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Assessment of Melon Fertigation with Compost-Cocopeat Mix, Different Cultivars and Plant Boosters

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Abstract
Melon cultivation in Malaysia faces challenges in optimizing growth, yield, and sustainability under controlled environments. This study aimed to evaluate the effectiveness of integrating composted goat manure and cocopeat as a planting medium combined with fertigation strategies. A Randomized Complete Block Design (RCBD) was employed with two melon cultivars, Golden Melon Khaitongkham and Super Sweet D-165, across six treatment groups, including control, media ratios (70:30 and 50:50 cocopeat to compost), and foliar applications (agrodyke and an organic plant booster). Key growth parameters, including stem length, leaf count, fruit diameter, fruit weight, and Brix level, were measured and analyzed using SPSS. Results showed that the 50:50 mix significantly enhanced plant growth and fruit yield in Super Sweet D-165, while foliar treatments had a limited impact on yield but supported vegetative traits. The organic booster slightly outperformed Agrodyke in maintaining fruit weight. These results indicate that incorporating organic amendments with fertigation has the potential to enhance the performance of melon and can be utilized as a sustainable and economically viable method for cultivating high-value crops in Malaysia.
Keywords: fertigation system; melon cultivation; goat manure compost; organic amendment; sustainable agriculture

Introduction
The Golden Melon Khaitongkham and Super Sweet D-165 Melon belong to the family Cucurbitaceae, a large family of plants that primarily includes cucumbers, zucchinis, pumpkins, watermelons, and honeydew melons (Chomicki *et al.*, 2019). Cucurbitaceae, also known as the cucurbit family or melon family, comprises over 800 species (Schaffer and Paris, 2013), many of which are consumed at various stages, including immature and mature fruits, and seeds. Approximately 20 genera are widely used in cooking. Moreover, some species of cucurbits are also grown as ornaments because of their decorative shapes and colours.

The family is primarily located in tropical and subtropical regions, and some of the most economically valuable crop species in the world are found within this family. The cultivation of melons is a large-scale operation, primarily carried out in China, Turkey, and Iran (Masdek and Muhammad, 2016). Melons in Malaysia are primarily grown in the states of Johor, Kedah, Kelantan, Pahang, and Terengganu, which collectively account for major agricultural production, with a total production of 220,226 metric tonnes in 2014 (Masdek, 2020). Golden melon, specifically, is a high-demand crop due to its market value, hence a favourite among Malaysian farmers.

The popularity of the fertigation system in Malaysia has significantly impacted the production of melons in the country. Masdek and Muhammad (2016) estimate that 22 percent of all melon farmers in Malaysia adopt sophisticated technological fertigation, whereas 78 percent of farming operations are at the medium technological level. The process of fertigation, which is a synergy of irrigation and the accurate supply of nutrients, is cited to enhance crop productivity by regulating the electrical conductivity (EC) and pH levels during a drip system (Rural & Maria, 2014). In comparison to traditional techniques, fertigation allows for delivering nutrients to the roots of plants with a predetermined efficiency of uptake, along with a reduction in environmental effects (Liang *et al.*, 2014).

Furthermore, organic matter, such as goat manure compost, incorporated into fertigation is also beneficial for sustainable farming. The compost also enhances the soil's structure, helps enliven microbial activities, and increases the nutrients present. Specifically, goat manure has been demonstrated to have potential benefits in terms of biomass yield and nutrient content compared to other types of organic fertilizers (Vital *et al*., 2020). The study conducted by Handajaningsih et al. (2018) stated that potassium concentration in goat manure may reduce the need to utilize synthetic fertilizers, and Gichangi et al. (2010) focused on its use in optimizing the efficiency of phosphate fertilizers. Monteiro *et al*. (2013) also established that melon yield is positively correlated with enhanced soil nutrient availability resulting from compost amendments.

Based on the work of Garcia-Mas et al. (2012) and Fernandes et al. (2020), the current research investigates the potential of using a combination of goat manure, compost, and cocopeat through a fertigation system to maximize the growth performance and fruit quality of melons. The current project aims to identify suitable practices for sustainable and high-yield cultivation in Malaysian agricultural settings. This study will investigate the impacts of compost-based media and foliar application, aiming to maximize melon production while benefiting from the practice of green farming.

Materials and methods

The experiment was conducted under a netted rain shelter at Agrotani, Universiti Teknologi Malaysia (UTM), Skudai. A fertigation system was installed, consisting of a water pump, filter, and injector to supply nutrient solutions directly to the plant root zones via drip irrigation lines. Water was drawn and filtered to minimize the risk of clogging the injector. Then it was channelled through a fertigation injector that combined water-soluble fertilizer in specific quantities corresponding to the plant's needs. The solution, thus enhanced with nutrients, was then released in the roots of the plants using the emitters installed along the dripping lines. This fertigation method was used in conjunction with irrigation to provide the plants with an optimal nutrient supply during periods of maximum demand, as it minimizes losses and reduces nutrient leaching.

The experimental design followed a Randomized Complete Block Design (RCBD) with six treatments. Each treatment group consisted of 20 melon plants, giving a total of 140 plant samples. The growing medium used was a mixture of cocopeat and composted goat manure in various ratios. The media was sterilized using a 5% bleach solution, rinsed thoroughly, and allowed to dry for one day before planting to eliminate pathogens. Each polybag was filled with 1,500 grams of medium. In the 30 percent compost treatment, 450 grams of goat manure were added to 1,050 grams of cocopeat, and in the 50 percent compost treatment, 750 grams of each ingredient were added. In the case of Objective 1, a control treatment of 100 percent cocopeat was utilized, as well as T1 with a percentage composition of 70 percent cocopeat and 30 percent goat manure compost, and T2 with a 50:50 combination. For Objective 2, foliar spray treatments were applied: F1 used Agrodyke foliar spray, and F2 used an organic plant booster, both of which were grown in 100% cocopeat and received the same fertigation formulation.

Fertilization was managed using an AB stock solution system, where fertilizers A and B contained distinct macro- and micronutrient compositions. Equal measures of these stock solutions were combined and diluted in a 400-gallon tank with water until the desired electrical conductivity (EC) level was achieved as per formulation stipulations. The last nutrient solution was provided to the plants through the fertigation system, utilizing the main pipe complex. This system ensured efficient and uniform nutrient absorption across all treatments. The formulation of the AB solution and nutrient schedules throughout the planting period is provided in the respective tables.

Crop management practices included two phases of pruning during the melon growth cycle. Early pruning was done manually during this period (Week 2 to Week 6) and involved the removal of the oldest basal leaves, namely leaves 1 to 6. This promoted vertical growth, directing plant energy into the development of the main stem and flowers. Top pruning was undertaken in the later phase, which began in Week 7 and involved clipping off the uppermost leaves, especially those with numbers 25 and higher. This practice enhanced the infiltration and circulation of light and air inside the canopy of the plants, leading to healthier fruit growth and a decrease in the chances of disease occurrence.

The foliar application process differed among the treatment groups. The organic plant booster was made from dried fruit scraps, primarily bananas, which were dried at 70°C for seven hours to reduce moisture and accelerate decomposition. The dried material was then ground into powder form. The resulting booster was tested for pH and nutrient levels and then reconstituted in water until it reached an EC of 1.5 mS/cm. This solution was sprayed on plants at Weeks 4, 6, and 8 during cooler times of the day to enhance absorption through the leaf stomata. Agrodyke, the commercial foliar spray, was prepared by diluting 1–2 mL of the product per litre of water, as per manufacturer recommendations. The solution was mixed thoroughly and applied under similar conditions. Uniform coverage of both upper and lower leaf surfaces was ensured for effective nutrient uptake.

Pest and disease control measures were implemented weekly during early mornings or late afternoons. Post-transplantation, each plant received 100 mL of diluted Bayer Previcur 840 (3 mL per 10 litres of water) to prevent root rot. Spider mites were managed using Vintage 21.7EC and Comatec 21.6, alternated weekly, with each product diluted at 7.5 mL per 5 litres of water. Insect control was achieved using Bayer Decis 250, with a mixture of 5 ml per 5 litres of water. Additionally, Syngenta Amistartop and Antracol 70 WP were used as needed to prevent fungal infections. Throughout the pesticide and fungicide applications, personal protective equipment was used to ensure the safe handling of chemicals and to maintain safety standards.

Harvesting was performed at 70 DAT for both Golden Melon Khaitongkham and Super Sweet D-165 cultivars. A few days prior to harvest, fertigation was stopped to prevent excess moisture and nutrient accumulation in the fruits. Fruits were harvested manually, and data were collected during this process. Five fruits per treatment group were randomly selected for Brix analysis using a refractometer. Post-harvest, plants were removed from their polybags, and the used media were sterilized prior to disposal. Growth data, including stem length and leaf number, were recorded weekly to monitor development over the 10-week cultivation period.

Statistical analysis of all the collected data was conducted using SPSS version 29. T-tests of independent samples were utilized to compare the mean values of the treatment and control groups. The Levene test was initially used to test the homogeneity of variance, ensuring that the assumptions of the t-test were met. Additionally, Pearson correlation tests were conducted to determine the direction and strength of relationships between the growth parameters and fruit quality traits. These analyses made it possible to interpret the effects of the treatment and the policies they have on the cultivation of melons successfully.

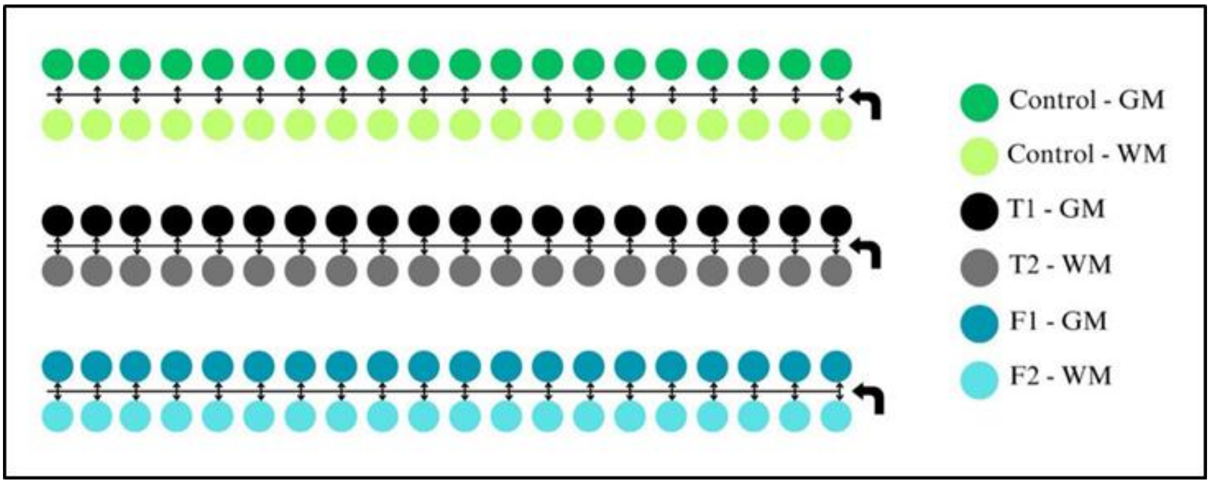

Figure 1 Layout of polybags in the greenhouse

Table 1: Plant nutrient supply

Week	Quantity (ml/day)	EC (mS/cm)	Duration (Mins: frequency)
1	200 - 500	1.50	1 min: 8, 9, 10, 11, 12, 1, 2, 3, 4, 5
2	400 - 600	1.65	2 mins: 8, 9, 10, 11, 12, 1, 2, 3, 4, 5
3	700	1.70 (+ 1 kg CN)	3 mins: 8, 9, 10, 11, 12, 1, 2, 3, 4, 5
4	800	1.80	4 mins: 8, 9, 10, 11, 12, 1, 2, 3, 4, 5
5	1200	2.20	6 mins: 8, 9, 10, 11, 12, 1, 2, 3, 4, 5
6	1200	2.35	6 mins: 8, 9, 10, 11, 12, 1, 2, 3, 4, 5
7	1500	2.50 (+ 1kg SOP)	7 mins: 8, 9, 10, 11, 12, 1, 2, 3, 4, 5
8	1500	2.60 (+ 1kg SOP)	7 mins: 8, 9, 10, 11, 12, 1, 2, 3, 4, 5
9	1500	2.80 (+ 1kg SOP)	8 mins: 8, 9, 10, 11, 12, 1, 2, 3, 4, 5
10	800	3.00 (+ 1kg SOP)	5 mins: 8, 9, 10, 11, 12, 1, 2, 3, 4, 5
11	Off	Off	Off

Results and discussion

Table 3 demonstrates the Golden Melon Khaitongkham variety, whose growth rate in the control group (27.26±0.29 cm/day) showed no significant difference compared to T1 (30% GMC), which recorded a similar growth rate of 27.32±0.25 cm/day ($p > 0.05$). This means that even with a 30% addition of the GMC, there was no pronounced increase in vegetative growth. No significant differences were observed in relation to fruit weight-to-length ratio between the control and treatment groups, as the ratio is similar in both groups. A statistically significant improvement was, however, detected in fruit diameter; T1 recorded a fruit diameter of 15.60±0.29 cm, while the control recorded a fruit diameter of 14.72±0.22 cm ($p<0.05$), suggesting that a 30% GMC has a sound efficacy in enhancing fruit girth.

Table 2: Effects of goat manure compost on plant growth and fruit quality of Golden Melon Khaitongkham

Treatments	Growth rate (cm/days)	Fruit weight (kg)	Fruit length (cm)	Fruit diameter (cm)
Control	27.26±0.29[a]	0.83±0.02[a]	7.42±0.24[a]	14.72±0.22[a]
T1 (30% GMC)	27.32±0.25[a]	0.94±0.04[a]	7.48±0.22[a]	15.60±0.29[b]

Notes: T1 = 70% Cocopeat + 30% Goat Manure Compost. Different letters indicate a statistically significant difference ($p<0.05$). Data were expressed as mean ± standard error mean (SEM) of analysis (N=5)

In contrast, the Super Sweet D-165 Melon cultivar, as shown in Table 4, responded more distinctly to higher compost inclusion. When compared with the control, the T2 treatment group (50% GMC + 50% cocopeat) reported exceptionally improved performance on all measured parameters. There was a growth rate increase in this order: 26.90±0.35 cm/day to 28.19±0.22 cm/day, and fruit weight improvement from 0.76±0.04 kg to 0.96±0.04 kg. Similarly, fruit length and diameter rose significantly, indicating that this particular cultivar benefited more from higher compost concentrations.

Table 3: Effects of goat manure compost on plant growth and fruit quality of Super Sweet D-165 Melon

Treatments	Growth rate (cm/days)	Fruit weight (kg)	Fruit length (cm)	Fruit diameter (cm)
Control	26.90±0.35[a]	0.76±0.04[a]	6.84±0.31[a]	14.22±0.25[a]
T2 (50% GMC)	28.19±0.22[b]	0.96±0.04[b]	7.65±0.09[b]	15.88±0.32[b]

Notes: T2 = 50% Cocopeat + 50% Goat Manure Compost. Different letters indicate a statistically significant difference ($p<0.05$). Data were expressed as mean ± standard error mean (SEM) of analysis (N=5)

As indicated by the study, goat manure compost can increase the growth and quality of the melons as well as increase the availability of nutrients and soil activity. The difference in responses between Golden Melon Khaitongkham and Super Sweet D-165 indicates that both cultivars respond differently to compost, possibly due to genetic differences. While higher compost rates improved growth in Super Sweet D-165, the same was not observed for Khaitongkham, indicating the need for cultivar-specific compost strategies. Overapplication, however, may lead to nutrient stress, so optimal rates must be carefully managed.

Table 5 analysis shows that for the Golden Melon Khaitongkham variety that the growth rate of the agrodyke-treated group is slightly higher (27.62±0.24 cm/day) than in the control (27.26±0.29 cm/day), but there is no significant difference ($p > 0.05$) between these two treatments, indicating limited bearing over vegetative growth. Nonetheless, the weight of the fruit in the agrodyke treatment (0.70 ± 0.03 kg) was significantly lower than that in the control (0.83 ± 0.02 kg), and this may be detrimental to fruit growth ($p < 0.05$). There were no significant differences in fruit length and diameter, while slight reductions in the agrodyke-treated group were observed.

Table 4: Effects of agrodyke application on plant growth and fruit quality of Golden Melon Khaitongkham

Treatments	Growth rate (cm/days)	Fruit weight (kg)	Fruit length (cm)	Fruit diameter (cm)
Control	27.26±0.29^{a}	0.83±0.02^{a}	7.42±0.24^{a}	14.72±0.22^{a}
F1 (Agrodyke)	27.62±0.24^{a}	0.70±0.03^{b}	6.66±0.22^{a}	14.04±0.19^{a}

Notes: F1 = Treatment of Golden Melon Khaitongkham with foliar spray using Agrodyke. Different letters indicate a statistically significant difference ($p<0.05$). Data were expressed as mean ± standard error mean (SEM) of analysis (N=5)

Table 6 demonstrates the Super Sweet D-165 Melon; there was a slight increase in the growth rate after the organic plant booster application (27.55±0.19 cm/day) compared to the control (26.90±0.35 cm/day), but this difference was not statistically significant. Fruit weight in the organic treatment group (0.66±0.03 kg) was also lower than in the control (0.76±0.04 kg), although this difference was not significant ($p > 0.05$). The length and diameter of fruits were similar between the two groups, indicating that the foliar booster had little impact on fruit morphology.

Table 5: Effects of organic plant booster application on plant growth and fruit quality of Super Sweet D-165 Melon

Treatments	Growth rate (cm/days)	Fruit weight (kg)	Fruit length (cm)	Fruit diameter (cm)
Control	26.90±0.35^{a}	0.76±0.04^{a}	6.84±0.31^{a}	14.22±0.25^{a}
F2 (Organic)	27.55±0.19^{a}	0.66±0.03^{a}	6.52±0.19^{a}	14.06±0.29^{a}

Notes: F2 = Treatment of Super Sweet D-165 Melon with foliar spray using Organic Plant Booster. Different letters indicate a statistically significant difference ($p<0.05$). Data were expressed as mean ± standard error mean (SEM) of analysis (N=5)

Between the two foliar treatments, the organic plant booster showed slightly better performance, maintaining fruit weight more effectively than Agrodyke, which resulted in a significant reduction. Both treatments, however, did not result in a significant increase in yield. The reason why the fruit weight has reduced could be that the small amount of nutrients provided through the foliar sprays failed to meet the demands of the fruits under high reproductive loads. Although both treatments facilitated certain vegetative growth, they did not have a significant effect on the yield. These results highlight the drawbacks of ensuring fertilization solely through foliar applications and emphasize the need to employ a combination of methods, including fertilization on both the roots and leaves, to promote equal nutrient delivery and higher melon productivity.

Table 7 analysis reveals Brix levels in *Golden Melon Khaitongkham* were unaffected by agrodyke (10.47±0.09% vs. control: 10.37±0.19%, $p > 0.05$). However, Super Sweet D-165 showed a significant increase with organic treatment (11.10 ± 0.21% vs. control: 10.33 ± 0.18%, $p < 0.05$). On the other hand, the organic-treated group, with a Brix level of 10.33±0.18%, showed a significant increase in Brix level compared to the control sample, at 11.10±0.21%. In the case of the Super Sweet D-165 Melon, a virtually identical Brix value was reported; the agrodyke treatment and organic foliar treatments yielded results that were very close to the control (10.33±0.18%).

Table 6: Effects of foliar application on Brix values

Brix percentage (%) for foliar application			
Golden Melon Khaitongkham		**Super Sweet D-165 Melon**	
Control	10.37 ± 0.19^{a}	Control	10.33 ± 0.18^{a}
F_1 (Agrodyke)	0.47 ± 0.09^{a}	F_2 (Organic)	11.10 ± 0.21^{b}

Notes: Different letters indicate a statistically significant difference ($p<0.05$). Data were expressed as mean ± standard error mean (SEM) of analysis (N=3)

The results indicate that organic foliar application significantly increased sugar content in Super Sweet D-165 Melon, while agrodyke showed no such effect. No significant changes were observed in *Golden Melon Khaitongkham* for either treatment. The improved sugars can be attributed to the high levels of potassium and magnesium in the banana-based organic control solution, which sustains osmotic balance and enhances photosynthesis. Organic applications also enhance the availability of phosphorus and potassium to the soil, as these are the primary nutrients essential for sugar accumulation. Super Sweet D-165 exhibited this effect more strongly, likely because it is more responsive to nutrient inputs in the form of organic materials.

Conclusion

This study highlighted the effectiveness of integrating goat manure compost (GMC) with cocopeat in fertigation systems for melon cultivation. A 50:50 GMC-cocopeat blend significantly enhanced plant growth, particularly in Super Sweet D-165 Melon, which outperformed Golden Melon Khaitongkham in fruit weight and Brix content. Although the AB fertilizer provided a consistent supply of nutrients to the plant, the foliar ones, like Agrodyke and the organic plant booster, were mainly to stimulate vegetative yield, with the organic booster showing slight superiority in sustaining fruit quality. These observations lend more weight to the use of root-zone nutrient management over foliar applications in maximizing yields. The research paper can be used to promote sustainable agricultural practices in the field of horticulture because the researcher confirmed the application of goat manure compost as a resource supporting the health of plants and biological processes in the soil, and proving less dependency on chemical fertilizers.

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