

***Trigona laeviceps* Foraging Activity and Colony Growth in Polyculture and Nutmeg (*Myristica fragrans*) Monoculture Plantations**

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Introduction

Sustainability of plant pollinators has become one of the world topics because our food availability depends on it. *Trigona* stingless bee is one of the universal pollinator and *T. laeviceps* has a wide dispersal. Understanding *T. laeviceps* behavior and colony growth in certain environment is necessary for its conservation and culture. It produces propolis, beepollen, and honey from plant resin, pollen, and nectar. Nutmeg (*Myristica fragrans*) tree provides resin which is the most necessary ingredient for *Trigona* bees. This experiment aimed to study and compare *T. laeviceps* foraging activity and colony growth in polyculture and monoculture plantations of nutmeg, as well as to find out the environment factors that suit them.

Materials and Methods

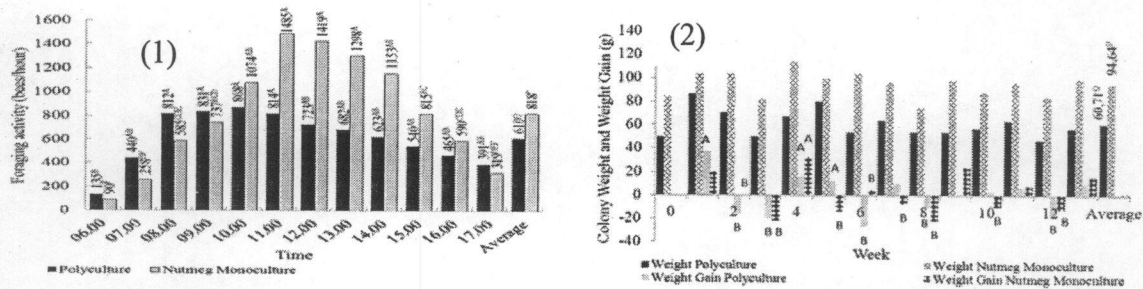
The polyculture plantation (2 ha) and nutmeg monoculture plantation (3.5 ha) were in West Java, Indonesia. Six *T. laeviceps* colonies were divided into polyculture (3 colonies; mean = 66.67 g) and nutmeg monoculture plantation (3 colonies; mean = 83.33 g). Number of bees that entered and left the hive was measured daily for ten minutes every hour from 06:00 until 17:00 hour. At the same time, temperature, humidity, and light intensity were taken. Colonies weight were measured every week for three months to obtain weekly colonies weight gain. The data were analyzed by ANOVA and Student t-Test at $p < 0.05$.

Results and Discussion

Foraging activity

Trigona laeviceps bees involved in daily foraging activity in nutmeg monoculture plantation were significantly higher ($p < 0.05$) than in polyculture (818 vs. 610 bees/hour; Figure 1.1), due to its larger initial colonies weight (83.33 vs 66.67 g), thus they had more worker bees and needed more feed (Inoue *et al.*, 1985). Foraging activity in each plantation also fluctuated significantly by hour ($p < 0.05$) and peak activity in nutmeg monoculture plantation occurred later (11:00-13:00) than in polyculture (08:00-11:00, Figure 1.1). This was due to differences in hour when the sunlight was shining through the canopy of trees in both plantations. When the hives received sunlight directly, both temperature and light intensity increased sharply and reached *Trigona* bees optimum requirement. The ambient temperature reached 26-30.75 °C, humidity around 66.39%-80.75%, and light intensity 21,331-140,460 lux at those times. When the ambient temperature is warm, resin takes a not too solid form that is more easily taken up by the bees (Wallace and Lee, 2009).

Foraging activity in polyculture plantation had a highly positive *correlation* with ambient temperature ($r = 0.912, R^2 = 0.832$), while in nutmeg monoculture plantation the correlation was with light intensity ($r = 0.919, R^2 = 0.845$). This phenomenon suggests that foraging activities were related to environmental factors, but the most influential factor may vary (Heard and Hendrikz, 1993).



A,B,...,F = different superscript on the same plantation means significantly different value ($p < 0.05$)

Figure 1. *T. laeviceps* Foraging Activity (1) and Colony Weight and Weight Gain (2) in Polyculture and Nutmeg Monoculture Plantation.

Colony weight and weight gain

The colonies in nutmeg monoculture plantation (94.64 g vs. 60.71 g; Figure 1.2) were heavier, but it is because of their heavier initial weights with more bees engaging in foraging activity (Figure 1.1). Colonies weekly weight gain in both plantations fluctuated and was significantly affected ($P < 0.05$) by the time of the study (Figure 1.2), but not by plantation type. *Trigona* colonies weight gain in this study seemed to be more determined by its initial weights than bee activity and the ambient factors as shown in Table 3. Coefficient of determination (R^2) of bees foraging activity, temperature, humidity, and light intensity on colonies average weight gain were very low, i.e. 0.198, 0.177, 0.323, 0.305 respectively in polyculture and 0.351, 0.438, 0.375, 0.187 in nutmeg monoculture plantation.

Conclusion

Trigona bee foraging activity in the polyculture was lower than in nutmeg monoculture plantation, but colonies weight gain was not significantly different in both plantations. Temperature determined foraging activity in nutmeg polyculture, but light intensity had greater influence in monoculture.

References

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