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Required amounts of medium and fertilizer for potted culture of zucchini

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ABSTRACT

In Japan, zucchini culture has yet to get underway, and the current costs of zucchini can be attributed to damage from soil-borne disease and the unstable yields due to seasonal change of female flowers. Eradication of these problems will lead to stable supply and a consequent price reduction of zucchini fruits. We previously clarified the efficacy of potted culture as a new culture method for zucchini, but potted culture can be burdensome as the weak water and nutrient retention capacity of the medium warrants its regular replacement. To solve this problem, in this study, we investigated the blend ratio for mixing rice husk charcoal with peat and the amount of fertilizer required for potted culture of zucchini. Results revealed no significant differences in the length of the largest leaf, total number of flowers, number of female flowers, and the ratio of female flowers to total flowers with different blend ratios of rice husk charcoal to peat. However, the number of harvested fruits increased with higher ratios of rice husk charcoal to peat and was highest at 80:20. The length of the largest leaf increased with increased amounts of fertilizer, with the best response was at 200 g. No significant differences were noted between the ratio of female flowers to total flowers in any treatments. In addition, the number of harvested fruits was highest with 160 g and 200 g of fertilizer. Taken together, the optimal blend ratio of rice husk charcoal to peat is 80:20, and the optimal amount of fertilizer with this ratio is 160 g.

Keywords: Zucchini; Rice Husk Charcoal; Peat; Potted Culture; Fertilizer

1. INTRODUCTION

In Japan, large-scale zucchini culture has yet to get underway, and the current costs of zucchini makes widespread distribution prohibitive. The high cost of zucchini can be attributed to damage from soil-borne disease and the unstable yields due to seasonal change of female flowers. Eradication of these problems will lead to stable supply and a consequent price reduction of zucchini fruits, which will open the door for zucchini business prospects.

Generally, zucchini is produced open culture, but the culture methods and cultivars are not established due to difference environmental condition in some areas. Especially, planting density in zucchini culture is important to prevent soil-borne disease. In fact, interstrain used in zucchini culture was from 50 cm to 100 cm, and different by producers or areas. There are many reports about study to demonstrate optimum interstrain and cultivar in zucchini culture [1].

We previously clarified the efficacy of potted culture as a new culture method for zucchini [2]. However, potted culture can be burdensome as the weak water and nutrient retention capacity of the medium warrants its regular replacement. To solve this problem, we considered using rice husk charcoal and peat moss as a medium as both are organic materials with a high cation exchange capacity and are often used as a medium in soilless culture [3-9]. Rice husk charcoal and peat moss have been studied for recycling and the subsequent reclamation of solid and organic residues produced in agriculture, faming, forestry, and industry, and they are also being successfully used as container media for ornamental plant production [9,10]. In addition, these organic materials are available for compost after use and are easily applied in the field [10,11]. In particular, rice husk charcoal is made from burning rice husks, which are generated from harvested rice, the principal food in Japan and Thailand [12]. In addition, rice husks are typically utilized as a medium for ornamental crops (e.g., *Chrysanthemum morifolium*) and as soil cover for protecting rice in nurseries by covering with oil paper. Such uses are common because rice husk charcoal is affordable, has high cation exchange and aeration properties, has good moisture retentiveness due to its porosity, and mixes well with other substances [4,13,14]. Moreover, Inden and Torres (2004) [14] re-

ported an increase in yield and total soluble solid content in tomato when using coconut coir or perlite plus carbonized rice hulls as a growth substrate. Islam (2008) [15] described focusing on good aeration and lightweight properties and thereby found rise husk charcoal to be a suitable medium for soilless culture. Peat moss, which has high moisture and nutrient retentiveness as well as a high buffering ability, is particularly utilized as a growth medium for strawberry culture [5,16].

In this study, we investigated the effects of different ratios of rice husk charcoal to peat moss as a medium as well as the optimal amount of fertilizer required for zucchini potted culture.

2. MATERIALS AND METHODS

2.1. Culture Conditions

Zucchini seeds "Diner" (Takii Co. Ltd., Kyoto, Japan) were planted in a plastic tray containing propagation medium (Coop Chemical Co. Ltd., Tokyo, Japan) and vermiculite (Showa vermiculite Co. Ltd., Kanagawa, Japan) (1:1). A hydroponic fertilizer (Otsuka house No. 1 and No. 2) diluted 2-fold in tap water (as a standard concentration) was added for propagation. Interstrain and interrow spaces after settled planting were 60 cm and 80 cm, respectively. Agrisheet was laid out in a greenhouse as the pots should not have contact with regular soil. Rice husk charcoal and peat were purchased from Berry's life Co. (Kagawa, Japan) and Nichias Co. (Tokyo, Japan). Irrigation after settled planting was conducted at 3 $L \cdot pot^{-1}$ at 7 am daily.

2.2. Blend Ratio of Rice Husk Charcoal to Peat

Culture was conducted in a greenhouse at Meiji University from July 6, 2008 to October 28, 2008. Zucchini seeds were planted in 12-cm plastic pots (height 10 cm) containing propagation medium, and seedlings were cultured until developing 7 leaves. The plants were then settled in 30.5-cm plastic pots (height 30.5 cm; medium volume, 15 L; Kaneko Seed Co. Ltd., Gunma, Japan) on July 28, 2008.

The following four blend ratios of rice husk charcoal to peat were set: 80:20, 60:40, 40:60, and 20:80. Eighty grams of delayed release fertilizer, Ecolong 424 (N:P:K = 14:12:13, JCAM AGRI. Co., Ltd., Tokyo, Japan), and 210 g of compost (Fujimi group, Sizuoka, Japan) were added, and the pH of each medium was adjusted to the same level (pH 6.5) by adding 7 g of magnesium lime (Aiko Sekkai Co., Tochigi, Japan) for 80:20 and 60:40 and 120 g of magnesium lime for 40:60 and 20:80. After adding each medium, fertilizer, compost, and water were mixed in a soil mixer and drained. All experiments were replicated 3 times, with 10 plants per replicate.

2.3. Amount of Fertilizer

Culture was conducted from August 11, 2009 to December 15, 2009 under the same conditions with different blend ratios of rice husk charcoal to peat. Plants were settled in 30.5-cm plastic pots on August 29, 2009. The following four amounts of fertilizer were set: 80 g, 120 g, 160 g, and 200 g. Based in the results of the above experiments, the most appropriate ratio of medium was mixed to a volume of 15 L. Other applied fertilizers were 210 g of compost and 7 g of magnesium lime. All experiments were replicated 3 times, with 10 plants per replicate.

Growth, Pollination, and Harvest

The length of the largest leaf, the total number of flowers, and the number of female flowers were measured once every 7 days to establish the female flower to total flower ratio. Pollination was conducted at 8 - 9 am, and fruits were harvested at a size with a market value (16 - 19 cm).

2.4. Statistical Analysis

Data are presented as mean and standard error values, and statistical differences between treatments were tested using the Tukey-Kramer test at $P < 0.05$.

3. RESULTS AND DISCUSSION

The effect of different ratios of rice husk charcoal to peat on zucchini growth is shown in **Table 1**. There was no significant difference in the length of the largest leaf, total number of flowers, number of female flowers, or the ratio of female flowers to the total number of flowers. The number of harvested fruits per pot was 2.8 with 20:80, 2.7 with 40:60, 4.2 with 60:40, and 4.8 with 80:20, respectively; an obvious increasing trend with increasing rice husk charcoal (**Figure 1**). Endo *et al*. (2006) [16] demonstrated the effects of root zone substrates consisting of coir and peat mixture on the growth and yield of strawberry and indicated that the marketable yield of strawberries increased with decreasing peat ratios. Islam (2008) [15] described that rice husk charcoal gave similar and/or better crop performance and yield of tomatoes than rock wool under high-temperature stress conditions (30˚C and 35˚C versus 25˚C), which showed that rice husk charcoal can be used successfully as a growing medium amendment for producing greenhouse tomato as well as other nursery crops. Promchot and Boonprakob (2007) [12] reported that rice husk charcoal was better than agar for embryo culture of nectarines and that it may be a substitute for vermiculite. Thus, rice husk

Table 1. Effect of different blend ratios of rice husk charcoal to peat on the growth of zucchini.

Treatment		Days after planting (mean ± S.E.)					
		15 days	22 days	29 days	36 days	43 days	50 days
The length of largest leaf (cm)	20:80	71.20 ± 2.86a[y]	84.20 ± 4.29a	85.20 ± 1.87a	86.70 ± 2.26a	88.80 ± 4.87a	89.44 ± 5.03a
	40:60	70.40 ± 4.38a	85.60 ± 3.50a	87.30 ± 2.91a	88.70 ± 2.79a	89.70 ± 2.41a	91.10 ± 3.14a
	60:40	70.80 ± 2.66a	84.10 ± 4.56a	86.60 ± 5.06a	88.33 ± 4.80a	90.56 ± 3.21a	91.56 ± 3.00a
	80:20	68.20 ± 4.76a	80.40 ± 5.62a	84.80 ± 5.55a	87.30 ± 4.81a	88.30 ± 4.90a	89.10 ± 5.03a
A number of female flowers (flower)	20:80	3.00 ± 0.94a	5.80 ± 0.79a	8.50 ± 0.71a	12.20 ± 1.75a	15.80 ± 1.87a	20.33 ± 1.87a
	40:60	2.90 ± 0.57a	5.60 ± 0.70a	8.20 ± 0.63a	12.10 ± 1.20a	15.50 ± 1.18a	18.70 ± 1.19a
	60:40	3.00 ± 1.05a	5.40 ± 1.11a	7.80 ± 2.10a	11.78 ± 1.72a	15.11 ± 2.37a	18.56 ± 2.35a
	80:20	3.60 ± 1.07a	6.20 ± 0.92a	8.90 ± 1.66a	13.00 ± 2.11a	16.50 ± 2.55a	19.90 ± 3.05a
Total number of flowers (flower)	20:80	20.90 ± 0.88a	28.40 ± 0.97a	34.00 ± 1.25a	42.70 ± 1.42a	50.60 ± 1.78a	57.89 ± 1.96a
	40:60	20.10 ± 0.57a	27.30 ± 0.67a	33.80 ± 1.03a	42.30 ± 0.82a	50.10 ± 0.88a	57.40 ± 1.43a
	60:40	21.00 ± 1.25a	29.00 ± 1.15a	35.50 ± 1.58a	43.00 ± 1.73a	51.44 ± 1.88a	57.22 ± 1.79a
	80:20	21.20 ± 1.03a	28.50 ± 5.62a	35.30 ± 3.09a	43.00 ± 3.02a	51.40 ± 2.95a	58.00 ± 3.97a
The ratio of female flowers to the total number of flowers (%)	20:80	14.35 ± 1.08a	20.42 ± 0.82a	25.00 ± 0.57a	28.57 ± 1.23a	31.23 ± 1.05a	35.12 ± 0.95a
	40:60	14.43 ± 1.00a	20.51 ± 1.04a	24.26 ± 0.61a	28.61 ± 1.45a	30.94 ± 1.35a	32.58 ± 0.83a
	60:40	14.29 ± 0.85a	18.62 ± 0.96a	21.97 ± 1.33a	27.39 ± 0.99a	29.37 ± 1.26a	32.43 ± 1.32a
	80:20	16.98 ± 1.04a	21.75 ± 0.16a	25.21 ± 0.54a	30.23 ± 0.70a	32.10 ± 0.86a	34.31 ± 0.77a

Treatment		Days after planting (mean ± S.E.)					
		57 day	64 day	71 day	78 day	85 day	92 day
The length of largest leaf (cm)	20:80	89.44 ± 5.03a	89.75 ± 5.26a	89.75 ± 5.26a	89.75 ± 5.26a	89.75 ± 5.26a	89.75 ± 5.26a
	40:60	91.60 ± 3.50a	91.60 ± 3.50a	91.60 ± 3.50a	91.60 ± 3.50a	91.22 ± 3.49a	91.22 ± 3.49a
	60:40	91.50 ± 2.78a	91.50 ± 2.78a	91.43 ± 2.99a	91.43 ± 2.99a	91.43 ± 2.99a	91.43 ± 2.99a
	80:20	89.10 ± 5.30a	89.67 ± 5.29a	89.67 ± 5.29a	89.67 ± 5.29a	89.67 ± 5.29a	89.67 ± 5.29a
A number of female flowers (flower)	20:80	22.89 ± 2.52a	25.50 ± 2.73a	27.00 ± 3.38a	28.88 ± 4.22a	30.50 ± 4.78a	31.38 ± 4.78a
	40:60	20.70 ± 2.21a	22.70 ± 1.64a	24.10 ± 1.79a	26.10 ± 2.13a	28.78 ± 2.64a	29.00 ± 2.40a
	60:40	20.78 ± 3.15a	22.88 ± 3.87a	24.86 ± 4.74a	26.43 ± 4.72a	28.43 ± 4.93a	30.29 ± 4.57a
	80:20	21.80 ± 2.94a	24.00 ± 3.20a	25.67 ± 3.46a	27.56 ± 3.54a	29.22 ± 4.38a	29.67 ± 3.61a
Total number of flowers (flower)	20:80	62.89 ± 2.62a	67.13 ± 2.36a	70.75 ± 2.49a	74.25 ± 4.65a	77.63 ± 5.66a	80.00 ± 6.61a
	40:60	62.80 ± 1.55a	66.60 ± 1.65a	69.80 ± 2.20a	74.20 ± 3.33a	79.44 ± 2.96a	83.22 ± 2.82a
	60:40	63.25 ± 2.12a	67.25 ± 2.25a	71.00 ± 2.00a	74.71 ± 2.06a	78.00 ± 2.52a	81.14 ± 2.54a
	80:20	61.90 ± 5.02a	66.67 ± 2.60a	69.89 ± 2.67a	73.67 ± 2.92a	77.22 ± 2.82a	80.44 ± 3.05a
The ratio of female flowers to the total number of flowers (%)	20:80	36.40 ± 0.96a	37.99 ± 1.16a	38.16 ± 1.36a	38.89 ± 0.91a	39.29 ± 0.85a	39.22 ± 0.72a
	40:60	32.96 ± 1.43a	34.08 ± 0.99a	34.53 ± 0.81a	35.18 ± 0.64a	36.22 ± 0.89a	34.85 ± 0.85a
	60:40	32.85 ± 1.49a	34.01 ± 1.72a	35.01 ± 2.37a	35.37 ± 2.29a	36.45 ± 1.96a	37.32 ± 1.80a
	80:20	35.22 ± 0.58a	36.00 ± 1.23a	36.72 ± 1.30a	37.41 ± 1.21a	37.84 ± 1.55a	36.88 ± 1.18a

The ratio of female flowers to the total number of flowers = a number of female/total number of flowers × 100; [y]Different letter indicate statistical differences between treatments were tested using the Turkey-Kramer test at $P < 0.05$ ($n = 10$).

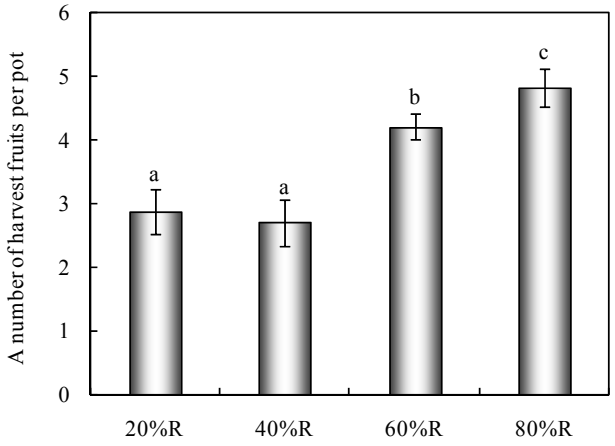

Figure 1. Effect of different blend ratios of rice husk charcoal to peat on the number of harvested zucchini fruits Vertical bars represent one standard deviation of the mean. Different letters indicate significant difference at the 5% level according to the Tukey-Kramer test between treatments (n = 10).

charcoal has various effects on plant variety and growth stages, but its most prominent effect is as a culture medium. In addition, variety-specific responses should be considered when giving recommendations for adding the optimum proportion of organic material amendments to horticultural potting substrate [17].

It is considered that the 80:20 medium drained well because the amount of peat (which retains water) was decreased and because zucchini is better suited to well-drained soil. Oshio *et al*. (1981) [4] discussed that rice husk charcoal has a porous structure which contributes to aeration and water retention, which in turn enhances water and nutrient (especially potassium and phosporous) retention. These factors suggest that the number of harvested fruits increased because sufficient nutrients were available as a result of the enhanced water and nutrient retention in the medium.

Potted culture of zucchini is essential to be cheaper cost of medium due to consisting mostly medium cost. In Japan, rice is the staple crop, and rice husk charcoal is abundant and affordable [14]. Therefore, the cost of rice husk charcoal medium for potted culture will enable feasible cultivation options for zucchini.

The effect of different amounts of applied fertilizer on the growth of zucchini is shown in **Table 2**. The length of the largest leaf, total number of flowers, and the number of female flowers increased with higher amounts of applied fertilizer and was highest at 200 g. This was thought that a number of nude increased to have great vigor of fruits growth with rise amount of applied fertilizer. There was no significant difference in the ratio of female flowers to the total number of flowers in any treatments. Temperature is an important external environmental factor for female differentiation of Cucurbitaceae plants, the family to which zucchini belongs [18]. All experiments in the present study were conducted under the same conditions in the same greenhouse to ensure the same external variables. Thus it can be inferred that the ratio of female flowers to the total number of flowers does not fluctuate.

The effect of different amounts of applied fertilizer on the number of harvested zucchini fruits is shown in **Figure 2**. The number of harvested fruits per pot was 4.6 with 80 g, 6.1 with 120 g, 8.7 with 160 g, and 8.9 with 200 g, and increased with increasing amounts of fertilizer and was highest with 200 g. There was no significant difference in the number of harvested fruits and the growth of zucchini with 160 g and 200 g. It was assumed that the nutrient uptake ability of the roots was limited because the roots were restricted by the pot. For effective tomato culture, Zuraiqi and Battilhi (1992) [19] recommended four applications of nitrogen fertilizer per season at a rate of 30 kg/ha at two-week intervals. In contrast, Diez *et al*. (1997) [20] and Eghball and Power (1999) [21] obtained no yield differences between crops grown with compost and those grown with chemical fertilizer. Evanylo *et al*. (2008) [22] reported that various treatments with organic fertilizer and a commercial agricultural fertilizer did not affect pumpkin or bell pepper growth. Reiners and Riggs (1997) [23] demonstrated the effect of nitrogen application and the variety of pumpkin (*Cucurbita pepo* L.) marketable yield and found that pumpkin yield was unaffected by 67, 112, and 157 $kg{\cdot}N{\cdot}ha^{-1}$. On the other hand, Takemyou *et al*. (2002) [24] reported that the growth of zucchini and harvested fruits increased in line with increased amounts of applied fertilizer and that 80 - 160 g medium from a 10 L volume is suitable for potted culture of zucchini. In this study,

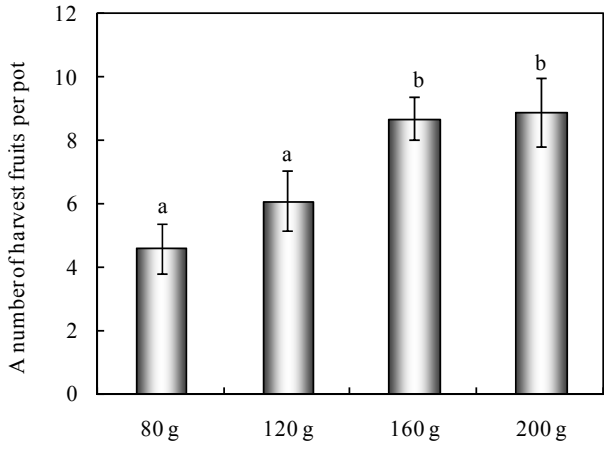

Figure 2. Effect of different amounts of applied fertilizer on the number of harvested zucchini fruits Vertical bars represent one standard deviation of the mean. Different letters indicate significant difference at the 5% level according to the Tukey-Kramer test between treatments (n = 10).

Table 2. Effect of different amounts of applied fertilizer on the growth of zucchini.

Treatment		Days after planting (mean ± S.E.)							
		3 days	10 days	17 days	24 days	31 days	38 days	45 days	52 days
The length of largest leaf (cm)	80 g	28.9 ± 0.5a[y]	35.2 ± 1.1a	51.0 ± 1.5a	61.9 ± 1.9a	66.3 ± 2.0a	73.0 ± 2.0a	75.8 ± 2.4a	78.0 ± 2.0a
	120 g	30.4 ± 0.4a	34.9 ± 0.5a	49.6 ± 1.1a	62.0 ± 1.6ab	68.7 ± 1.8a	77.6 ± 2.7a	80.7 ± 2.4a	83.1 ± 2.2a
	160 g	30.1 ± 0.6a	35.2 ± 0.7a	52.2 ± 1.4a	65.5 ± 1.3b	75.0 ± 2.0a	81.3 ± 1.9ab	83.4 ± 1.6ab	84.6 ± 1.6ab
	200 g	31.3 ± 1.0a	34.7 ± 0.7a	50.0 ± 1.7a	63.6 ± 3.0ab	75.9 ± 4.0a	82.2 ± 2.8b	84.4 ± 3.0b	85.3 ± 3.2b
A number of female flowers (flower)	80 g	6.8 ± 0.1a	11.4 ± 0.3a	17.4 ± 0.3a	22.6 ± 0.3a	30.0 ± 0.4a	32.8 ± 0.4a	37.1 ± 0.5a	40.9 ± 0.7a
	120 g	7.0 ± 0.0a	11.5 ± 0.2a	17.4 ± 0.2a	23.0 ± 0.3a	30.2 ± 0.4a	33.9 ± 0.4a	37.8 ± 0.4a	41.0 ± 0.6a
	160 g	6.9 ± 0.1a	11.7 ± 0.2a	17.5 ± 0.3a	23.4 ± 0.2a	31.0 ± 0.3a	34.6 ± 0.3a	39.3 ± 0.3a	43.0 ± 0.4ab
	200 g	6.8 ± 0.1a	11.3 ± 0.2a	17.2 ± 0.2a	22.9 ± 0.5a	30.7 ± 0.6a	34.8 ± 0.6a	39.4 ± 0.7a	43.8 ± 0.7b
Total number of flowers (flower)	80 g	0.0 ± 0.0a	0.1 ± 0.1a	2.2 ± 0.2a	4.9 ± 0.3a	8.0 ± 0.5a	9.2 ± 0.8a	11.3 ± 0.8a	13.0 ± 1.0a
	120 g	0.0 ± 0.0a	0.6 ± 0.2a	2.1 ± 0.2a	5.1 ± 0.2a	8.1 ± 0.2a	9.7 ± 0.2ab	11.7 ± 0.4ab	13.4 ± 0.6ab
	160 g	0.0 ± 0.0a	0.3 ± 0.2a	2.4 ± 0.3a	5.4 ± 0.4b	8.8 ± 0.3a	10.6 ± 0.5b	12.6 ± 0.6b	14.6 ± 0.9b
	200 g	0.0 ± 0.0a	0.1 ± 0.1a	1.6 ± 0.2b	4.6 ± 0.5a	7.9 ± 0.5a	9.4 ± 0.6a	11.7 ± 0.6ab	13.4 ± 0.9ab
The ratio of female flowers to the total number of flowers (%)	80 g	0.0 ± 0.0a	1.0 ± 1.0a	12.6 ± 1.4a	21.7 ± 1.3a	26.8 ± 2.0a	27.9 ± 2.1a	30.3 ± 1.8a	31.6 ± 2.0a
	120 g	0.0 ± 0.0a	5.2 ± 1.4a	12.1 ± 1.1a	22.2 ± 1.0a	26.9 ± 0.9a	28.7 ± 0.9a	31.0 ± 1.3a	32.8 ± 1.6a
	160 g	0.0 ± 0.0a	2.6 ± 1.3a	13.7 ± 1.7a	23.1 ± 1.6a	28.4 ± 0.9a	30.6 ± 1.4a	32.1 ± 1.6a	33.9 ± 1.9a
	200 g	0.0 ± 0.0a	0.8 ± 0.8a	9.2 ± 1.2a	19.9 ± 1.8a	25.6 ± 1.3a	26.8 ± 1.4a	29.5 ± 1.8a	30.5 ± 1.8a

Treatment		Days after planting (mean ± S.E.)							
		59 days	66 days	73 days	80 days	87 days	94 days	101 days	108 days
The length of largest leaf (cm)	80 g	78.0 ± 2.0a	78.0 ± 2.0a	78.0 ± 2.0a	78.0 ± 2.0a	78.0 ± 2.0a	78.0 ± 2.0a	78.0 ± 2.0a	78.0 ± 2.0a
	120 g	83.1 ± 2.2a	83.1 ± 2.2a	83.1 ± 2.2a	83.1 ± 2.2a	83.1 ± 2.2a	83.1 ± 2.2a	83.1 ± 2.2a	83.1 ± 2.2a
	160 g	84.6 ± 1.6ab	84.6 ± 1.6ab	84.6 ± 1.6ab	84.6 ± 1.6ab	84.6 ± 1.6ab	84.6 ± 1.6ab	84.6 ± 1.6ab	84.6 ± 1.6ab
	200 g	85.3 ± 3.2b	85.3 ± 3.2b	85.3 ± 3.2b	85.3 ± 3.2b	85.3 ± 3.2b	85.3 ± 3.2b	85.3 ± 3.2b	85.3 ± 3.2b
A number of female flowers (flower)	80 g	42.8 ± 0.7a	46.5 ± 0.8a	50.2 ± 0.8a	52.5 ± 0.9a	54.7 ± 1.0a	56.2 ± 1.1a	57.5 ± 1.4a	59.0 ± 1.5a
	120 g	43.6 ± 0.4a	46.7 ± 0.6a	50.4 ± 0.7a	52.9 ± 0.9a	54.9 ± 1.0a	56.3 ± 1.2a	58.8 ± 1.4a	59.9 ± 1.6a
	160 g	45.4 ± 0.4ab	49.6 ± 0.6ab	53.2 ± 0.7ab	55.6 ± 0.8ab	58.0 ± 1.0ab	59.7 ± 1.1ab	61.3 ± 1.3ab	63.1 ± 1.6ab
	200 g	45.8 ± 0.7b	50.1 ± 0.7b	54.5 ± 0.8b	57.2 ± 0.7b	59.5 ± 0.8b	61.8 ± 0.9b	63.7 ± 0.9b	66.1 ± 1.3b
Total number of flowers (flower)	80 g	14.0 ± 1.2a	16.2 ± 1.3a	18.9 ± 1.1a	20.9 ± 1.0a	22.5 ± 1.1a	23.8 ± 1.1a	25.3 ± 1.1a	26.4 ± 1.2a
	120 g	14.8 ± 0.7ab	16.7 ± 1.0ab	19.3 ± 1.0ab	21.9 ± 0.9ab	23.9 ± 0.7ab	25.3 ± 0.6ab	26.6 ± 0.4ab	27.9 ± 0.5ab
	160 g	15.8 ± 0.8b	18.0 ± 1.2b	21.0 ± 1.0b	23.3 ± 0.9b	25.2 ± 0.9b	26.8 ± 0.8ab	28.4 ± 0.7ab	29.9 ± 0.7ab
	200 g	14.8 ± 1.0ab	16.6 ± 1.2ab	20.2 ± 1.2ab	22.9 ± 1.3ab	24.7 ± 1.3ab	26.9 ± 1.1b	28.6 ± 1.1b	30.8 ± 1.1b
The ratio of female flowers to the total number of flowers (%)	80 g	32.5 ± 2.3a	34.6 ± 2.3a	37.6 ± 2.0a	39.8 ± 1.7a	41.1 ± 1.7a	42.3 ± 1.5a	44.0 ± 1.5a	44.7 ± 1.5a
	120 g	34.0 ± 1.9a	35.9 ± 2.4a	38.6 ± 2.5a	41.7 ± 2.2a	43.8 ± 2.0a	45.3 ± 1.8a	45.6 ± 1.7a	46.9 ± 1.6a
	160 g	34.9 ± 2.0a	36.3 ± 2.4a	39.6 ± 2.1a	42.0 ± 2.0a	43.6 ± 2.0a	45.1 ± 1.8a	46.5 ± 1.6a	47.6 ± 1.4a
	200 g	32.2 ± 1.9a	33.0 ± 2.3a	37.0 ± 2.2a	40.0 ± 2.3a	41.5 ± 2.2a	43.6 ± 2.0a	44.9 ± 1.7a	46.6 ± 1.6a

The ratio of female flowers to the total number of flowers = a number of female/total number of flowers × 100; [y]Different letter indicate statistical differences between treatments were tested using the Turkey-Kramer test at $P < 0.05$ ($n = 10$).

the volume of medium was 15 L. Water retention and nutrient capacity of rice husk charcoal differ from those of peat, suggesting that the amount of applied fertilizer in the present study is slightly higher than that of Takemyou *et al*. (2002) [24].

Taken together, the optimum blend ratio of rice husk charcoal to peat for potted culture of zucchini is 80:20, and the optimum amount of fertilizer is 160 - 200 g. In the future, we intend to examine the effect of timing of side dressing application on zucchini yield.

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