

Abiotic environment of *myopopone castanea* (hymenoptera: formicidae) in oil palm plantation

Widihastuty^{1,2}, MaryaniCyccu Tobing³, Marheni³, RetnaAstuti Kuswardani⁴

¹ Dept of Biology of Mathematics and Natural Science Faculty of Dian Nusantara University, Medan

² Doctoral Program of Agricultural Science of Sumatera Utara University, Medan

³ Dept of Agrotechnology of Agriculture Faculty of Sumatera Utara University, Medan

⁴ Dept of Agrotechnology of Agriculture Faculty of Medan Area University, Medan

ABSTRACT

Ants are social insects which widespread and play many important roles in an ecosystem. *Myopopone castanea* ants are predator for the pre-adult stage of pest *Oryctes rhinoceros* which is one of the important pests in oil palm plantations. At the oil palm plantations, *M. castanea* and pre-mature stadia from pests *O. rhinoceros* live on decaying palm oil stems. This study aimed to explore the existence of *M. castanea* ants in oil palm plantations and measure the parameter of abiotic environment in the ant nest in order to mass rearing of *M. castanea* ants. Study was carried out in the laboratory to support the natural enemy augmentation program in biological control of *O. rhinoceros* pest. The exploration of ant nests took place in smallholder oil palm plantations in Tanah Merah sub-district, Binjai Selatan Subdistrict, Binjai city, North Sumatra Province. The results showed that the temperature range obtained at the ant nest was 28-31⁰ C, the humidity was 68-75%, the pH range was 5.9-7, and the weathering rate (C / N ratio) was 33.93-92.34 %. A suitable abiotic environment will support life and mass rearing of *M. castanea* ant colonies.

Keywords: abiotic environment, *Myopopone castanea*, oil palm, mass rearing

INTRODUCTION

In an ecosystem, ants occupy various ecological niches and play an important role such as acting as pollinators, predators for herbivorous insects and scavengers. The role of ants as predators in an ecosystem has been widely reported (Yamazaki, 2010; Dassou et al., 2015; Oliveira et al., 2012). Various species of ants are widely used as biological agents for the pest control in the plantation crops, such as weaver ants (*Oecophylla smaragdina*) that is able to prey on nettle caterpillars (*Setoranitens*) at the high level of predation reached 83% (Falahudin, 2013, Nurdiansyah, 2016). *Dolichoderus thoracicus* can suppress the attack of *Helopeltis* sp on cocoa plantations in Sulawesi (Anshary and Pasaru, 2008). The surrounding environment can affect the presence and abundance of

ant populations. Ants were a sensitive organism to the alteration within their environment, including organisms that are very sensitive to changes that occur in their environment (Latumahina et al., 2015).

Myopopone castanea (Hymenoptera: Formicidae) is an ant from the *Amblyoponinae* family, most of these ants are predatory ants (Ito, 2010). In Indonesia, these ants are the predator of *Oryctes rhinoceros* (Coleoptera: Scarabaeidae) pest which is one of the important pests in oil palm plantations (Marheni, 2012; Junaedi et al., 2014; Widihastuty et al., 2018). These ants attacked the premature stage of *O. rhinoceros* (larvae and pupae). *M. castanea* ants are widely found in forests, temperate regions, or in the tropics. In hot regions, these ants live in the soil (Wilson, 1971). In the palm plantations, *M. castanea* ants can be found on fallen palm stems and have decayed due to the aged or because of stem rot. *O. rhinoceros* larvae on the palm plantations usually also lived on the decayed palm trunks and in a pile of organic. The similarity of the living niche between *M. castanea* and *O. rhinoceros* larvae provided a great opportunity to utilize these predator ants as the potential biological agent for *O. rhinoceros* pest through natural enemy augmentation program. As mass rearing of a biological agent, it was necessary to understand the various ecological aspects of the natural enemy. Information about the ecological aspects of the *M. castanea* ant, especially those that encompassed the abiotic environment of ants in the palm plantations did not exist, yet. Therefore, it needs to explore some information about the ecological aspects of ants *M. castanea* in the field, especially about the microhabitat of ants in the palm plantations, hence it can be applied to the mass rearing of these ants in the laboratory.

MATERIALS AND METHODS

The study was conducted from February to July 2018 with the exploration methods in the smallholders' palm plantations in the area of Tanah Merah sub-district, Binjai Selatan District, Binjai city, North Sumatra Province.

The Ants Nest Exploration

Seeking the *M. castanea* ant colonies was carried out 10 times in the smallholders' palm plantations. *M. castanea* ants in the palm plantations were living on the fallen and decayed trunks and stumps of the palm stems due to the aged or die of stem rot. The decayed palm stem or stump cut into pieces and chopped up to find ant colonies (Figure 1) if the ant colonies found then a thermometer, humidity (Hygrometer) and pH (pH meter) were plunged into the ant nests to measure the *abiotic* environment in ant nests. After the *abiotic* factor measurement was recorded and completed, the ants were compiled and put into

a plastic box included the pieces of palm oil stem where the ant nests placed and taken to the USU Faculty of Agriculture's plant pest laboratory of Sumatera Utara University for mass rearing.

The pieces of palm oil where the ant nest was then analyzed the C/N ratio in the laboratory of PT Nusa Pusaka Kencana Asian Agri, Medan. The obtained results were tabulated and analyzed statistically.



Figure 1. The Ant nests of *M. castanea* in the palm plantation. a= ant nest in oil palm stump; b= ant nest in fallen palm oil stems.

RESULTS AND DISCUSSIONS

The results of the measurement of *abiotic* environmental factors in the *M. castanea* ant nests that was explored as follows:

Temperature

The range temperature value during the exploration of the *M. castanea* ant nests in the smallholders' plantations is 28 – 31 ° C (Figure 2). The plants of oil palm in the plantation have range age of 5-20 years old. The palm plantations between the ages of 15-20 years canopy plants have covered each other so that the atmosphere in the plantation environment became shadier.

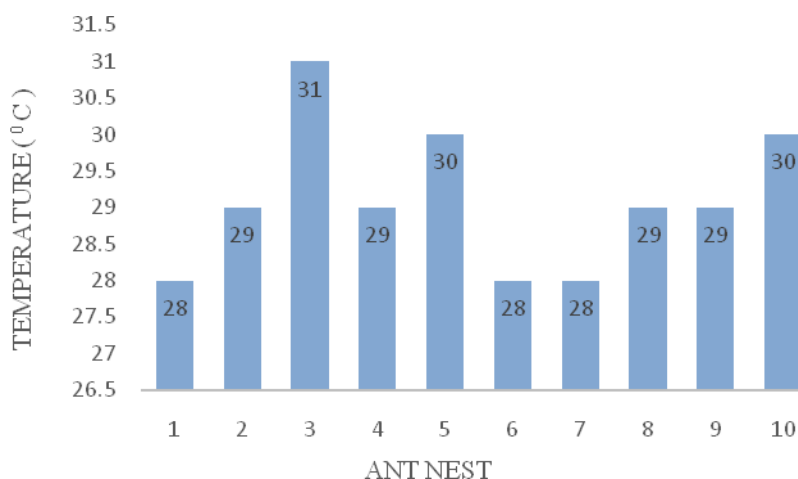


Figure 2. The range temperature in the ant nest of *M. castanea*

The temperature range is at the optimal range that needed by the insect for its life. In an ecosystem, the temperature is able to regulate the growth and the deployment of animals that live in it (Aneni et al., 2012; Cardoso and Schoereder, 2014; Wang et al., 2001).

Humidity

Air humidity affects the lives of insects directly or indirectly. The results showed that the range of air humidity obtained in the *M. castanea* ant nest ranged between 68-75% (Figure 3). The ant nests found during the exploration process in the two plantations were mostly found in the trunks of the palm trees whose trunks look slightly wet (moist), and the ants usually found in the bottom of the fallen palm trunk, there were even ant colonies of *M. castanea* found in the soil (Figure 4). *M. castanea* ants like a moist place to make their nests (Wilson 1971). Temperature and humidity are factors that greatly affected the ant life and activity. It was observed by Ronque et al. (2018) on *Camponotus renggeri* ants and *Camponotus rufipes* which live in the Brazilian savannah area. These ants were also found alive and make nests on decaying logs.

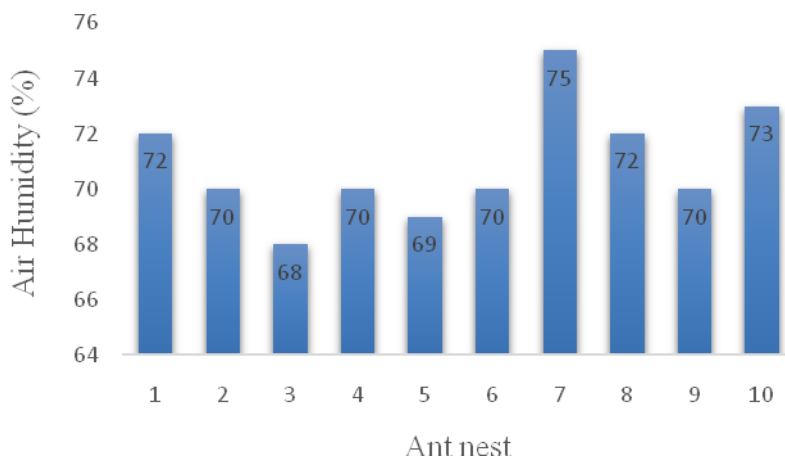


Figure 3. The range air humidity in the *M. castanea* ant nests.



Figure 4. *Myopoponecastanea* colonies: a= larvae; b= pupae

pH

The results of the pH measurements in the exploration of ant nests is a range 5.9 – 7. (Figure 5). In the weathering process of palm stems, microorganisms such as fungi play an important role in the destruction of lignin and cellulose. The research result from Fadzilah et al. (2017) showed that fungi such as *Trametes versicolor* and *Schizophyllum commune* was able to accelerate the decomposition process of the palm stems. In order to carry out this

decomposition process, these fungi preferred the pH in a neutral range. *P. crisosporium* mushroom which was a fungus that played an important role in the wood weathering process preferred the 4-7 pH range as the place of life (Fadillah et al., 2008).

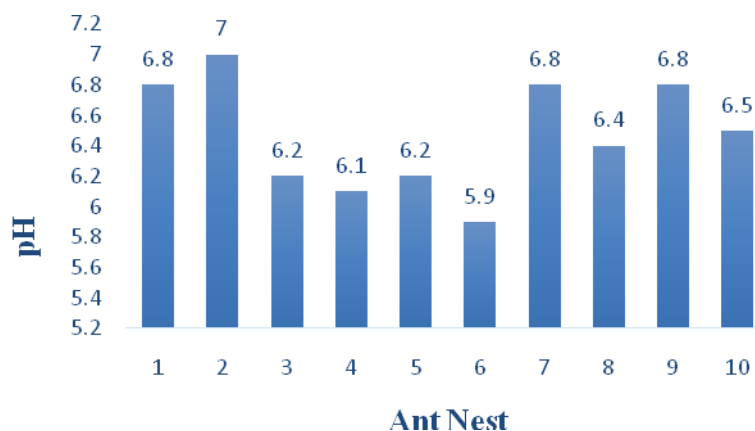


Figure 4. The range measurement results of the pH of *M. castanea* ant nests

Rate C/N ratio

The decomposition rate of organic material was indicated by the changes in the C/N balance. The range of C/N ratio balance obtained from the smallholders' palm plantations was 33.93 – 92.34% (Figure 5). Decomposition of cellulose to simple compounds involved many roles of enzymes and microorganisms (Fadzilah et al., 2017; Fadillah et al., 2008). Most possibly, the process of cellulose-decomposing to simple sugar compounds invited ants to make nests in the decaying logs. The low C/N ratio indicated an advanced weathering process and impact to the cellulose degradation and decreasing the sugar compounds needed by ants.

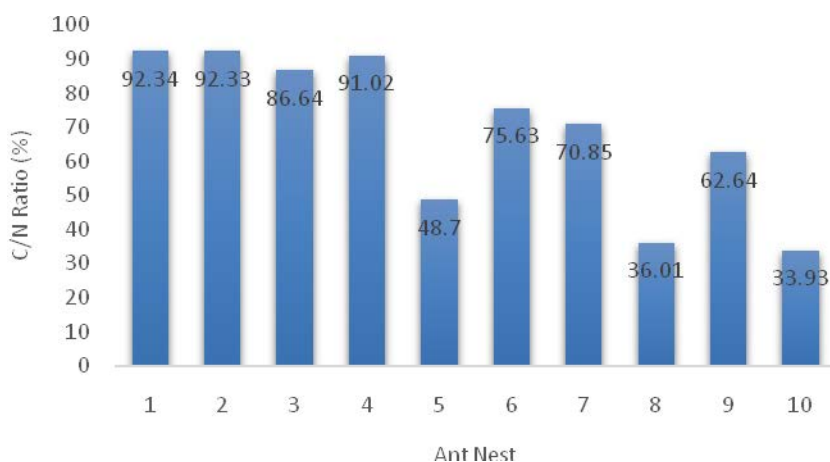


Figure 5. The range level of weathering of palm stems as ant nest of *M. castanea*.

CONCLUSIONS

1. The range of *abiotic* environment in the ant nest of *M. castanea* in the smallholders plantations was temperature of 28 - 31° C, humidity of 68 - 75%, pH of 5.9 – 7.0 and C / N ratio of 33.93 – 92. 34%.
2. The appropriate *abiotic* environment will support life and mass rearing of *M. castanea* ant colonies.

ACKNOWLEDGEMENT

This work was supported by Ministry of Riset Teknologi dan Pendidikan Tinggi with grant number 011 / P3M.05 / 2018

REFERENCES

- Aneni T.I, Aisagbonhi C.I, Iloba B.N, Adaigbe V.C. 2012. Influence of microhabitat temperature on *Coelaenomenodera elaeidis* and its natural enemies in Nigeria. *J.African Crop Sci* 20: 517-522
- Anshary A, Pasaru F 2008 Teknik perbanyak dan aplikasi predator *Dolichoderus thoracicus* Smith (Hymenoptera: Formicidae) untuk pengendalian penggerek buah kakao *Conomorpha cramerella* (Snellen) di perkebunan rakyat. *Journal Agroland*. 15(4):278-287

- Dassou A.G, Carval D, Depigny S, Fansi G, Tixier P. 2015. Ant abundance and *Cosmopolites sordidus* damage plaintain fields as affected by intercropping. *J. Bio Control* 81: 51-57.
- Cardoso D.C, Schoereder J.H. 2014. Biotic and abiotic factors shaping ant (Hymenoptera: Formicidae) assemblages in Brazilian Coastal sand dune: The case of Restinga in Santa Catarina. *J. Florida Entomologist* 97(4): 1443-1450.
- Fadilah, DistantinaS, Artati E.K, Jumari A. 2008. Biodelignifikasi batang jagung dengan jamur pelapuk putih *Phanerochaete chrysosporium*. *J.Ekuilibrium* 7(1):7-11.
- Fadzilah K, Saini H.S, Atong M. 2017. Phsycochemical characteristics of Oil Palm Frond (OPF) composting with fungal inoculants. *Pertanika J. Trop. Agric. Sci.* 40(1): 143-160.
- Falahudin, I. 2013. Peranan Semut Rangrang (*Oecophylla smaradigna*) dalam Pengendalian Biologis pada Perkebunan Kelapa Sawit. Prosiding Konferensi AICIS XII.2604-2618.
- Ito, F. 2010. Notes on the Biologyof the Oriental Amblyoponinaeant *Myopopone castanae*: Queen-worker dimorphism, worker polymorphism an larval hemolymph feeding by workers (Hymenoptera: Formicidae). *Entomological science* 13: 199-204.
- Junaedi D, Bakti D, Zahara F. 2014. Daya Predasi *Myopopone castanae* (Hymenoptera: Formicidae) Terhadap Larva *Oryctes rhinoceros* L (Coleoptera: Scarabidae) di Laboratorium *J.Online Agroekoteknologi.* 3(1):112-117.
- Latumahina F, Musyafa, Sumardi, Putra N.S. 2015. Respon semut terhadap kerusakan antropogenik dalam hutan lindung Sirimau Ambon. *J. Manusiadan Lingkungan* 22(2): 169-178.
- Marheni. 2012. *Karakteristik Ekologi dan Biologi Oryctes rhinoceros pada Pertanian Sawit di Sumatera Utara*. Disertasi. Universitas Gadjah Mada, Yogyakarta.
- Nurdiansyah F, Denmead L.H, Clough Y, Wiegand K, Tscharnke T. 2016. Biological control in Indonesia oil palm potentially enhanced by landscape context. *J. Agricultural, Ecosystem & Environment vol.* 232 : 141-149.
- Oliveira R.F, Almeida L.C, Souza D.R, Munhae C.B, Bueno O.C, Morini M.S.C. 2012. Ant diversity (Hymenoptera: Formicidae) and predation by

ants on the different stages of the sugarcane borer life cycle *Diatraea saccharalis* (Lepidoptera: Crambidae). *Eur. J. Entomol.* 109: 381–387.

- Ronque M.U.V, Fourcassie V, Oliveira P.S. 2018. Ecology and field biology of two dominant *Camponotus* ants (Hymenoptera: Formicidae) in the Brazilian savannah. *J. Nat. History* 52:3-4, 237-252.
- Wang C, Strazanac J.S, Butler L. 2001. Association between ants (Hymenoptera: Formicidae) and habitat characteristics in Oak-Dominated mixed forest. *Environ.Entomol* 30(5): 842-848.
- Widihastuty, Tobing M.C, Marheni, Kuswardani R.A. 2018. Prey preference *Myopopone castanea* (Hymenoptera: Formicidae) toward larvae *Oryctes rhinoceros* (Coleoptera: Scarabaeidae). *IOP Conf. Ser.: Earth Environ. Sci.* 122 012120.
- Wilson, E.O. 1971. *The Insect Societies*. The Belknap Press of Harvard University Press. Cambridge, Massachusetts. London.
- Yamazaki K. 2010. Parachutting behavior and predation by ants in the nettle caterpillar *Scopelodes contracta*. *J.insect sci.* 10:39 10pp.