
**UNIVERSITI PUTRA MALAYSIA**

***THE ABUNDANCE DIVERSITY OF INSECT POLLINATOR IN STAR FRUIT***

**EMIR NAQIB BIN ABDULLAH RADZY**

**FP 2017 27**

# THE ABUNDANCE DIVERSITY OF INSECT POLLINATOR IN STAR FRUIT

**EMIR NAQIB BIN ABDULLAH RADZY**

**FACULTY OF AGRICULTURE**

**UNIVERSITI PUTRA MALAYSIA**

**SERDANG, SELANGOR DARUL EHSAN**

**2016/2017**

# THE ABUNDANCE DIVERSITY OF INSECT POLLINATOR IN STAR FRUIT

By

EMIR NAQIB BIN ABDULLAH RADZY

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

FACULTY OF AGRICULTURE

UNIVERSITI PUTRA MALAYSIA

SERDANG, SELANGOR DARUL EHSAN

2016/2017

**ENDORSEMENT**

This project paper entitled **THE ABUNDANCE DIVERSITY OF INSECT POLLINATOR IN STAR FRUIT** is prepared by EMIR NAQIB BIN ABDULLAH RADZY and submitted to Faculty of Agriculture in fulfillment of the requirement of PRT 4999 (Final Year Project) for the award of degree of the Bachelor of Agricultural Science.

Student's Name:

EMIR NAQIB BIN ABDULLAH RADZY Student's Signature

**……**

Approved by,

**……..**

(ASSOC. PROF. DR. NUR AZURA ADAM)

Project Supervisor
Department of Plant Protection
Faculty of Agriculture
Universiti Putra Malaysia

Date: **……**

**ACKNOWLEDGEMENTS**

In the name of Allah the Most Gracious and Most Merciful.

First of all, my utmost gratitude to Allah S.W.T for all his blessings that gave me strength to complete my final year project thesis. My deepest gratitude goes to my supervisor, Assoc. Prof. Dr. Nur Azura Adam, whose expertise and guidance me along my way to complete this thesis. Appreciation is also extended to my tutor , Asiah who encourage me to pursue this topic and spent time helping me out in this experiment

I am indebted to the Prof Ahmad for providing me facilities during my experiment. I also would like to acknowledge a special gratitude to En. Hishamuddin, Labaratory Asisstant in Department of Plant Protection, for his assist and cooperation throughout the preparation of material needed in my experiment.

Many thanks to my fellow colleagues; Asilah and Siti Najwa for their help during the experiment and good conversation advise. A special thanks to all my friends for their helpful discussion and kept supporting me on completing this project.

Thank you

## TABLE OF CONTENTS

## LIST OF PLATES

## LIST OF TABLES

## LIST OF ABBREVATIONS

DOA Department of Agriculture

FAO Food and Agricultural Organization

MOA Ministry of Agriculture

## LIST OF APPENDCES

## ABSTRACT

Star fruit is one of the main fruit that been produce by Malaysia in large scale. The higher production of star fruit shows that it has a highly demand worldwide. Star fruit is the type of crop that need cross pollination in order to produce fruit set. Thus, the cross pollination process is widely been carried by insect. However the declining number of insect pollinator due to many factor such as climate change, urban agriculture and disease caused declining number of insect pollinator. The declining number of insect pollinator told us that we need to manage the existence species of insect pollinator before extinction happen. This experiment was conducted to identify the abundance number of insect pollinator in star fruit. The result of this experiment will help farmer and grower to manage their insect pollinator in sustainable way. All of the insect that visit the flower of the selected tree will be collected as sample. The experiment was conducted in two ways which is sampling and observation of the insect. The collected insect was been determine by referring to collection insect in museum of entomology, Department of Plant Protection, Faculty of Agriculture UPM. The data collected showed that there are four order of insect that visit the star fruit flower which is Hymenoptera, Diptera, Lepidoptera and Coleoptera. Based on the result obtained, there are 15 species of insect that visit the star fruit flower and the main species is *Genotrigona thoracica*. This proved that *G. thorracica* is the most abundance insect pollinator in star fruit compared to other species of insect that been collected.

## ABSTRAK

Belimbing adalah salah satu buah-buahan utama yang dihasilkan Malaysia dalam skala yang besar. Pengeluaran hasil belimbing yang tinggi menunjukkan bahawa ia mempunyai permintaan yang tinggi di seluruh dunia. Belimbing adalah jenis tanaman yang memerlukan pendebungaan silang untuk menghasilkan set buah-buahan. Oleh itu, proses pendebungaan silang telah dibawa secara meluas oleh serangga. Walau bagaimanapun penurunan bilangan serangga pendebunga disebabkan pelbagai faktor seperti perubahan iklim, pertanian bandar dan penyakit menyebabkan penurunan jumlah serangga pendebunga. Penurunan bilangan serangga pendebunga menyatakan bahawa kita perlu menguruskan spesies yang sedia ada bagi mengelakkan kepupusan berlaku. Eksperimen ini dijalankan untuk mengenal pasti spesis dan jumlah serangga pendebunga pada buah belimbing. Hasil daripada eksperimen ini akan membantu petani dan penanam belimbing untuk menguruskan serangga pendebunga dengan cara yang mampan. Semua serangga yang datang ke bunga belimbing akan ditangkap dan dijadikan sebagai sampel. Eksperimen ini dijalankan dalam dua cara iaitu pensampelan dan pemerhatian serangga. Serangga yang diperolehi akan dikenalpasti dengan merujuk pada koleksi serangga di muzium entomologi, Jabatan Perlindungan Tumbuhan, Fakulti Pertanian UPM. Data yang dikumpul menunjukkan bahawa terdapat empat order serangga yang melawat bunga belimbing iaitu Hymenoptera, Diptera, Lepidoptera dan Coleoptera. Berdasarkan keputusan yang diperolehi, terdapat 15 spesies serangga yang melawat bunga belimbing dan spesies yang mendominasi adalah *Genotrigona thoracica*. Ini membuktikan bahawa *G. thoracica* adalah yang paling banyak menjadi serangga pendebunga dalam buah belimbing berbanding dengan spesis serangga lain yang telah dikumpulkan.

# CHAPTER 1

# INTRODUCTION

## 1.1 Background

Star fruit is one of the fruit that have highly demand worldwide. Malaysia is one of the countries that produce star fruit in large amount of number. The summary data of fruits crop Malaysia shows that in year 2014 the planted area of fruits crop is 199 569 ha and the average production of fruits is 10.6mt/ha (DOA, 2014). Before 1999, star fruit commodity is number four in Malaysia and the value total of exportations is around 20-30 million but in 2001 it shows positive impact on total value exportation of star fruit which is 31 million (MOA, 2016). It shows increasing about 3.33 percent which shows a good sign of demand.

In Malaysia, star fruit mostly cultivated in Johor, Selangor and Negeri Sembilan. It is exported in many countries such as German, Holland, Singapore and Hong Kong. There are two popular varieties being cultivated in Malaysia for the exportation purpose which is B10 and B17. A B10 variety have orangey-yellow skin when ready, it is delicious, top notch and has smooth surface while B17 is more oval fit as a fiddle, yellowish when ready, somewhat more firm however has a more stringy surface (MOA, 2016). Malaysia also has B2 variety which use in pollination process. Star fruit need two different varieties of star fruit in order to make sure the pollination process successfully.

## 1.2 Justification

Pollination is the process of transferring pollen from the anther of one flower to the stigma of another or different flower (Kevan 1999). There are two categories of pollinator agent which is biotic and abiotic. Under the biotic categories there are many pollination agents such as bats, bird, and insect. Insect carry an important role as pollination agent in the cross pollination process. Hence the abundance of insect pollinator at star fruit helps not only in increasing production of yields but also the quality of the fruits. Thus, for a better understanding of the pollination agent in star fruit, we need to determine the types of insects that show the positive relation with star fruit tree that help in pollination process. Furthermore, when we identify the types of insect pollinator, we can design a proper way to manage them and also maximize our yield production. Farmers should take action in maintaining the population of pollinator to ensure uniformed pollination of fruits.

Despite pollinators are known as to provide symbiosis processes with the ecosystem function, the study about the specific plant pollinator are still poorly described. Thus, the identification of insect pollinator species will help to better manage the pollination population in order to maximize the pollinator activities. Therefore, this study was proposed to determine the pollinator's communities that pollinate star fruit tree. The result from this study would provide the guideline for the grower to manage the population of pollinator in proper way.

## 1.3 Objectives

In view of the importance of pollinators to crop production, this experiment is carry to emphasize on the pollination activity by insect focusing on the following objectives:

1. To identify the insect pollinators of star fruit
2. To compare the abundance of insect pollinator species on star fruit

## REFRENCES


Abdullah, A. L., Sulaiman, N. M., Aroua, M. K., & Noor, M. M. M. (2007). Response surface optimization of conditions for clarification of carambola fruit juice using a commercial enzyme. *Journal of Food Engineering*, *81*(1), 65-71

Abrol, D. P. (2012). Decline in pollinators. In *Pollination Biology* (pp. 545-601). Springer Netherlands.

Aizen, M. A., & Harder, L. D. (2009). The global stock of domesticated honey bees is growing slower than agricultural demand for pollination. *Current biology*, *19*(11), 915-918.

Bawa, K. S. (1990). Plant-pollinator interaction in tropical rain forests. *Annual Review of Ecology and Systematics*, *21*, 399-422.

Bernhardt, P., & Thien, L. B. (1987). Self-isolation and insect pollination in the primitive angiosperms: new evaluations of older hypotheses. *Plant Systematics and Evolution*, *156*(3-4), 159-176.

Bohart, G. E. (1972). Management of wild bees for the pollination of crops. *Annual review of entomology*, *17*(1), 287-312.

Bonmatin, J. M., Moineau, I., Charvet, R., Colin, M. E., Fleche, C., & Bengsch, E. R. (2005). Behaviour of imidacloprid in fields. Toxicity for honey bees. In *Environmental Chemistry* (pp. 483-494). Springer Berlin Heidelberg.

Chittka L, Lunau K (1992) Colour coding and innate preferences for flower color patterns in bumblebees. In: Elsner N, Richter DW (ed) Rhythmogenesis in neurons and networks. Proc 20th Grttingen neurobiology conf 1992. Thieme, Stuttgart, p 298.

Corlett, R. T. (2004). Flower visitors and pollination in the Oriental (Indomalayan) Region. Biol. Rev, 79, 497-532.

Crane, J. H. (2001). *The carambola (star fruit)*. University of Florida Cooperative Extension Service, Institute of Food and Agriculture Sciences, EDIS.

Department of Agriculture Malaysia (2012). *Fruit Crops Statistic* The Ministry of Agriculture and Agro-based Industry, Malaysia

Department of Agriculture Malaysia (2014). *Fruit Crops Statistic* The Ministry of Agriculture and Agro-based Industry, Malaysia

Dukas R, Real L (1991) Leaming foraging tasks by bees: a comparison between social and solitary species. Anim Behav 42: 269-276

Elwin B. (n.d.) Pollination Fertilization Germination Retrieved From http://slideplayer.com/slide/6303099/

Food and Agriculture Organization of the United Nations (FAO) (2016). *Pollinators vital to our food supply under threat*. Food and Agriculture Organization of the United Nations, Kuala Lumpur, Malaysia.

Free, J. B. (1970). *Insect pollination of crops*. Insect pollination of crops.

Garibaldi, L. A., Steffan-Dewenter, I., Winfree, R., Aizen, M. A., Bommarco, R., Cunningham, S. A., ... & Bartomeus, I. (2013). *Wild pollinators enhance fruit set of crops regardless of honey bee abundance*. science, *339*(6127), 1608-1611.

Heard, T. A., & Exley, E. M. (1994). Diversity, abundance, and distribution of insect visitors to macadamia flowers. *Environmental Entomology*, *23*(1), 91-100.

Hein, L. (2009). The economic value of the pollination service, a review across scales. *Open Ecology Journal*, *2*, 74-82.

Holden, C. (2006). Report warns of looming pollination crisis in North America. *Science*, *314*(5798), 397-397.

International Tropical Fruits Network, (2006). (Date posted: 15 December 2003, Source: Business Development Centre). Accessed 19.08.06.

Ismail, M.R., Usof, M.K. and Masturi, A. (1996) Growth and flowering of water stressed starfruit plants and responses to ameliorate water stress. Proceedings: International Conference on Tropical Fruits, Kuala Lumpur, July 1996: 97-106.

Jadhav, J. A., Sreedevi, K., & Prasad, P. R. (2011). Insect pollinator diversity and abundance in sunflower ecosystem. *Current Biotica*, *5*(3), 344-350.v

Kevan, P. G. (1999). Pollinators as bioindicators of the state of the environment: species, activity and diversity. Agriculture, Ecosystems and Environment, 74, 373-393.

Kevan, P. G., & Baker, H. G. (1983). Insects as flower visitors and pollinators. Annual review of entomology, 28(1), 407-453.

Kjol, M., Nielsen, A., & Stenseth, N. C. (2011). Potential effects of climate change on crop pollination.

Klein, A. M., Vaissiere, B. E., Cane, J. H., Steffan-Dewenter, I., Cunningham, S. A., Kremen, C., & Tscharntke, T. (2007). Importance of pollinators in changing landscapes for world crops. *Proceedings of the Royal Society of London B: Biological Sciences*, *274*(1608), 303-313.

Kluser, S., & Peduzzi, P. (2007). Global pollinator decline: a literature review.

Landry, C. (2012). Mighty Mutualisms: the nature of plant-pollinator interactions. *Nature Education Knowledge*, *3*, 37.

Larson, B. M. H., Kevan, P. G., & Inouye, D. W. (2001). Flies and flowers: taxonomic diversity of anthophiles and pollinators. *The Canadian Entomologist*, *133*(04), 439-465.

Lewis T. 1997. Flight and dispersal. *In* T. Lewis [ed.], Thrips as crop pests, 175–196. CAB International, Oxon, UK.

Linsley, E. G. (1958). *The ecology of solitary bees*. University of California.

Malaysian Tropical Fruit Information System (2006) Starfruit: Marketing and Trade-General Information . Accessed 19.08.06.

Mawdsley, J. R., & Sithole, H. (2010). Diversity and abundance of insect visitors to flowers of trees and shrubs in a South African savannah. *African Journal of Ecology*, *48*(3), 691-698.

Mayer, C., Adler, L., Armbruster, W. S., Dafni, A., Eardley, C., Huang, S. Q., ... & Stout, J. C. (2011). Pollination ecology in the 21st century: key questions for future research. *Journal of Pollination Ecology*, *3*, 8-23.

Mazokhin-Porshniakov GA (1962) Farbmetrischer Beweis der Trichromasie des Farbensehens der Bienen (am Beispiel der Hummeln). Akad Nauk USSR Biofizika 7:221-227

McGregor, S. E. (1976). *Insect pollination of cultivated crop plants* (Vol. 496). Agricultural Research Service, US Department of Agriculture.

Menzel R (1979) Spectral sensitivity and colour vision in invertebrates. In: Autrum H (ed) Invertebrate photoreceptors (Handbook of sensory physiology, vol. VII/6A). Springer, Berlin Heidelberg New York, pp 503-580

Menzel R, Backhaus W (1991) Color vision in insects. In: Gouras P (ed) Vision and visual dysfunction, vol. VI. The perception of colour. Houndsmills: MacMillan Press, pp 262-293

Ministry of Agriculture and Agro-Based Industry Malaysia (MOA) (2016) *Star fruit potential*. Ministry of Agriculture and Agro-Based Industry Malaysia, Putrajaya, Malaysia.

Moog, U., Fiala, B., Federle, W . and Maschwitz, U. (2002). Thrips pollination of the dioecious and plant *Macaranga huletti* (Euphorbiaceae) in Southeast Asia. *American Journal of Botany* 89: 50-59

Nagamitsu, T., & Inoue, T. (1997). Cockroach pollination and breeding system of Uvaria elmeri (Annonaceae) in a lowland mixed-dipterocarp forest in Sarawak. *American Journal of Botany*, *84*(2), 208-208.

Ollerton, J., Winfree, R., & Tarrant, S. (2011). How many flowering plants are pollinated by animals?. *Oikos*, *120*(3), 321-326.

Ricketts, T. H., Regetz, J., Steffan- Dewenter, I., Cunningham, S. A., Kremen, C., Bogdanski, A., ... & Morandin, L. A. (2008). Landscape effects on crop pollination services: are there general patterns?. *Ecology letters*, *11*(5), 499-515.

Roth, L. M., AND E. R. Willis. 1960. The biotic associations of cockroaches. Smithsonian Miscellaneous Collections 141: 139–165.

Shepherd, M., & Ross, E. S. (2003). *Pollinator conservation handbook*. Xerces Society in association with Bee Works.

Steffan-Dewenter, I., Potts, S. G., & Packer, L. (2005). Pollinator diversity and crop pollination services are at risk. *Trends in ecology & evolution*, *20*(12), 651-652.

Triplehorn, C. A., & Johnson, N. F. (2005). Borror and Delong's Introduction to the Study of Insects. *Belmont, CA: Thomson Brooks/Cole*.

Von Frisch, K. (1967). The dance language and orientation of bees.

Warren, S. D., Harper, K. T., & Booth, G. M. (1988). Elevational distribution of insect pollinators. *American Midland Naturalist*, 325-330.

Woodcock, T. S. (2012). Pollination in the agricultural landscape. *Best Management Practices for Crop Pollination. Guelph, ON, Canada: Canadian Pollination Initiative, University of Guelph*.

Zabedah, M. and Izham A. (1996) Rehabilitation of starfruit by rebudding commercial clones B10 and B17 on to old plants of B1, B2 and B3. Proceedings: International Conference on Tropical Fruits, Kuala Lumpur, July 1996: 169-174