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FORAGING BEHAVIOUR OF STINGLESS BEE, *Heterotrigona itama* ON STAR FRUIT TREES (*Averrhoa carambola* L.)

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BY

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A project report submitted to Faculty of Agriculture, Universiti Putra Malaysia, in fulfillment of the requirements of PRT 4999 (Final Year Project) for the award of the degree of Bachelor of Agricultural Science.

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CERTIFICATION

This project entitled "Foraging Behaviour of Stingless Bee, *Heterotrigona itama* on Star Fruit Trees (*Averrhoa carambola* L.)" is prepared by Siti Najwa Binti Mohamad Yusoff and submitted to the Faculty of Agriculture in fulfillment of the requirement of PRT 4999 (Final Year Project) for the award of the degree of Bachelor of Agricultural Science.

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ABSTRACT

Pollination by an insect is important to increase fruit size at yield, hastens maturity, and produces a more symmetrical fruit shape. Malaysia is rich with native pollinator such as stingless bees, but the study about it is still lacking. Thus, the objectives of this study were: 1) To determine the frequency of foragers going out and coming back to the hive; 2) To investigate the average number of flowers visited and time taken per flower visit. The study was conducted in star fruit cultivated plot with established colonies of *H. itama* at Integrated Farm, Faculty of Agriculture, Universiti Putra Malaysia. Foraging bees were enumerated by using a manual tally counter to determine the number of individuals that flew out and in their hive from 0800 hours to 1300 hours. Ten foragers were selected randomly. The number of flowers visited by individuals within three minutes has been counted manually and time taken for each flower visited by an individual was measured using a stopwatch. Data obtained were subjected to one-way Analysis of Variance (ANOVA). While the number of flowers visited and time taken per flower were averaged. This study showed that there was no significant difference for the number of foragers that flew out and coming back to the hive between times. However, this study has shown that *H. itama* active in the morning between 0800 hours and 1030 hours while the flowers were open. The study of the average number of flower visited and time taken per flower visit showed that the overall total number of flowers visited by 30 individuals is 463 flowers. While, the most frequent number of flowers visited is 10 to 15 flowers.

ABSTRAK

Pendebungaan oleh serangga adalah penting untuk meningkatakan saiz buah, untuk mempercepatkan kematangan, dan untuk menghasilkan buah yang mempunyai bentuk lebih bersimetri. Malaysia kaya dengan pelbagai spesies pendebunga, seperti lebah kelulut, tetapi kajian mengenainya masih kurang. Oleh itu, objektif kajian ini adalah: 1) Untuk menentukan kekerapan lebah pencari makanan keluar dan kembali ke sarang; 2) Untuk mengkaji purata bilangan bunga dilawati dan masa yang diambil bagi setiap bunga yang dilawati. Kajian ini telah dijalankan di plot penanaman belimbing yang mempunyai koloni *H. itama*, bertempat di Ladang Bersepadu, Fakulti Pertanian, Universiti Putra Malaysia. Lebah pencari makanan telah dihitung dengan menggunakan alat pengira manual untuk menentukan bilangan individu yang terbang keluar dan masuk ke dalam sarang mereka dari pukul 0800 hingga pukul 1300. Sepuluh lebah pencari makanan telah dipilih secara rawak. Bilangan bunga yang dikunjungi oleh setiap individu dalam tempoh tiga minit telah dikira secara manual dan masa yang diambil untuk setiap bunga dikunjungi bagi setiap individu tersebut telah diukur menggunakan jam randik. Data yang diperoleh telah ditentukan dengan menggunakan Analisis Varians (ANOVA). Manakala bilangan bunga yang dilawati dan masa yang diambil bagi setiap bunga telah dipuratakan. Kajian ini telah menunjukkan bahawa tiada perbezaan yang ketara bagi bilangan lebah pencari makanan yang terbang keluar dan kembali ke sarang diantara masa. Walaubagaimanapun, kajian ini telah menunjukkan bahawa *H. itama* aktif pada waktu pagi diantara pukul 0800 dan pukul 1030 sementara bunga masih terbuka. Kajian mengenai purata bilangan bunga dilawati dan masa yang

diambil bagi setiap bunga yang dilawati telah menunjukkan bahawa jumlah keseluruhan bunga dikunjungi oleh 30 individu adalah sebanyak 463 kuntum bunga. Manakala, bilangan bunga yang paling kerap dilawati ialah 10 hingga 15 kuntum bunga.

CHAPTER 1

INTRODUCTION

1.1 Background

Star fruit (*Averrhoa carambola* L.) is an evergreen tree that belongs to Oxalidaceae family (Manda *et al*., 2012). Star fruit got its name from the shape of a cross-section of the fruit. Star fruit trees bloom and bear fruit almost all year round, with peak production in April to May, July to August, and November to December (Warren *et al.*, 2011).

It has been cultivated in Southeast Asia for centuries (Crane, 2001) and it has attained a commercial status in Malaysia. Star fruit was identified among 17 fruits that were given priority in the National Agrofood Policy 2011-2020 and it is one of the fruit productions for export. Usually, star fruit from Malaysia will be exported to Netherlands, German, Singapore, and Hong Kong (Malaysia, Crop Protection & Plant Quarantine Services Division, 2004).

Although Malaysia is the largest exporter of star fruit in the world, our production of star fruit has decreased from 13,475.6 metric tons in 2012 to 10,072.2 metric tons in 2014 (DOA, 2015). There are many reasons for the decline of star fruit production in Malaysia. One of it is caused by the flowers on a given star fruit variety

have either long or short styles; this condition is called heterostyly, where, it require cross pollination for good fruit set and yields (Crane, 2007). Therefore, by using a suitable and efficient insect pollinator for star fruit, it will improve the production of star fruit.

Insects including honeybees, bumblebees, butterflies and moths are vital for the pollination of many cultivated plants. They play a crucial role in the production of agricultural crops such as oilseed rape, raspberries, and tomatoes as well as pollinating horticultural plants. Bees are considered to be the best agents of crop pollination because they visit the flowers purposely to gather pollen and other floral rewards, have high floral constancy, their body is body profusely hairy, are amenable, and honey bees and stingless bee also provide honey and other valuable bee products (Thakur, 2012).

1.2 Justification

Honey bees, *Apis mellifera*, are one of the pollinators that have been used from a long time ago as a pollinator. However, there is clear evidence of recent declines in honey bees and it is urgent need to look for alternative and native pollinators. Good candidates for future pollinator can be found in the diverse group of stingless bees (Slaa *et al.*, 2006; Rindfleisch, 1980; Roubik, 1995b; Heard, 1999; Sommeijer and de Ruijter, 2000). There are many stingless bee species in Malaysia that have the potential as a pollinator, one of it is *H. itama*.

Heterotrigona itama is one of the common stingless bee species in Malaysia as it is easy to be found. Therefore, in 2012, MARDI has chosen this species as species for stingless bee honey industry in Malaysia. A high density of colonies, easily maintained, high resistance to disease, and produce a lot of honey is among the criteria for being selected (Jaapar *et al.*, 2016). Unfortunately, the study related on the foraging behaviour of *H. itama* as a pollinator is still lacking.

1.3 Objectives

Thus, the objectives that needs to be accomplishing in this study is: 1) To determine the frequency of foragers going out and coming back to the hive; 2) To investigate the average number of flower visited and time taken per flower visit.

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