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The role of ants (Hymenoptera: Formicidae) in rice field

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Abstract. The purpose of the research is to determine the role of ant population and their activities consuming food provided in rice field. Experimental research was held in Tanasitolo village, Wajo district, South Sulawesi Province, Indonesia. Based the observation and identification we find four ant species as predator of insect pests at rice field namely: *Pheidologeiton diversus*, *Anoplolepis gracilipes*, *Solenopsis geminata* and *Dolichoderus thoracicus*. The different species of ant in rice field representing their survival ability. The result of research is very useful information for management *S. geminata* as potential predator for improving rice harvest especially in Tanasitolo village.

1. Introduction

The agricultural sector plays a vital role in contributing to the Indonesian economy, trade surplus, and the primary source of domestic consumption [1]. Many efforts of increasing food productivity for especially staple food such as rice are needed to ensure national food security. Increasing rice productivity is very important increasing farmer income and subsequently contributes positively to economy of the country. South Sulawesi is one of the provinces mainly producing rice in Indonesia. As producers of rice, pest infestation is one of main problems in reducing quality and quantity of yield. There are several important types of pests attacking rice plant such as: rice stem borer, brown planthopper, green planthopper [2] and rice grain bug *Paraecosmetus pallicornis* Dallas (Hemiptera: Lygaeidae) found in South Sulawesi [3]. The application of pest control, for example using of predaceous arthropods is still developed. Predaceous arthropods niche to rice canopy including spiders, such as Lycosidae, Salticidae and Tetragnathidae. A group of spiders is an effective predator for insect pest in soil surface i.e. Carabidae and Formicidae and other family insects are as well [4, 5].

Ant (Hymenoptera: Formicidae) has colony with abundant population and various types of agroecosystem. Formicidae as the natural enemy is the one important family predator for several crops including rice. Based on the proportion abundance of predaceous arthropods found on soil surface in some seasonal plants, the ant population occupies the first rank. The abundance of ants at the ground level in the sweet potato crop reached 66.92%, in chili plantations 45.13%, and in maize plantations reached 54.52% [6]. Ant colonies have several advantages as potential predator for established through conservation and effectively control rice pests. For instance, (a) ant colonies have foraging behavior, carrying food to the nest and this activity can control pest population led. (b) they are classified as social insects [7] which mean to have a clear job description and morphological structure to every caste i.e. worker, soldier and queen. Job description and morphological structure have a special character in hunting larvae of rice stem borer or large larvae. The role of soldier ant caste is to



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paralyze and attract prey. The caste of worker ants is to find, handle a small prey and the caste of soldier is to carry prey into the main nests. (c) Once prey is unavailable or low population, ant colonies can still survive by eating grass seeds, or deliberately given feed [8]. (d) Habitat of the colonies in the rice fields less disturbance of rice harvesting and tillage activities allows it to control pest population and to conserve ant colonies.

The diversity and benefit of ant in many plantation ecosystems have been widely reported. In cocoa plantation, weaver ant (*Oecophylla smaragdina*) and *Iridomyrmex* sp. are important predators for cocoa pod borer (*Conopomorpha cramerella Snellen*) [8, 9]. Black ant *Dolichoderus thoracicus* are reported to repel *Helopeltis* sp. Weaver ant also preys on various pests such as green ladybugs, leaf-eating caterpillars, fruit-eating caterpillars, ticks on *Anacardium* sp. and oranges [10]. According to Yudiyanto et al. [11] suggested that there were 28 ant species associated with pepper plants. *Solenopsis* species living in rice field is important predator for stemborer, grasshopper and caterpillar [7, 10, 12, 13]. Way et al. [14] stated that predacious ant has abundant population in the tropics and in the rain forest the population may represent between one third and half of insect biomass.

Ecosystems in rice cultivation areas are often by harvesting activities, puddles, application of pesticides and tillage. Conversely, the condition surrounding of the habitat is relatively stable, never flooded, rarely planted and never cultivated. Dyke is a square structure of rice field as the boundary of land between cultivation and other places such a village road or forest. In the regency centers of rice planting in South Sulawesi, the boundary is usually from 40 to 60 cm width. As the boundary, it can be a reservoir for various types of predaceous arthropods such ant species to further colonize rice crops and prey on rice pests when rice plants are available [3, 4].

The use of rice field's boundary for conserving arboreal predatory arthropod can be undertaken by providing flowering plants as refugia plants, for example soybean growers, green beans and cowpea or other flowering plants [4, 6]. The integration of the performance of arboreal predators with predaceous ground-level insects i.e. ant in the rice fields is necessary before the pest population initiates to increase. Predaceous ant from rice field can be pursued by increasing population and dispersing them. Conserving and increasing the ant population are only achieved by providing protection such as nest and supplementary food [8, 9, 15]. Therefore, this study focused to determine the abundance of ant and their activities in consuming food provided for integrated pest control management in rice plantations in Indonesia.

2. Material and methods

The field experiment of abundance of ant population and activities was conducted during dry season (May-September) at Tanasitolo village, Wajo district, South Sulawesi Province, Indonesia. This study focused on the abundance of ant at rice field and their activities/preferences in different food.

2.1. Presence of ant and their role in rice field

The abundance of ant population was observed using 80 pitfall traps at rice field. Pitfall trap was made from plastic cup (diameter 8 cm; height 10 cm), about half of its volume filled with alcohol 70%. Each pitfall trap was installed by digging a hole in the surface of the boundary surrounding of rice field. The pitfall trap was lip about 1 cm higher than the ground to avoid waterlogged holes. Around the pitfall trap lip are grounded and flattened surface arthropods can still be trapped inside. To reduce disruption of water drop, above each pitfall trap was fit with a roof (length 20 cm) from immature banana stems. This activity was carried out 20 rice fields and each patch of rice fields was only used by one of boundary, with minimum length 20 m. Each boundary at rice field was applied four pitfall traps with a distance about 4 m from each other [4, 5]. The installation of the pitfall trap was carried out about 2 weeks before rice transplanting and all rice fields sprayed pesticides by farmer. Pitfall trap was left on boundary for 24 hours. After 24 hours, pitfall trap was removed, all trapped arthropods and their liquid from each glass was transferred into each small collection bottle for identification in the laboratory. Observation abundance of ant and their activities began when one to ten weeks after transplanting with seven days interval of observation. Additional data were collected once after harvesting.

2.2. Type of ant

The observation was carried out directly by observing type of ant and their activities in the rice field. Observation was carried out to the natural ant nest found on the boundary then measured their temperature and humidity by placing the thermohygrometer near the natural nest. Data from the tool was recorded. Identification of ant species used microscope and literature [7, 10, 14].

2.3. Dominant ant preferences and food consumption

After received information about dominant ant as a predator in rice field, the observation continued to the next step. The experiment was observed the activities of ant in consuming three different types of food: dry fish whole meat and bones were roughly crushed; chicken duodenal loop was dried in two hours then cutting into small pieces with length about 3 – 5 mm and crushed dry shrimp, respectively. Each type of food was weighed as much as 5 g used a circular paper (diameter 12 cm). The three types of food were placed randomly in circular paper with distance about 50 cm around natural nest of the most dominant ant species found in observation of boundary in rice field. All of food was exposed to the sunlight for 30 min. The experiment commenced in the afternoon with observation about 30 min. The parameters including : a) time searching and manage food by ant (min) and b) the preference and amount of each food by ant over a period (g). The experiment was arranged in a Randomized Block Design used three treatments with nine replication.

2.4. Data analysis

Collecting data were analyzed using ANOVA. A significant difference among treatments was detected then the treatment means were separated using a Duncan's Multiple Range Test at 0.05.

3. Result and discussion

3.1. Ant species in rice field

Rice field has a different condition-based water content, management land and type of rice. There was a general trend that the greatest population of *S. geminata* was found in boundary than another ant population. Based the result of observation and identification we find four species of ants at boundary surrounding rice field namely: *Pheidologeiton diversus*, *Anoplolepis gracilipes*, *Solenopsis geminata* and *Dolichoderus thoracicus* [7, 10, 14].

3.2. *Pheidologeiton diversus*

The result of observations at boundary of rice field, the activity of *P. diversus* began when the sunlight increasing soil temperature around 30.8°C and RH about 82%. The *P. diversus* started activities by picking up young weeds and bringing it to the nest. In boundary that are not flooded with temperatures 34.4°C and RH 53%, *P. diversus* carried a stem borer larva found in rice into the nest. At temperature of 32.8°C with RH 60%, it is seen in waterlogged fields, *P. diversus* bring to the nest the snail eggs found in the clumps of rice plants. The ant used dead weeds as a bridge from the boundary to the rice clump. Commonly at temperature of 31.8°C with RH 70%, *P. diversus* built natural nest on boundary from small weeds family Poaceae. In general, the nest on dry land built with coarse earthy clumps, containing grayish gray sand. Ant digging and lift the soil to the surface formed small tunnels with natural nest diameter around 2 to 4 mm. When RH about 72%, *P. diversus* leaving natural nest and brings their eggs to the higher areas. According to Ramos *et al.*; Way and Khoo [9, 11] *P. diversus* is one of active ant species in rice field. The colony is able to suppress presence of some important pest in rice field.

3.3. *Anoplolepis gracilipes*

The natural nest observation with a temperature 29.3°C and RH about 72% was showed nest of *A. gracilipes* under banana plant with a distance of about 1 m from the other banana tree and coconut tree

contained many wood piles. In the formation of natural nests, the ants digging and made some holes in the ground. The diameter of natural nest of *A. gracilipes* around 2 - 4 mm [2, 10].

3.4. *Solenopsis geminata*

S. geminata colony was dominant ant species at rice field. The ant built nest made from cassava plant with clay sandy soil with 28.2°C and RH 79%. The colony dig the soil with 2 mm diameter. *S. geminata* killed small grasshopper and brought to the nest [10-15].

3.5. *Dolichoderus thoracicus*

D. thoracicus was active in rice fields and the colony moved rapidly and foraging separately. the colony moved around of the rice fields. The nest built was found waste coconut trunk [10, 13]. The observation was undertaken at 29.2°C and RH 72%.

Detecting ant diversity shown that number of Formicidae species was higher than another arthropods family. The findings suggested that *S. geminata* is the important predator in rice field with higher population [14, 15]. The main reason is that *S. geminata* has a big size than another ant species, and the second many arthropods such as grasshopper, leafhopper and especially rice stem borer larvae available throughout the year. The availability of natural prey in rice field provides more food for predaceous arthropods surrounding rice field. It is known that *S. geminata* as important predator for crops pest and spread in many areas in tropics [10].

3.6. *S. geminata* activities in different food

The boundary of rice field was a suitable habitat for many arthropods including pest and natural enemies. *S. geminata* species had the highest population in observation. The result preference of three different food by *S. geminata* was shown in figure 1.

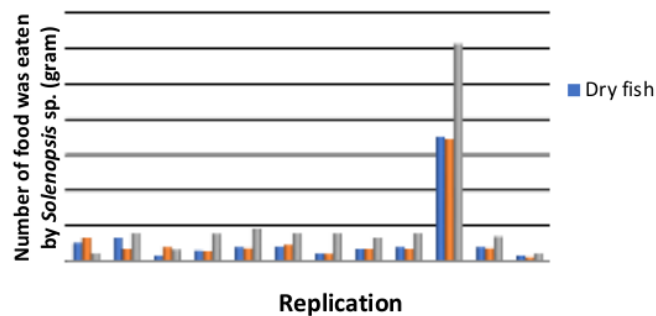


Figure 1. Preference of *S. geminata* in three different kinds of food

Figure 1 shows that *S. geminata* preferred dry shrimp to dry fish and chicken duodenal loop. The finding suggested that dry shrimp has a strong taste and much more protein than another food. Structure of dry fish easier feed than dry fish and chicken duodenal loop [10]. The piece of chicken is difficult for ant to be preferred due to a hard and slightly structure. Also, smell of the chicken material is not strong enough when compared to dried shrimp. Ant was used the antenna and foreleg to detection presence of food and their content. It is expected that smell of the food is main reason of *S. geminata* attractant. The result of time needed at food consumption by *S. geminata* was shown in figure 2.

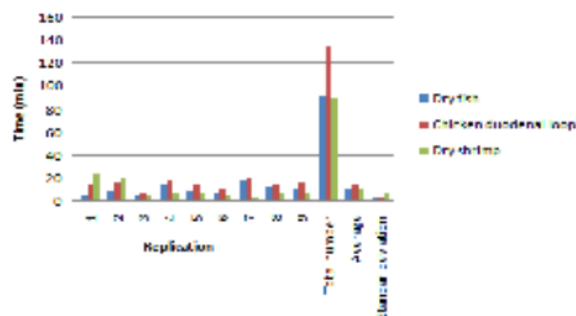


Figure 2. Time of food consumption by *S. geminata*

Figure 2 demonstrates that consumption time of *S. geminata* varied. This predaceous insect spent more time in dry shrimp (25 min), followed by chicken duodenal loop (21 min) and dry fish (18 min), respectively. *S. geminata* shown to eat dry shrimp faster than chicken duodenal loop and dry fish. According to [Pudiyanto et al., \[11\]](#) states that the diversity and community structure of ant is influenced by the availability of food and protection. The moisture of soil surface in paddy dykes perhaps provided sufficient environmental protection for *S. geminata*. Relative scarcity of food sources and survival ability in the rice field was found to have much lower population numbers of another ant species than others.

4. Conclusion

The difference species of ant in boundary of rice field represents their survival ability. This result of research is very useful information for management presence of *S. geminata* as potential predator for improving rice harvest in Tanasitolo village.

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