, 18,19]. It is predicted due to Acrididae food gathering behaviour, when vegetative phase of rice field provides more suitable food for this family of insect. Not only that, high population rate of Acrididae was caused by low population of insect predators. Therefore, Acrididae has less threat and its frequencies were burst out.

Alydidae, Drossophilidae, Culicidae, and Formicidae were among the dominant families during vegetative phase. High population of Alydidae in phase caused by vegetative phase of rice field provides more suitable food for Alydidae. The high Alydidae abundant in the refugia block indicate that this family attacked the refugia plant (Long Bean). Also, less predators for Alydidae causes this herbivore insect more abundant [12].

This study showed that the effect of refugia block on the diversity of Arthropod visitors. Compare to the control blocks, refugia block seem to balance the composition between predator and herbivores. The observation shows that not only herbivore, but predator and parasitoid also take a role on crop field without refugia. This result indicates that the composition structure of Arthropod is well distributed. Refugia provides a new shelter and hiding place for predators. Several predator families were found in this study including Oxyopidae, Tettigoniidae, Syrphidae, Aeshnidae, Coenagrionidae, Coccinellidae and Libellulidae. Paddy field with refugia block attracted several natural enemies such as Coccinellidae, Aeshnidae, Syrphidae, and Ichneumonidae [6]. Among the predators, Odonata is one of the important in paddy field [17, 19].

The diversity of Arthropod in all blocks was considered medium. This situation indicated relatively medium environment stability. Therefore, the interactions between species are high. High diversity in a ecosystem indicates a stability of a living environment [20]. Arthropod diversity is seldom to reach more than 3 [6,13]. This may be caused by analysis at family level. Diversity of Arthropod in the refugia blocks indicate that this block support paddy field community diversity. Diversity of Arthropod in the paddy field was higher than in control blocks [13].

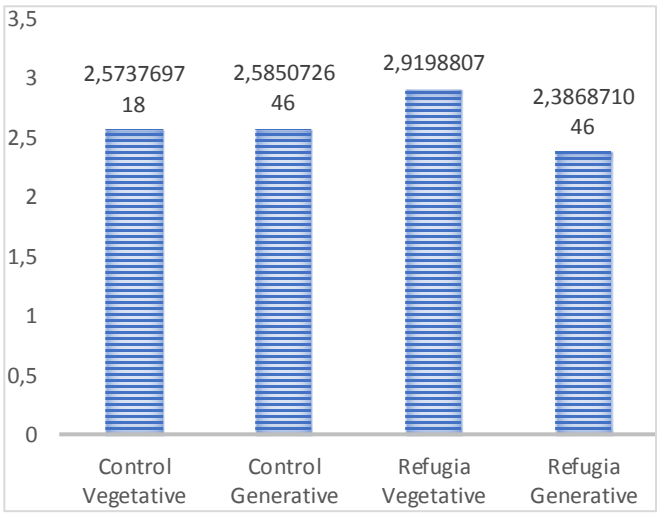

Figure 5. Diversity Index in each rice field blocks

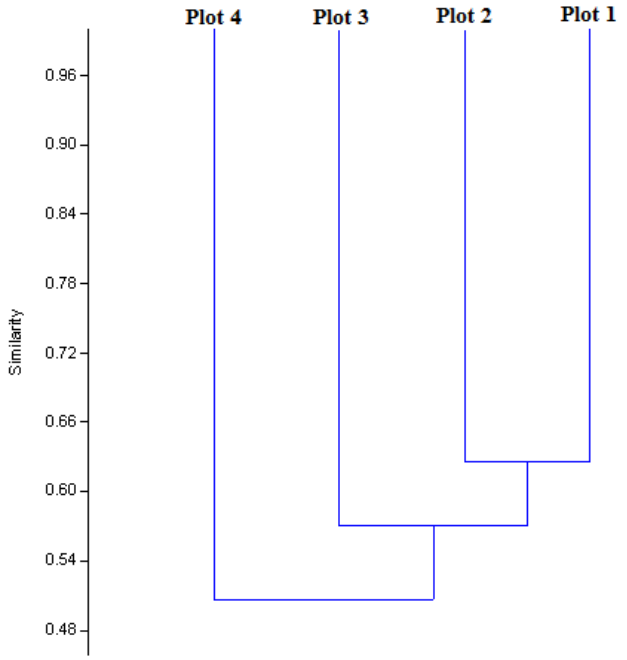

Figure 6. Dendogram similarity level of insect compotition base o n *Bray Curtis* Index

The Arthropod was most abundant in the morning (09.00-10.00), decreased in the noon (12.00-13.00) and increase again in the afternoon (15.00-16.00). In the morning, the humidity and light intensity are almost the same as evening. High abundace of predators is predictedly caused by refugia plant which have striking organs that attract the predators to come.Predator's abundance indicates its prey abundance. But not only predators, it also can be effected by chemical substances and plants species. More number of insects visited the flower during late morning hours (09.00-10.15) followed by a sharp decline afterwards the noon. Variation in the abundance and diversity associated with resource abundance and temperature [18, 21]. Other study also showed the most favorable range of temperature has been 25ºC to 35ºC for the visits of pollinators on the blossom of *Z. mauritiana*.

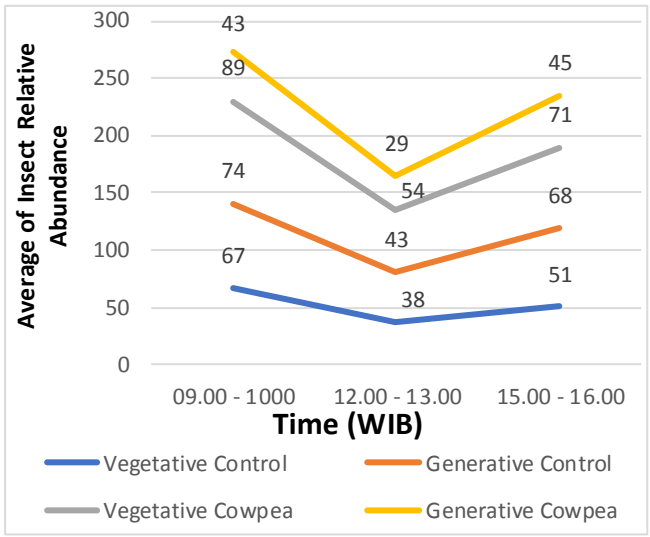

Figure 7 Average of insect relative abundance in field rice blocks in each visual control periods

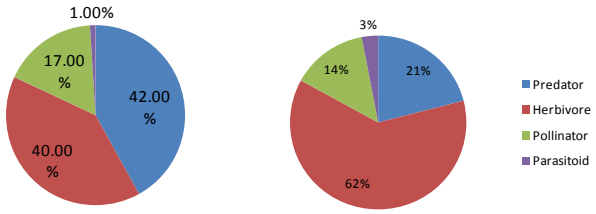

Figure 8 Average of insect relative abundance of Arthropod functional status in Refugia block (left) and control (right)

Abiotic factors are important to affect some varieties of insect to come. At the day, high intensity of light and temperature cause the insects rarely to come. This might happen due to adaptical behaviour of insects towards the sun light. This adaptation allows insects decrease the dehidration inside the body. But, some observations show the light intensity and temperature during the day (12.00-13.00) are lower than the morning observation (09.00-10.00). These phenomena are predictedly caused by natural anomalies, cloudy, windy, and plant's canopy.

CONCLUSION

This study concluded that the refugia blocks support family richness and diversity of Arthropod visitors. These refugia blocks contribute to balance composition between predator and herbivore. The Arthropod was peak in the morning.

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