Test on Cayenne chili (Capsicum frutescens L.) varieties on different growing media bioponically

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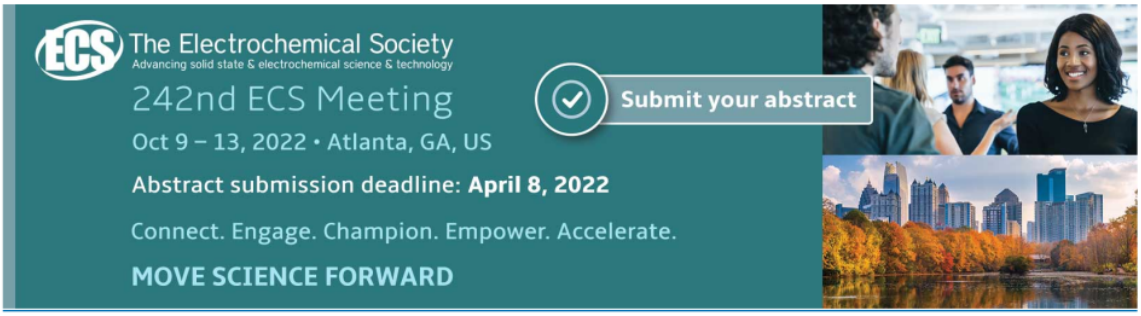

Test on Cayenne chili (*Capsicum frutescens* L.) varieties on different growing media bioponically

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Abstract. The research aims to determine the varieties and composition of the planting media that provide the best growth and production, to determine which varieties provide the best growth and production of chili plants, one of the compositions of the planting medium that provides the best growth and production of chili plants, and to determine the parameters that high heritability value. The research took place from January to April 2019. The study used a separate plot design. The main plot is the composition of the planting medium which consists of 3 types of composition, namely: Burnt Husk, Cocopeat, and Baked Husk: Cocopeat 1: 1. Sub-plot, namely cayenne pepper, 5 varieties of chili, namely: Bara, Pelita 8 F1, Merapi, Sonar, and Centil. The results showed that the treatment that gave the highest growth and production was the treatment of cocopeat growing media with Sonar varieties with a value of 10.22 g / plant. The planting medium that gave the highest growth and production was the treatment of roasted husk growing media: cocopeat 1: 1 with a value of 8.68 g / plant. The variety that had the highest growth and production was the Sonar variety treatment with a value of 9.43 g / plant. Parameters that give high heritability are plant height, number of productive branches, flowering age, harvest age, fresh root weight, root volume, number of fruit harvested, production, and fruit length.

1. Introduction

Indonesia is an agricultural country, in 2009, as many as 43,029,493 Indonesians or 41.18 percent of the total Indonesian workforce worked in the agricultural sector [1]. An agricultural country the role of the agricultural sector is very important in supporting the national economy, especially as a provider of food, clothing and shelter for the entire population, as well as a producer of non-oil and gas export commodities to attract foreign exchange. The agricultural sector consists of several sub-sectors, namely the horticultural sub-sector, food crops, plantations, fisheries, forestry and livestock [2].

Cultivation of chili in lowland generally has advantages and disadvantages. One of the advantages is that the light intensity is higher then the planting area is wider and there is no slope, making it easier to cultivate chilies in the lowlands. In addition, the lowlands also have shortcomings, including the number of pests and diseases caused by high temperatures which can damage and reduce the quality and production of chili plants [3]. Disease disorders in chili plants are very complex, both in the rainy season and in the dry season which can cause considerable losses. Anthracnose is a scourge for chili farmers because it can destroy crops by 20-90%, especially during the rainy season. The fungus that causes anthracnose disease develops very rapidly when the humidity is high enough, namely when relative humidity is more than 80% with a temperature of 32 ºC [4]. Therefore, hydroponic farming methods are

used to overcome the problems of pests and diseases in the rainy season and the problem of high temperatures.

Cultivation of cayenne pepper can be done by hydroponics. One of the advantages of the hydroponic system is that plants can be cultivated in controlled environmental conditions [5]. In a hydroponic system, environmental factors such as water availability, temperature, and relative humidity can be regulated, besides that there are fewer plant pests. The planting medium functions as a place to hold the roots of the planted plants and to absorb the nutrient solution when watered or dropped. The hydroponic system that is currently being widely applied is the substrate hydroponic system [6]. The use of substrates in hydroponic systems is considered to be able to bind water and nutrients so that they are available for plants. The substrates that are widely used are roasted husk and cocopeat. The roasted husk is the result of burning from rice husks which is then used as a planting medium, especially in hydroponic systems. Its crumbly structure allows the burnt husk media to have good aeration for plant root growth [7]. Cocopeat is an organic growing medium made from coconut husk powder. Because it is organic, it can be said that cocopeat is an environmentally friendly growing medium. Cocopeat is a planting medium that has very high water absorption, has a pH range between 5.0-6.8 and is quite stable, so it is good for root growth.

Based on the results of Wibowo's research [8], giving husk charcoal growing media gave the best results from each treatment on the parameters of the number of leaves 11.75 and leaf area of 537.36 cm2 / plant. Whereas from the results of Laksono's [9] research, the optimal EC value of Cocopeat was 2.0-2.5 mS cm^{-1} with a maximum fresh weight per plant yield of 168, 31 g. cocopeat) the optimal EC value is 2.0 - 2.5 mS cm^{-1} with a maximum yield of 180.[illegible]g of fresh weight per plant.

Based on the description, one of the steps taken to increase the growth and production of chili plants, it is necessary to conduct research on the test of several varieties of cayenne pepper (*Capsicum frutescens* L.) on various plant media compositions bioponically. The purpose of this study was to determine the varieties and composition of the growing media that provide better growth and production of chili plants.

2. Methodology

The research was conducted in a screen house in Tamalanrea District, Makassar City. The research was conducted from January to April 2019. This study used a separate plot design (RPT). The main plot is the composition of the planting medium which consists of 3 types of composition, namely: Burnt Husk (m1), Cocopeat (m2), and Burnt Husk: Cocopeat 1: 1 (m3). Meanwhile, sub-plots are cayenne pepper 5 varieties, namely: Bara (v1), Pelita 8 F1 (v2), Merapi (v3), Sonar (v4), and Centil (v5). Thus there are 15 treatment combinations, each treatment has 2 experimental units and is repeated 3 times so that there are 90 experimental units.

2.1. Preparation of seed sowing

The method of sowing the seeds is by preparing a tray for the seedlings that have been filled with Rockwool and then moistened with water. Before sowing the chili seeds, they are soaked in warm water for about 30 minutes. The Rockwool which has been moistened with water is then made a planting hole of + 0.5 cm, then insert two chili seeds into the Rockwool. After sowing the chili seeds, cover the seedling trays with black plastic or plastic mulch and place them in the shade to keep them moist.

2.2. Growth media preparation and planting

Making the planting medium is done by inserting each of the roasted husks (M1), cocopeat (M2) and mixing the roasted husk: cocopeat 1: 1 (M3) into a plastic pot up to a quarter of the pot.

The seeds that have been sown can be transferred after the age of + 30 days or the chili seeds have 4-5 leaves. Planting is carried out by making a planting hole with a depth of 5 cm in a plastic pot that has been arranged in each hydroponic installation hole which is supplied with water.

Making planting media in plastic pots is done by perforating the bottom of the pot using a grinder with a size that matches the netpot. Next, put rockwol and flannel with a size of 2 cm x 15 cm into the netpot.

Then connect the netpot to the bottom of the plastic pot that has been perforated so that the hole in the plastic pot is covered by the netpot. After that, put the planting medium into a plastic pot and the seed planting process is carried out. The seeds that have been planted in plastic pots are then arranged in each hydroponic installation hole (figure 1).

Figure 1. Planting Cayenne chili (A), Arrangement of plastic pots in hydroponic installation (B).

2.3. Plant maintenance

Maintenance activities include embroidering plants, giving Nasa POC, and checking water. Replanting is done by replacing and removing damaged, dead or declining (unhealthy) plants in growth. The Liquid organic fertilizer (POC Nasa) was given by dissolving liquid organic fertilizer (POC Nasa) at a dose of 6 mL per 1 L of water and putting it in a reservoir. Water testing and addition of POC Nasa were carried out every 2 days (figure 2). Harvesting is done after the plants are about 65-75 days after transplanting, the plants are harvested on fruits that meet the harvest criteria, namely all parts of the fruit are orange to red (figure 3).

Figure 2. Application of POC Nasa: (A) The solution (B) Addition of POC Nasa.

Figure 3. Harvest of cayenne pepper plant.

2.4. Observation parameters

Parameters observed and measured were plant growth parameters such as plant height, number of productive branches, age to flowering, and harvest age, root growth such as root length and volume, and root fresh weight. In addition, observations were made on production parameters, namely the number of fruit harvested, fruit length and production.

2.5. Data analysis

2.5.1 Analysis of Variance. The data obtained from the observations were analyzed using one-way anova according to the separate plot design (RPT). If it was significantly different, a further analysis was carried out by the LSD test (α = 0.05).

2.5.2 Heritability. Based on the analysis of variance, it is also used for heritability analysis, while the formula according to Stansfield (1983).

3. Results

3.1. Effect of growing media on plant height and number of productive branches.

The variance analysis showed that the interaction between the treatment of the growing medium and the variety had a significant effect on plant height and the number of productive branches of cayenne pepper planted hydroponically. Response of five cayenne pepper varieties were varied with growing media used (table 1).

Table 1 shows that the treatment of roasted husk planting medium with the Merapi variety (M1V3) had the highest plant height (101.75 cm), significantly different from the plant height of other varieties. Whereas in the planting medium for burnt husk with the Merapi variety (M1V3) it was not significantly different from the planting medium for cocopeat (M2V3), but was significantly different from the height of the plant in the planting medium for roasted husk: cocopeat 1: 1 (M3V3). The centil variety with the planting medium of cocopeat (M2V5) had the lowest plant height (50.17 cm).

The treatment of roasted husk planting medium: cocopeat 1: 1 with Centil (M2V5) variety had the highest number of productive branches (68.83), significantly different from the number of productive branches in other varieties. Whereas in the planting medium of roasted husk: cocopeat 1: 1 with Centil variety (M3V5) was significantly different from the number of productive branches in each of the other growing media treatments. Merapi varieties with roasted husk growing media: cocopeat 1: 1 (M3V3) had the lowest number of productive branches (19.17).

Table 1. Average plant height (cm) and number of productive branches of five varieties of cayenne pepper hydroponically on various types of planting media.

Variety	Growing Media			$LSD_{0.05}$ [Variety]
	RHC	Cocopeat	RHC+Cocopeat 1:1	
	Plant height (cm)			
Bara	59.58^{cd}_{r}	81.50^{a}_{p}	65.00^{b}_{q}	
Pelita 8 F1	85.67^{b}_{p}	83.33^{a}_{p}	81.67^{a}_{p}	
Merapi	101.75^{a}_{p}	88.83^{a}_{pq}	81.83^{a}_{p}	12.41
Sonar	67.17^{c}_{p}	63.50^{b}_{p}	63.83^{b}_{p}	
Centil	50.50^{d}_{p}	50.17^{b}_{p}	57.00^{b}_{p}	
$LSD_{0.05}$ [Growing Media]		14.57		
	Number of productive branches (branch			
Bara	5.29^{b}_{p}	6.24^{b}_{p}	5.83^{b}_{p}	
Pelita 8 F1	6.12^{b}_{q}	7.32^{b}_{q}	9.41^{a}_{p}	
Merapi	8.21^{a}_{q}	6.21^{b}_{q}	10.03^{a}_{p}	6.87
Sonar	9.47^{a}_{p}	10.22^{a}_{p}	8.62^{a}_{p}	
Centil	8.31^{a}_{p}	9.93^{a}_{p}	9.51^{a}_{p}	
$LSD_{0.05}$ [Growing Media]		1.30		

Numbers followed by different letter on the same column (a,b,c,d) and same row (p,q) means significantly different based on $LSD_{0.05}$.

3.2. *Effect of growing media on root length, root volume, and root fresh weight.*

The analysis of variance shows that the treatment of growing media and growing media significantly affects root growth of the cayenne pepper (table 2).

Table 2 shows that the treatment of roasted husk media with Sonar (M1V4) variety had the highest root length (55.83 cm), significantly different from the root length of other varieties. Meanwhile, the planting medium of roasted husk with Sonar (M1V4) varieties was significantly different from the root length in each of the other growing media treatments. Centil variety with roasted husk (M1V5) planting medium had the lowest root length (28.25 cm).

The treatment of roasted husk with the Merapi variety (M1V3) had the highest root fresh weight (85.33 g), which was significantly different from the root fresh weight of other varieties. Meanwhile, the planting medium of roasted husk with the Merapi variety (M1V3) was significantly different from the fresh weight of the roots in each of the other growing media treatments. Centil variety with cocopeat husk media (M2V5) had the lowest root fresh weight (24.67 g).

The treatment of roasted husk: cocopeat 1: 1 with the Merapi variety (M3V3) had the highest root volume (54.33 mL), which was significantly different from the root volume of other varieties. Meanwhile, the planting medium of roasted husk: cocopeat 1: 1 with the Merapi variety (M3V3) was significantly different from the root volume in each of the other growing media treatments. Centil variety with roasted husk media: cocopeat 1: 1 (M3V5) had the lowest root volume (17.17 mL).

Table 2. Average root length (cm), root volume (mL), root fresh weight (g) of five varieties of cayenne pepper hydroponically on various types of planting media.

Variety	Growing Media			$LSD_{0.05}$ [Variety]
	RHC	Cocopeat	RHC+Cocopeat 1:1	
	Root length (cm)			
Bara	43.67^{b}_{p}	36.17^{a}_{p}	39.33^{a}_{p}	
Pelita 8 F1	39.17^{bc}_{p}	30.50^{a}_{q}	31.33^{b}_{pq}	
Merapi	34.00^{cd}_{p}	33.83^{a}_{p}	33.50^{ab}_{p}	7.36
Sonar	55.83^{a}_{p}	32.50^{a}_{q}	36.17^{ab}_{q}	
Centil	28.25^{d}_{q}	36.50^{a}_{p}	36.50^{ab}_{p}	
$LSD_{0.05}$ [Growing Media]		8.12		
	Root volume (mL)			
Bara	26.67^{b}_{q}	25.00^{c}_{q}	39.00^{b}_{p}	
Pelita 8 F1	38.33^{a}_{p}	25.00^{c}_{q}	39.83^{b}_{p}	6.66
Merapi	43.33^{a}_{q}	46.67^{a}_{q}	54.33^{a}_{p}	
Sonar	42.50^{a}_{p}	35.00^{b}_{q}	35.33^{b}_{q}	
Centil	26.67^{b}_{q}	27.83^{c}_{p}	17.17^{c}_{q}	
$LSD_{0.05}$ [Growing Media]		6.56		
	Root fresh weigth (g)			
Bara	31.67^{c}_{p}	35.33^{c}_{p}	35.00^{c}_{p}	
Pelita 8 F1	40.50^{b}_{r}	55.00^{b}_{q}	48.83^{b}_{q}	
Merapi	85.33^{a}_{p}	71.17^{a}_{q}	74.50^{a}_{q}	4.51
Sonar	44.33^{b}_{p}	33.33^{c}_{q}	34.17^{a}_{q}	
Centil	32.67^{c}_{p}	24.67^{d}_{q}	31.00^{c}_{p}	
$LSD_{0.05}$ [Growing Media]		6.12		

Numbers followed by different letter on the same column (a,b,c,d) and same row (p,q) means significantly different based on $LSD_{0.05}$.

3.3. Effect of growing media on production

The variance survey showed that the treatment of the planting medium had no significant effect on fruit production, while the variety and the interaction between the growing medium and the variety had a very significant effect on fruit production.

Table 3 shows that the treatment of the cocopeat growing medium with the Sonar variety (M2V4) had the highest production (10.22 g), not significantly different from the Centil variety (M2V5), but significantly different on the same planting medium compared to the production of the Merapi variety (M2V3), the Pelita 8 F1 (M2V2) variety and the Bara (M2V1) variety. Meanwhile, the cocopeat growing medium with the Sonar variety (M2V4) was not significantly different from the production in each of the other growing media treatments. Bara variety with roasted husk (M1V1) planting medium had the lowest fruit production (5.29 g).

Table 3. Average fruit weight (g) of five varieties of cayenne pepper by hydroponics on various types of planting media.

Variety	Growing Media			$LSD_{0.05}$ [Variety]
	RHC	Cocopeat	RHC+Cocopeat 1:1	
Bara	5.29^{b}_{p}	6.24^{b}_{p}	5.83^{b}_{p}	
Pelita 8 F1	6.12^{b}_{q}	7.23^{b}_{q}	9.41^{a}_{p}	
Merapi	8.21^{a}_{q}	6.21^{b}_{q}	10.03^{a}_{p}	1.69
Sonar	9.47^{a}_{p}	10.22^{a}_{p}	8.62^{a}_{p}	
Centil	8.31^{a}_{p}	9.93^{a}_{p}	9.51^{a}_{p}	
$LSD_{0.05}$ [Growing Media]		1.93		

Numbers followed by different letter on the same column (a,b,c,d) and same row (p,q) means significantly different based on $LSD_{0.05}$.

3.4. Heritability

Table 4 shows that all the characters observed, both vegetative and production components, have low to high heritability values based on the index value of each character. Based on the results of the heritability analysis in table 4, it shows that the high heritability value is at 8 characters and low at 1 character.

Table 4. Heritability value of cayenne pepper varieties on various types of planting media.

No.	Parameter	h^2 (%)	Category
1.	Plant height	79.65	High
2.	Number of productive branches	92.04	High
5.	Root length	4.96	Low
6.	Root fresh weight	98.00	High
7.	Root volume	81.08	High
9.	Production	62.26	High

Information: 0 <h2 <20 (low), 21 <h2 <50 (moderate), and 50 <h2 <100 (high)

4. Discussion

The results of variance showed that the treatment of planting media had a very significant effect on root volume, and had a significant effect on the number of productive branches and root length, but had no significant effect on plant height, flowering age, harvest age, root fresh weight, number of fruit harvested, fruit weight, and the length of the fruit.

The treatment of roasted husk growing media obtained the highest number of productive branches (68.83) and root length (55.83 cm). Whereas in the treatment of roasted husk planting medium: cocopeat 1: 1, the highest root volume was obtained (54.33 mL). This is due to the high nutrient content of nitrogen, phosphorus and potassium which makes the planting medium loose and encourages plant roots to grow optimally thereby increasing the availability of nitrogen, phosphorus, and potassium. According to Isro'i [10], the burning media for burning husk has a higher nitrogen (N) content (1.86%), this helps stimulate overall growth, especially stems, branches, and leaves as well as green leaf matter for photosynthesis and has phosphorus and potassium elements needed by plants compared to manure.

Cocopeat growing media has the ability to absorb high water so that it can help root growth and can increase the volume of plant roots. This is in accordance with the opinion of Ahmi in Pratiwi [11], which states that cocopeat has a very large ability to store water, namely 69%. Cocopeat is considered a good component of growing media with pH, EC, and other chemical reactions.

Various planting media materials used must continue to support plant growth and development so that productivity can be better. Organic matter has the potential to retain water and pores, which are rich in air, making seedling growth at a very good germination level and can help new roots grow fast and thick. The planting medium functions as a place for roots to attach, as well as a nutrient provider for plants. The mixture of several materials for planting media must produce an appropriate structure because each type of media has a different effect on plants [12].

Good plant growth is influenced by environmental factors and genetic factors of the plant itself. Environmental factors that affect crops include water availability, nutrients, climate and the presence of pests and diseases [13]. Marsono and Lingga in Laksono [9], stated that plant growth is strongly influenced by available nutrients, if the nutrients that can be absorbed by plants are sufficient, the plant development process will be normal, whereas if the nutrients are absorbed by plants slightly causes stunted plant growth.

Heritability analysis is a quantitative measure to determine whether the phenotype difference of a character is caused by genetic or environmental factors, so that it can provide an idea of whether the observed characters more influenced by genetic or environmental factors. According to Farid et al. [14], which states that characters with high heritability will increase the effectiveness of selection in endurance testing because the observed characters are a reflection of the influence of genetic factors compared to environmental influences. The quantitative character which has high heritability will produce a selection progress for the desired traits, whereas if the heritability is low it will be less effective to be used as selection material.

5. Conclusion

Based on the research that has been done, it can be concluded that:

- Treatment interactions that provide better growth and production of chili plants, namely the growing medium of cocopeat with Gamar varieties with a value of 10.22 g / plant.
- Planting media that provide better growth and production of chili plants, namely the treatment of roasted husk planting media: cocopeat 1: 1 with a value of 8.68 g / plant.
- Parameters that provide high heritability are the parameters of plant height, number of productive branches, flowering age, harvest age, fresh root weight, root volume, number of fruit harvested, production, and fruit length.

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