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Comparison of bracket pot, tunnel, and vine rope planting system on pure line selection of oriental melon makuwauri

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Abstract. This study aimed to obtain the right planting system in a greenhouse-scale oriental makuwauri melon plant breeding program and knowing the interaction between the line and the oriental melon growing system at the greenhouse scale. The research design used a Randomized Complete Block Design (RCBD) with two factors, namely melon lines (ougan makuwauri and ginsen makuwauri), and planting systems (tunnel, bracket pot, and vines rope), repeated four times. Observational data were analyzed using analysis of variance and least significant different (LSD) test at 5% levels. The results showed that the best planting system is the bracket pot. This planting system has a unique and attractive appearance as well as more optimal growth compared to tunnel systems and vines rope. Based on the qualitative variable data tested, namely vine length (122.25 cm), stem diameter (0.79 cm), and petiole length (11.86 cm), the bracket pot planting system was significantly different from the tunnel and vines rope planting system. There was an interaction between the lines and the planting system on the observed variables, namely vine length, number of leaves, leaf width, leaf length, petiole length, and stem diameter. This research indicates that bracket pot planting system is recommended for oriental melon plant breeding program.

1 Introduction

The cropping system is a system that is used to maximize land function and is expected to increase land productivity and to increase farmer income [1]. The need for melons in the country continues to increase every year in line with the diet of the population that requires fresh fruit [2]. Melon production in Lampung province in the last three years has increased, namely in 2018, 2019, and 2020, 479 tons, 494 tons, and 622 tons respectively, with a harvested area of 99 hectares [3]. Some of the most widely grown and marketed melon varieties are the Skyrocket Melon, Rock Melon, and Golden Melon varieties. These varieties have their characteristics such as fruit shape, fruit color, taste, level of sweetness, skin color, and size. Character differences depend on the variety grown, and the environment, and are influenced by cultivation techniques [4].

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Melon production in Lampung province has also increased, in line with the increasing demand for seeds. One of the obstacles in the production of melon seeds is cultivation techniques. Until now, melon varieties circulating in Indonesia still rely on imports from Taiwan, Thailand, and Japan. Melon seed production must be of high quality so that seed availability at the national level can be met. The varieties produced must be superior and the seeds must be of high quality so that their existence is expected to replace imported seeds [5]. Seed production in a greenhouse aims to facilitate the control of some environmental factors that affect plant growth, these environmental factors include air temperature, sunlight, air humidity, wind speed, and nutrients in controlling pests and diseases are easy to control because these environmental factors controlled by planting in a greenhouse [6]. This study aimed to obtain the right cropping system in a greenhouse-scale oriental makuwauri melon plant breeding program, knowing the right line for the planting system being tested, and knowing the interaction between the line and the oriental melon growing system at the greenhouse scale.

2 Method

This research was conducted in June-September 2021 at the Seed Teaching Farm (STEFA) of the Politeknik Negeri Lampung. This study used a Randomized Block Design (RCBD), with two factors, namely the cropping system (bracket pot, tunnel, vines rope) and oriental melon (Ginsen and Ougan Makuwauri cultivar). Observations were made on quantitative characters. There were four replications. The data obtained were analyzed using the 5% F-test, and then continued using the LSD-test at the 5% and 1% levels.

Fig 1. The cropping system of tunnel, bracket pot, and vine rope

Quantitative observation (18 variables):

a. The length of the tendrils (cm) was carried out when the plants were seven days after planting (DAP) with an interval of seven days until the plants entered the flowering phase.
b. The number of leaves was counted when the plants were seven days after planting (DAP) and carried out every seven days for four weeks.
c. Stem diameter (cm) was measured when the plants were 51 DAP. Observations were made on the stem under the cotyledons.
d. Leaf length (cm), was carried out when the plant was 37 days after planting DAP, observations were made on the 21st leaf.
e. Leaf width (cm), measured when the plant was 37 DAP, observed on the 21st leaf.
f. Stem length (cm), measured when the plant was 37 days after planting (DAP), on the 21st leaf.
g. Age of flowering, carried out when the plants enter the flowering phase is calculated when the plants are 50% flowering.

h. Pollination age, carried out when the female flowers appear 50% pollination taken on the 7th-14th tendrils.
i. Harvest age, calculated when the plants are 70-75 days after planting.
j. Fruit weight (gr), carried out at harvest, weighing is done on each fruit.
k. Fruit length (cm), was carried out during postharvest, by splitting the fruit into two parts and then measuring its length.
l. Fruit width (cm), was carried out during postharvest, by dividing the fruit into two parts and then measuring the width of the fruit.
m. The thickness of the fruit flesh (cm) was carried out during postharvest, together with the measurement of the length and width of the fruit.
n. Total dissolved solids (% Brix), carried out at the time of postharvest, by taking part of the fruit flesh and measured using a refractometer.
o. Seed weight (g), carried out at the time of postharvest, when the seeds are dry and ready to be stored.
p. The number of seeds per fruit, carried out on each fruit per sample.
q. Weight of 1000 seeds (gr), carried out at postharvest.

3 Result and Discussion

The results showed that the planting system, lines, and their interaction has significant effect in tendril length, leaf length, and petiole length. The lines (makuwauri) has a significant effect in the number of leaves but the planting system and interaction of lines and planting system did not significant effect. The planting system, lines, and their interaction has not significant effect in fruit weight, sugar content, fruit length, fruit width, fruit thick flesh, the number of seeds, and 1000 seeds weight. The recapitulation of quantitative observations is presented in Table 1.

Table 1. Recapitulation of quantitative observations.

Variables	F-test						CV (%)
	A (planting system)		B (lines or cultivars)		A x B		
Tendril length	5.18	*	40.71	**	7.75	**	10.23
The number of leaf	3.10	ns	50.59	**	2.22	ns	5.46
Leaf width	3.11	ns	14.15	**	10.37	**	8.79
Leaf length	9.06	**	57.95	**	37.08	**	5.33
Petiol length	14.87	**	19.53	**	10.40	**	11.01
Stem diameter	0.70	ns	3.10	ns	3.59	*	9.73
Fruit weight	0.56	ns	2.25	ns	0.20	ns	19.90
Sugar content	1.28	ns	1.26	ns	0.31	ns	10.92
Fruit length	0.12	ns	1.14	ns	0.91	ns	8.04
Fruit width	1.58	ns	0.15	ns	0.19	ns	4.03
Fruit thick flesh	0.96	ns	0.44	ns	1.82	ns	15.37
The number of seeds	0.78	ns	0.68	ns	1.69	ns	19.72
1000 seeds weight	0.41	ns	2.00	ns	0.33	ns	25.02

Notes : CV): Coefficient of Variance; *): Significant different; **): very significant different; ns): not significant differents.

Cultivation of oriental melon in the greenhouse scale has connection with temperature condition. Too high a temperature causes high transpiration and then the respiration increases. The decomposition of photosynthesis to produce energy decreases, the activity of enzymes in the photosynthetic process is disrupted so that the photosynthate yield decreases.

Air temperatures that are too high can affect nutrient uptake, causing plants to wither, as a result the plants will die [7].

The results of the statistical analysis showed that the treatment of different planting systems on the length of the tendrils of melon plants was different between the tunnel, bracket pot, and vines rope. This is in line with the statement that between treatments shows that the length of the tendrils of different melon plants can be caused by environmental factors such as rainfall, temperature, and humidity [8]. The tendril length data is presented in Table 2.

Tabel 2. Interaction between lines and planting systems on plant tendril length

Lines	Tendril length (cm)		
	Tunnel	Bracket pot	Vines rope
OM	113.73 a	122.25 a	120.95 a
	B	A	A
GM	103 b	100.62 b	69.37 b
	A	A	B
LSD 5%	8.094		

Note: The numbers in each column and row followed by the same letter are not significantly different at the 5% LSD test levels. Lowercase letters denote the notation for the treatment of cropping systems, while capital letters denote the lines.

The results of statistical analysis between the influence of the ougan makuwauri (OM) lines and the planting system showed that the largest diameter in the vines rope plating system was 0.86 cm and the smallest diameter in the tunnel planting system was 0.74 cm, which was not significantly different from the bracket pot and vines rope planting system. The results of statistical analysis between the effect of the ginsen makuwauri (GM) lines and the planting system on stem diameter, showed that the bracket pot planting system had the largest stem diameter of 0.79 cm and the smallest stem diameter in the vines rope planting system, which was 0.69 which was significantly different from the tunnel planting system and vines rope. The pruning of melon plants will have a real effect on stem diameter [9]. Interaction data between lines and planting systems on stem diameter is presented in Table 3.

Tabel 3. Interaction between lines and planting systems on stem diameter

Lines	Stem diameter (cm)		
	Tunnel	Bracket pot	Vines rope
OM	0.74 a	0.79 a	0.86 a
	B	B	B
GM	0.75 a	0.79 a	0.69 b
	A	A	B
LSD 5%	0.05		

Note: The numbers in each column and row followed by the same letter are not significantly different at the 5% LSD test levels. Lowercase letters denote the notation for the treatment of cropping systems, while capital letters denote the lines.

The results of statistical analysis (Table 4) between the effect of OM lines and the planting system on leaf length showed that the vines rope planting system had the largest leaf length (13.95 cm), and the smallest leaf length in the bracket pot planting system was 12.16 cm, which was significantly different. The results of the influence of the GM lines on the planting system showed that the bracket pot planting system had the largest value (12.35 cm) and the smallest value in the vines rope planting system (8.81 cm), which had a significant effect on the tunnel and bracket pot planting systems.

Tabel 4. Interaction between lines and planting systems on leaf length

Lines	Leaf length (cm)		
	Tunnel	Bracket pot	Vines rope
OM	13.27 a	12.16 a	13.95 a
	A	B	A
GM	12.2 a	12.35 a	8.81 b
	A	A	B
LSD 5%	0.48		

Note: The numbers in each column and row followed by the same letter are not significantly different at the 5% LSD test levels. Lowercase letters denote the notation for the treatment of cropping systems, while capital letters denote the lines.

The results of statistical analysis (Table 5) between the effect of the OM line and the planting system on leaf width showed that the vines rope planting system had the highest leaf width (16.26 cm) and the smallest leaf width in the tunnel planting system (15.01 cm), which was not significantly different from the bracket pot planting system and vines rope. The results of the analysis between the effect of the GM lines and the planting system on leaf width showed that the tunnel planting system had the highest leaf width (15.05 cm) and the smallest leaf width value in the vines rope planting system which was significantly different from the tunnel and bracket pot planting systems.

Tabel 5. Interaction between lines and planting systems on leaf width

Lines	Leaf width (cm)		
	Tunnel	Bracket pot	Vines rope
OM	15.01 a	15.26 a	16.26 a
	A	A	A
GM	15.05 a	14.63 a	10.96 b
	A	A	B
LSD 5%	0.96		

Note: The numbers in each column and row followed by the same letter are not significantly different at the 5% LSD test levels. Lowercase letters denote the notation for the treatment of cropping systems, while capital letters denote the lines.

The results of the analysis (Table 6) between the OM lines and the planting system for petiole length showed that the bracket pot planting system had a petiole length of 11.86 cm, while the shortest petiole length was found in the tunnel planting system (8.93 cm), which was significantly different from the bracket pot planting system. and rope vines. The results of the analysis between the GM lines and the planting system for petiole length showed that the tunnel planting system had the longest petiole, which was 9.89 cm and the smallest petiole length in the rope vines planting system, which was 5.99 cm, which was significantly different from the tunnel planting system and pot brackets.

Tabel 6. Interaction between lines and planting systems on petiole length

Lines	Petiole length (cm)		
	Tunnel	Bracket pot	Vines rope
OM	8.93 b	11.86 a	10.13 a
	B	A	A
GM	9.89 a	9.85 a	5.99 b
	A	A	B
LSD 5%	0.77		

Note: The numbers in each column and row followed by the same letter are not significantly different at the 5% LSD test levels. Lowercase letters denote the notation for the treatment of cropping systems, while capital letters denote the lines.

Leaf length and leaf width are related with the process of plant photosynthesis is influenced by environmental factors such as sunlight, nutrients, CO_2, water and growing space. The higher the intensity of solar radiation, the wider the leaves are produced because plants adapt by expanding the field of photosynthesis. CO_2 concentrations within the greenhouse decrease rapidly and cannot meet the needs of photosynthesis, affecting both the yield and quality of the crop [10]. The oriental melon (*Cucumis melo* var. *makuwa* Makino) belongs to Cucurbitaceae family and is an annual vegetable crop that is native to China, Japan and India. The fruit is used as the edible organ, and the growth period is approximately 90 days. It is generally cultivated in solar greenhouses in winter in Northern China; however, the lack of CO_2 limits production during winter/spring and autumn/winter. To counteract this, studies suggest that CO_2 enrichment can promote photosynthesis and water use efficiency, enhancing plant growth [11,12,13]. Under suitable cultivation conditions, CO_2 fixation can affect the photosynthetic capacity of plants [14]. Previous experimental studies found that CO_2 enrichment can promote plants to capture light energy and CO_2 fixation, improving the photosynthetic rate, and thus, enhancing the photosynthetic capacity of the plant [15,16,17].

4 Conclusion

The best planting system is the bracket pot. This planting system has a unique and attractive appearance as well as more optimal growth compared to tunnel systems and vines rope. Based on the qualitative variable data tested, namely vine length (122.25 cm), stem diameter (0.79 cm), and petiole length (11.86 cm), the bracket pot planting system was significantly different from the tunnel and vines rope planting system. There was an interaction between the lines and the planting system on the observed variables, namely vine length, number of leaves, leaf width, leaf length, petiole length, and stem diameter. This research indicate that bracket pot planting system can increased production of melon.

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