UNIVERSITI PUTRA MALAYSIA

EFFECTS OF DIFFERENT POLLINATION METHODS AND HOT WATER TREATMENT ON PROLONGING SHELFLIFE OF ROCKMELON (*Cucumis melo* L) PRODUCTION

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By

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January 2020

Chairman : Associate Professor Norida binti Mazlan, PhD
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Rockmelon is gaining a lot of importance due to its high production potential as well as its high nutritive value. The presence of insect pest in rockmelon has various problems, includes direct injury to the crop and acting as vector to disease, which leads to economic losses. Use of insecticidal sprays tends to kill or repel both the pest and the natural pollinators. Many synthetic chemicals are employed today for postharvest treatment of fruit and vegetables throughout the world, but the fungicidal residues often represent a major threat to human life. The present study was conducted to determine (1) the effect of different pollination methods on rockmelon production, (2) to assess the effect of insecticide on honeybee and (3) to evaluate the effect of postharvest hot water treatments in prolonging the shelf-life of differently pollinated rockmelon. The experiments were conducted at Field 10, Faculty of Agriculture, Universiti Putra Malaysia and Laboratory B, Department of Crop Science, Faculty of Agriculture. The rockmelon was planted in rain shelter and open shelter systems. The first experiment was a 3×2 factorial (pollination methods and insecticides application) and was laid out in a nested design in three replications. The plants were pollinated using three different pollination methods, namely; natural, honeybee, and hand-pollination; and treated with and without insecticide. The second experiment involved different dipping time and differently pollinated rockmelon with 2×4 factorial laid in a complete randomized design (CRD) with four replications. The experiment is carried out on differently pollinated fruits which are (1) hand pollinated fruits and (2) honeybee pollinated fruits, hot water treatment at 55℃ was also examined in different dipping time periods of 0 minute (control), 1 minute, 2 minute, and 3 minutes. The result of first experiment shows that honeybee pollination is better compared to other pollination methods with having higher plant (192.83 cm), more male flower (58.3) and female flower (7.5), higher sex ratio (11.5), longer days of flowering (27.66), more number of fruit (5.6) and fruit weight (933.33 g). For insecticide and no-insecticide treatments, the result shows the best combination is the insecticide-treated plots

having a higher number of the female flower (6.55) and sex ratio (10.22) compared with no-insecticide.

The postharvest treatment shows that hot water treatment (55°C) prolongs the shelf life of rockmelon fruits with 2 minutes has the lowest weight loss of 11.9%, while the 1-minute treatment has highest firmed fruit (6.33 N), brix index (8.0 °Brix), juice content (79.88 %), larger rind thickness (3.2 mm) and the best appearance (3.75). On the *Fusarium* disease severity, the 2 minutes treatment has the least infestation of 1.0 scale compared to control treatment. However, the regression result shows that with longer dipping time, it will lower the quality of fruit. At 3 minutes dipping time, it has increased the weight loss, decreases the firmness, reduction in juice and appearance compared to 1 minute and 2-minute dipping. The observations also show that honey bee pollinated rock melon is capable of retaining the fruit quality within the three weeks of storage than the hand-pollinated fruits.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KESAN KAEDAH POLLINASI BERBEZA PADA PENGELUARAN DAN JANGKA HAYAT ROCK MELON (*Cucumis melo* L)

Oleh

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Buah rockmelon semakin mendapat tempat dan berkepentingan dikalangan petani disebabkan potensi hasilnya yang menguntungkan di samping nilai nutrisi yang tinggi. Walaubagaimanapun, kehadiran serangga perosak pada buah *rockmelon* telah menyumbang kepada pelbagai masalah, termasuk kecederaan langsung kepada hasil tanaman dan ia juga bertindak sebagai pembawa penyakit yang akan mengakibatkan kerugian ekonomi. Penggunaan semburan racun perosak cenderung untuk memusnahkan atau menghalau kedua-dua serangga perosak dan pendebunga semulajadi. Pada masa kini, terdapat banyak bahan kimia sintetik digunakan di serata dunia dalam rawatan lepas tuai bagi buah-buahan dan sayur-sayuran, namun residu racun merupakan ancaman utama kepada kehidupan manusia. Kajian ini telah dijalankan untuk mengetahui kesan pendebungaan yang berbeza terhadap penghasilan buah *rockmelon*, mengkaji kesan racun serangga perosak terhadap lebah madu (pendebunga) di samping menilai kesan rawatan lepas tuai dalam memanjangkan jangka hayat *rockmelon* yang didebunga secara berbeza. Eksperimen pertama telah dijalankan di Ladang 10 dengan penanaman *rockmelon* dilakukan di bawah sistem teduhan hujan dan sistem teduhan terbuka. Manakala eksperimen kedua telah dijalankan di Makmal B jabatan sains taremah. Eksperimen pertama telah direka secara 3x2 faktorial (pendebungaan dan serangga perosak) dangan reka bentuk bersarang sebanyak 3 replikasi. *Rockmelon* didebunga menggunakan lebah madu, tangan dan semulajadi; *rockmelon* dirawat dengan ran perak dan tampa racun serangga. Eksperimen kedua menggunakan rekabentuk faktorial 2 x 4, yang dijalankan secara rekabentuk rawak lengkap (CRD) dengan empat replikasi. Ia dijalankan terhadap buah yang didebunga secara berbeza iaitu didebunga secara tangan dan didebunga menggunakan lebah madu. Rawatan air panas pada 55℃ juga dikaji mengikut masa celupan berbeza: 0 minit (kawalan) 1 minit, 2 minit dan 3 minit. Keputusan eksperimen pertama menunjukkan pendebungaan menggunakan lebah madu adalah lebih baik berbanding cara pendebungaan tangan dan semulajadi dengan pokok yang lebih tinggi (192.83 cm), lebih banyak bunga jantan (58.3) and bunga

betina (7.5), nisbah jantina yang lebih tinggi (11.5), masa berbunga yang lebih panjang (27.66), lebih bilangan buah (5.6) dan juga lebih berat buah (933.33 g). Untuk rawatan racun serangga dan tanpa racun serangga, keputusan menunjukkan bahawa kombinasi yang terbaik adalah plot dengan rawatan racun serangga yand mempunyai bilangan bunga jantan yang lebih banyak (6.55) dan nisbah jantina (10.22) berbanding dengan tanpa racun serangga. Keputusan rawatan pascatuai menunjukkan bahawa rawatan air panas memanjangkan jangka hayat buah *rockmelon*, rawatan selama 2 minit menghasilkan kehilangan berat terendah iaitu 11.9%, sementara rawatan 1 minit mempunyai kesegaran buah tertinggi (6.33 N), indeks brix dengan mengurangkan berat buah, mengkekalkan kesegaran, meningkatkan indeks brix (8.0 °Brix) dan kandungan jus (79.88 %), lebih ketebalan kulit (3.2.mm) dan rupa buah yang terbaik (3.75). Dari segi kekritikalan penyakit Fusarium, rawatan 2 minit mempunyai jangkitan terendah (1.0) berbanding rawatan kawalan. Walaubagaimanapun, keputusan regresi menunjukkan masa rendaman yang lama akan mengurangkan kualiti buah. Pada masa 3 minit rendaman, ia meningkatkan kehilangan berat, mngurangkan kesegaran, penurunan dalam penghasilan jus and rupa bentuk berbanding dengan 1 minit dan 2 minit rendaman. Pemerhatian juga menunjukkan bahawa *rockmelon* yang didebunga oleh lebah madu berupaya mengekalkan kualiti buah dalam masa tiga minggu penyimpanan berbanding dengan buah yang didebungan secara tangan dengan tangan.

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LIST OF ABBREVIATIONS

USEPA	United States Environmental Protection Agency
HWT	Hot Water Treatment
RCBD	Randomized Complete Block Design
DAT	Day After Transplanting
ANOVA	Analysis of Variance
LSD	Least Significant Difference
PDA	Potato Dextrose Agar
SEM	Scanning Electron Microscopy
CRD	Complete Randomized Design
PH	Plant Height
NF1	Number of Flowers
DF	Days of Flowering
NF2	Number of Fruit
FW	Fruit Weight
NLB	Number of Bee Landed
NBF	Number of Bees Fanning
NBG	Number of Bees Grooming
NDB	Number of Dead Bee
EC	Electrical Conductivity

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Rockmelon, scientifically known as (*Cucumis melo* L) is from Cucurbitaceae family, associated with muskmelon, pumpkin, squash, cantaloupe and other ground vine plants. They are found in the temperate area of Central Asia, Africa and the Mediterranean (Siddiq et al., 2012). Rockmelon has a very nice and delicious flavour, and it also has countless dietary attributes. Rockmelon had captured marketable value in numerous nations such as Europe, the United States and Asia (Sidik et al., 2012). Malaysia is one of the countries that imports rockmelon seed from other countries, especially Europe and Japan, as these cultivars are not created in this country (Norrizah et al., 2012). Malaysia has three kinds of melons, especially rockmelon, watermelon and honeydew. These melons are generally planted in the Peninsular Malaysia of Johor, Kedah, Kelantan, Melaka, Perak, Selangor and Terengganu with a total hectarage of 220,9 ha, a harvest area of 217,1 ha and a total output of 5634,4 Mt (DOA, 2016).

The best normal temperature range for melon production through the growing season is between 18℃ and 35℃ and availability of moisture during the growing season (Orzolek et al., 2006). Rockmelon flowers may be considered self-fertile but not self-fertilizing; therefore, pollen must be transmitted from the anthers to the stigma by cross-pollination or insects (Mayer, 2000). The produce of most fruit-bearing glasshouse vegetables rests on the achievement of fruit set, which is connected to pollination. The glasshouse pollination needs assistance because of the limited movement of air and high humidity (Chen et al., 2012). Pollination is assisted either by using mechanical vibration or by bees and other insects. However, pollen viability and the quantity of pollen, are dependent on temperature, which is also essential for successful pollination (Koller et al., 2016). Honeybees are economically the most vital set of pollinators around the world; 35 % of the world food production relies upon pollinators (Blacquière et al., 2012). A vast, dynamic honeybee populace is essential for the complete pollination and natural product set (Orzolek et al., 2006). The development of commercial crops includes crop improvement and protection methods such as preventing harm from pathogens, arthropods and weeds. Yields may be affected by pathogens that include fungi, bacteria and decay, competition for resources of nutrients with weeds and attack from insects throughout any stage of the growth and fruit maturing period.

Insecticide sprayed to flowers in blossom can unfavourably influence pollinating insect population. With insect pests tainting melons during bloom, care must be taken in the selection of insecticide during this critical period to reduce the effect of insecticide on the pollinating insects (Orzolek et al., 2006). Neonicotinoids are the developing class of insecticide in the world as far as utilization and market deals as they are enrolled in more than 120 countries and include 24% of the insecticide market and 80% of all insecticide are for seed treatment (Jeschke et al., 2011). Commercial producers frequently apply neonicotinoids for use on cucurbits. Even though neonicotinoids have magnificent insecticidal properties against the pest, they are high or modestly dangerous to honeybees (Nixon et al., 2014). Watermelons, muskmelons, and honeydews are delightful season delicacies. Melons must be harvested at the actual phase of maturity to get the best flavour. Once reaped, proper storage extends the shelf life for as long as possible (Richard, 2011). Freshly harvested fruit is highly perishable, and, naturally, there will be some decline in quality during the marketing process. The level of deterioration will depend on the care or mishandling of the produce during harvesting, handling, transportation and storage (Paltrinieri, 2014). Improving postharvest losses is a high significance for the entire supply chain. Lack of proper postharvest management and exposure to high temperature during supply chain and storage are the most severe environmental factors restraining long shelf life and freshness of fruits (Kiaya, 2014). Poor logistics such as the absence of refrigerating facilities can truly shorten the shelf life of melons. Thus, resulting in quality control problems which trouble the value of the end product, since the appearance and external situations are among priority features in determining the excellence of the final product (Masde et al., 2016).

1.2 Statement of the problem

Rockmelon is gaining a lot of importance due to its high production potential as well as its high nutritive value. The demand for melon in peninsular Malaysia is comparatively high, and this is supported by farmers' responses in the survey by Rantaian et al. (2015). The presence of insect pest in rockmelon has various problems, includes direct injury to the crop and acting as an insect vector to disease, which leads to economic losses. Use of insecticidal sprays tends to kill the pest, and it also affects the natural pollinators. Many synthetic chemicals are employed today for postharvest treatment of fruit and vegetables throughout the world, but the fungicidal residues often represent a significant threat to human life. There is ample indication in current literature that pre-harvest factors may affect the post-harvest fruit value of tropical and subtropical fruit (Arpaia, 1994). Efforts to understanding the character of preharvest factors on postharvest value draw the attention of this research into actively producing and controlling the quality of rockmelon produce and helps to make it participate in the quest for optimizing product quality.

Therefore, the objectives of this study are.

1. To determine the effect of different pollination methods on rockmelon production and to assess the effect of insecticide on honeybee as a pollinator.
2. To evaluate the effect of hot water treatments in prolonging the shelf-life of differently pollinated rockmelon

1.3 Significance of the study

The conclusions of this study will be of benefit to researchers, farmers, extension service workers and the policymakers to understand the best and efficient pollination method in producing rockmelon fruit. To reduce the effect of pesticide on honeybee activity and the effectiveness of hot water treatment on rockmelon fruit by prolonging its shelf. The result could be as a reference point for the relevant parties to take necessary actions in improving the yield, securing the honeybee, providing a favourable treatment for storage and affordable control of the disease.

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Abubakar M. M., Norida M., Rafii M. Y., Juju J. N. (2019). A Review Study of Warm Water Treatment on the Fungi Contamination, Value and Shelf life of Rockmelon Fruit. Asian Journal of Agriculture and Biology. UNDER REVIEW.

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