GROWTH AND PRODUCTION OF *Piper sarmentosum* Roxb. ex Hunter IN POT WITH DIFFERENT GROWING MEDIA

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ABSTRACT

Piper sarmentosum can be used *as part of traditional cuisine; it also has many potent medicinal functions. The information on plant cultivation is very limited and needs more studies. It might be necessary to begin with studying the suitable growing media. The experiment used completely randomized block design with single factor (i.e. types of growing media) and 4 replicates. The treatments were: soil only, soil + sand (3:1, v/v), soil + rice hull charcoal (3:1, v/v), and soil + cow manure (3:1, v/v). Each treatment consisted of 5 plants. Analysis of variance was used for data analysis. Plagiotropic cuttings with 3 nodes were used as plant material. Plastic bags were used as media containers. Anorganic fertilizers as source of N, P, and K were added with the rates that were equivalent to that of compound fertilizer 12:12:17:2 N-P-K-Mg. The results showed that most variables were significantly affected by different growing media. The addition of cow manure in media resulted in the best plant growth compared to those grown in other growing media. The application of cow manure resulted in better plant growth (shown by denser shoot and roots) and darker leaves; while the addition of sand and rice hull caused shorter plants and lighter leaves. Although not significantly different, plant grown in soil-only media showed a better performance of above ground parts than those in media with sand or rice hull addition.*

Keywords: *animal manure, container, herb, piperaceae, rice hull*

ABSTRAK

Piper sarmentosum (karuk) dimanfaatkan untuk masakan tradisional; namun tanaman ini juga berpotensi sebagai tanaman obat. Informasi tentang budidaya tanaman *P. sarmentosum* masih terbatas, oleh karena itu kajian ini diawali dengan pemilihan media tanam yang sesuai. Percobaan menggunakan rancangan acak kelompok lengkap satu faktor dengan perlakuan jenis media yaitu tanah saja, tanah+pasir (3:1, v/v), tanah+arang sekam (3:1, v.v), dan tanah+pupuk kandang sapi (3:1, v/v). Setiap perlakuan diulang 4 kali dan masing-masing terdiri atas 5 tanaman. Analisis data menggunakan sidik ragam. Bahan tanaman berupa stek plagiotrop dengan 3 buku dan polybag warna hitam sebagai wadah. Pupuk anorganik diberikan pada semua perlakuan dengan dosis setara pupuk majemuk N-P-K-Mg 12:12:17:2. Hasil percobaan menunjukkan bahwa perbedaan media mempengaruhi hampir semua peubah yang diamati. Pemberian pupuk kandang sapi menghasilkan keragaan dan produksi tanaman terbaik (ditunjukkan dengan tajuk dan akar yang lebih lebat serta daun yang lebih hijau dibandingkan tanaman yang mendapat perlakukan lainnya). Meskipun tidak nyata, ada kecenderungan bahwa pertumbuhan tanaman karuk lebih baik pada media tanah saja dibandingkan pada media dengan penambahan pasir atau arang sekam.

Kata kunci: *pupuk kandang, pot, sayuran fungsional, piperaceae, arang sekam*

BACKGROUND

Piper sarmentosum Roxb. ex Hunter (vernacular names: wild betel leaf-English, daun kadok-Malay, karuk-Indonesia, cha plu-Thailand) is a plant in the Piperaceae family used in many Southeast Asian cuisine, especially in Malaysia and Thailand. *Piper sarmentosum* is an erect, terrestrial herb and glabrous with long creeping procumbent branches about measuring 0.3-0.8 m in tall. The morphological features of *P. sarmentosum* are similar to those of *P. longum* (*P. retrofractum* L.) including the sweet taste of mature ripened fruit. As a creeping plant, *P. sarmentosum* can also be grown in a container as terna (bush) pepper by pruning the creeping branches (Mathew *et al.*, 2004) either as an ornamental plant or as home medicinal plant.

P. sarmentosum has not been widely used in Indonesia. However, besides as part of traditional cuisine, many studies had shown that the herb had many potent medicinal functions, thus it might be useful to promote the plant as an alternative herb to the common ones. Some of many findings on plant pharmacological activities were: methanolic extract of *P. sarmentosum* showed that the plant contained Naringenin, a natural antioxidant, that can be used as antioxidant dietary supplements (Subramaniam et al., 2003) ; ethanolic extract from *P. sarmentosum* induced anticarcinogenic activity *(Ariffin et al., 2009) ;* 14 chemical constituents were isolated from fruits of *P. sarmentosum and* 7 of them had antituberculosis and/or antiplasmodial activities *(Rukachaisirikul et al., 2004)* . This species also has bio-pesticide functions. *E*thanol extract of the plant showed an activity as possible mosquitocides, i.e. adulticidal activity, when tested against female mosquitoes *Stegomyia aegypti*. *Stegomyia aegypti* is a main vector of dengue and dengue haemorrhagic fever (Choochote *et al.*, 2006) . Methanol extract of *P. sarmentosum* showed an allelopathic effect and could be used as natural herbicides to control weeds .

The chemical constituents of *P. sarmentosum* and their activities had been extensively studied, but the information on plant cultivation is very limited and needs more studies. It might be necessary to begin with studying the suitable growing media. Organic and inorganic amendments are often used to improve chemical and physical properties of soils to support plant growth. To study *P. sarmentosum*, other *Piper spp*. are used as references. *P. retrofractum* grows well in sandy clay soil or sandy loam soil, rich in organic matter, and proper soil water content (Soleh *et al.*, 2001) . The best composition of the growing media for *P. retrofractum* and *P. nigrum* was soil, animal manure and sand (2-3:1:1, v/v) and it improved root growth (Darmawan, 1995; Januwati, and Emmyzar, 1994) .The objective of the study was to investigate the effect of different growing media on growth of *P. sarmentosum*.

RESEARCH METHODS

Plagiotropic cuttings with 3 nodes were used as plant material. Plastic bags were used as media containers. Anorganic and organic fertilizers were used as nutrient sources.

The experiment used completely randomized block design with single factor (i.e. types of growing media) and 4 replicates. The treatments were: soil only, soil + sand (3:1, v/v), soil + rice hull charcoal (3:1, v/v), and soil + cow manure (3:1, v/v). Each treatment consisted of 5 plants. Analysis of variance was used for data analysis followed by DMRT

Pre-planting: Base of plant cuttings were dipped into fungicide for 30 s, dried, dipped into root promoting hormone for 10 s, then planted in soil : compost (1:1, v/v) substrate in plastic bags (10 cm x 15 cm). ***Planting***: 4-week cuttings were then transplanted into different substrates in plastic bags (40 cm x 50 cm with the capacity of containing c.a. 10 kg soil). Two weeks after transplanting, mineral fertilizers as source of N, P, and K were added with the rates that were equivalent to that of compound fertilizer 12:12:17:2 N-P-K-Mg which was recommended by Wahid (1984) and Santosa (1993) for *P. nigrum* and *P. retrofractum,*

respectively. Variables observed were the increase of plant height, leaf numbers, flower and fruit numbers, and plant biomass.

RESULTS AND DISCUSSION

Many variables observed were significantly affected by different growing media. The addition of cow manure in media resulted in the best plant growth compared to those grown in other growing media. Plant height (Table 1), leaf numbers (Table 2), flower and fruit numbers (Table 3), shoot production (Table 4), and root weight (Table 5) showed similar results corresponding to the effect of the growing media. The non-significant differences also showed that the addition of cow manure resulted in the best plant growth.

Table 1. The weekly increase of plant height with different growing media

Growth period (week)	Growing media types			
	Soil only (control)	Soil : sand (3:1/v:v)	Soil : rice hull (3:1/v:v)	Soil : manure (3:1/v:v)
	……cm……			
0-2	3.21	2.98	3.09	3.07
2-3	1.39	1.24	1.39	1.28
3-4	2.08	1.65	1.70	2.10
4-5	1.61	1.25	1.56	1.49
5-6	2.47	2.04	2.33	2.69
6-7	1.83	1.96	1.72	1.99
7-8	2.09	1.55	1.63	2.93
8-9 Z)	1.91	2.54	1.52	2.85
9-10*	1.83 ab	1.37 b	1.19 b	2.71 a
10-11*	1.63 ab	1.11 b	0.78 b	2.45 a
11-12 Z)	1.07	0.91	0.49	1.75
12-13**	1.39 b	0.96 bc	0.53 c	2.85 a
13-14 Z) **	0.82 b	1.07 b	0.56 b	2.62 a
14-15*	0.79 ab	0.46 b	0.44 b	1.07 a
15-16 Z) *	0.48 b	0.45 b	0.64 b	2.39 a
0-16*	24.57 b	21.55 b	19.56 b	34.23 a
Plant height at planting	12.11	11.99	13.99	11.68
Plant height at 16 weeks after transplanting**	36.68 b	33.54 b	33.55 b	45.91 a

Notes: *, ** = significant at $p < 0.05$ and 0.01, respectively. Letters following numbers showed that values in the same row are significantly different according to DMRT. Z) = values transformed with $\sqrt{(x + 0.5)}$. These notes also explain other tables.

In manure-added media, plant height increased by 8.5 cm/month while in soil only, sand-added, and rice hull-added media the increase were 6.1, 5.4, and 4.9 cm/month, respectively (Table 1). Leaf numbers increased by 40/month from plants grown in manure-added media and this increase was 1.4 times of those grown in soil-only media (Table 2).

Table 2. The weekly increase of leaf numbers of *P. sarmentosum* with different growing media

Growth period (week)	Growing media types			
	Soil only (control)	Soil : sand (3:1/v:v)	Soil : rice hull (3:1/v:v)	Soil : manure (3:1/v:v)
0-2	2.1	2.1	2.6	1.6
2-3	1.9	2.3	2.1	2.0
3-4 Z)	2.7	2.9	3.1	2.7
4-5	3.0	3.0	2.9	2.9
5-6	4.3	4.6	5.6	3.9
6-7	4.9	4.3	5.1	6.2
7-8	8.3	8.0	7.9	7.9
8-9	9.2	8.7	9.6	8.9
9-10 Z)	11.2	9.7	9.9	13.5
10-11	11.7	9.7	12.2	13.1
11-12*	12.2 ab	9.8 b	9.7 b	15.4 a
12-13	11.3	9.3	8.5	16.6
13-14 Z) *	12.5 b	10.5 b	10.6 b	26.0 a
14-15	11.6	11.3	10.5	17.1
15-16**	10.1 b	9.0 b	7.7 b	22.5 a
0-16	116.8	105.1	108.1	160.1
Leaf numbers at planting	3.3	3.5	4.3	3.3
Leaf numbers at 16 weeks after transplanting	120.1	108.6	112.4	163.4

The performance of plants showed that the application of cow manure in the growing media resulted in better plant growth (shown by denser shoot and roots) and darker leaves; while the addition of sand and rice hull caused shorter plants and lighter leaves. Although not significantly different, plant grown in soil-only media showed a better performance of above ground parts than those in media with sand or rice hull addition (Figure 1).

Table 3. The weekly increase of flower and fruit numbers of *P. sarmentosum* with different growing media

Growth period (week)	Growing media types			
	Soil only (control)	Soil : sand (3:1/v:v)	Soil : rice hull (3:1/v:v)	Soil : manure (3:1/v:v)
0-2 Z)	0.7	0.7	0.7	0.5
2-3 Z)	0.4	0.6	0.3	0.3
3-4 Z)	0.2	0.5	0.7	0.5
4-5 Z)	0.7	0.7	0.7	0.3
5-6 Z)	1.1	1.6	1.3	1.5
6-7 Z)	1.7	1.5	1.3	1.7
7-8 Z)	2.2	2.5	2.3	2.4
8-9 Z)	2.5	2.3	2.9	2.6
9-10	3.3	3.0	2.3	2.8
10-11 Z)	3.7	2.7	3.3	3.8

11-12	3.2	2.3 b	2.4	4.1
12-13 Z)	3.7	3.4	2.7	4.4
13-14 Z)	3.6	2.6	3.3	6.9
14-15	3.8	2.8	2.8	3.7
15-16 Z) *	4.9 ab	2.5 b	2.3 b	8.3 a
0-16	35.8	29.7	29.4	43.7
Flower numbers at planting	0.0	0.4	0.5	0.3
Flower/fruit numbers at 16 weeks after transplanting	35.8	30.1	29.9	44.0

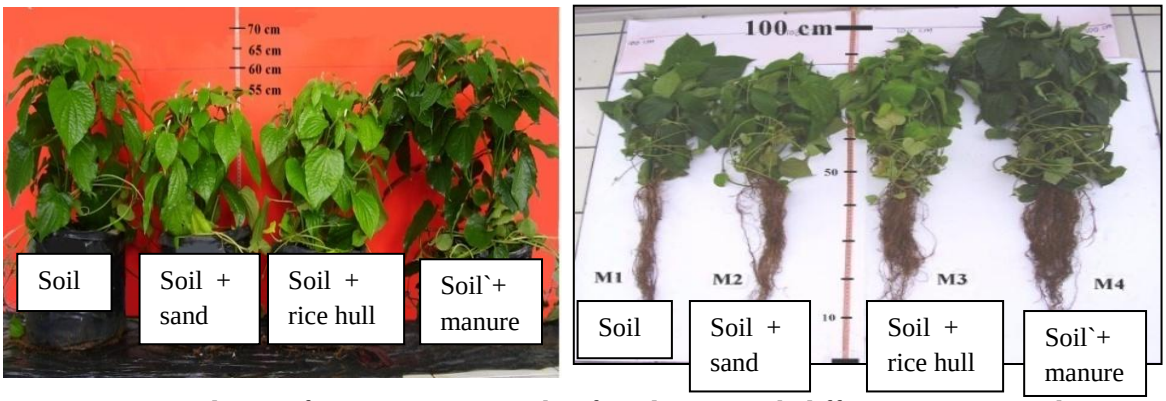

Figure 1. Plant performances at 16 weeks after planting with different growing media

Plants grown in manure-added media had fresh weight of leaves and total shoot c.a. 1.5-2.1 and 1.6-2.1 times, respectively, of those grown in other media (Table 4). Although there was a difference in dry weight of root, with manure application resulted in the highest weight, there was no difference in root length due to limited root growth in containers (Table 5).

Table 4. Shoot production of *P. sarmentosum* at 16 weeks after planting with different growing media

Plant parts	Growing media types			
	Soil only (control)	Soil : sand (3:1/v:v)	Soil : rice hull (3:1/v:v)	Soil : manure (3:1/v:v)
	...…..……fresh weight (g)……			
Leaves*	86.47 b	64.00 b	71.82 b	136.67 a
Stem*	82.98 b	63.71 b	71.74 b	141.50 a
Shoot*	169.44 b	127.71 b	143.56 b	278.17 a
	..……dry weight (g)……...			
Leaves	25.00 ab	18.50 b	25.33 ab	34.21 a
Stem Z)	18.67	15.70	18.88	27.79
Shoot	43.67	34.20	44.21	62.00
	……...……water content (%)……..…....			
Leaves	71.13	71.01	64.59	75.34
Stem*	78.12 ab	75.23 bc	73.89 c	80.55 a
Shoot*	74.37 a	73.08 ab	68.88 b	77.99 a

Tabel 5. Root and stolon of *P. sarmentosum* at 16 weeks after planting with different growing media

Variables	Growing media types			
	Soil only (control)	Soil:sand (3:1/v:v)	Soil: rice hull (3:1/v:v)	Soil:manure (3:1/v:v)
	……length (cm) ….....……			
Root	62.48	57.84	60.87	53.78
	……..…..fresh weight (g).....…….			
Root	24.89	22.31	22.42	30.76
Stolon [Z)] *	1.57 b	0.82 b	1.51 b	3.61 a
	……..…..dry weight (g)….....……..……...			
Root*	6.56 b	6.94 b	7.07 b	9.91 a
Stolon*	0.35 b	0.22 b	0.36 b	0.78 a
	……moisture content (%)……..……..			
Root	70.18	66.93	66.87	66.74
Stolon	77.75	64.37	75.12	77.37

The application of cow manure into the media had resulted in better plant performances and biomass than those in other media (Table 1-5). All pots from different media had been added with the recommended amount of fertilizers and cow manure had added nutrients more than sand or rice hull into the soil (Table 6). Furthermore, animal manure does not only give the benefit to plant from its nutrient content but also from its effect in improving physical and biological properties of the soil.

Table 6. Chemical characteristics of soil and soil amendments

Variables	Soil	Sand	Rice hull	Cow manure
pH H_2O	6.4	6.6		
C-Organic (%)	1.75	0.08	33.07	35.06
N-Total (%)	0.26	0.03	0.19	0.98
C/N	6.73	2.67	174.05	35.78
P-Bray- I (ppm)	3.3	22.3	2,600	2,400
Ca (me/100g)	4.07	6.99	6	47.5
Mg (me/100g)	1.4	3.34	5.83	28.33
K (me/100g)	0.25	0.35	11.03	7.69
Na (me/100g)	0.18	0.18		
CEC (me/100g)	15.6	11.58		
Bases (%)	37.28	93.78		
Al (me/100g)	Tr	Tr		
Fe (ppm)	4.16	112.56	643.8	1,930.00
Cu (ppm)	1.16	1.88	8.8	23.1
Zn (ppm)	2.24	3	26.6	77.4
Mn (ppm)	14	15.72	212.2	355.2
Texture (sand:silt:clay)	3.98:14.55:81.47			

The dense above-ground parts of the plant, as plant response to the application of cow manure, had resulted in plant collapse. This condition was related to higher moisture content of plant with animal manure than those with other media (Table 4), and also due to limited root growth in container that could not support the thick foliage. Plant grown in container may experience root circling due to limited space (container volume) for root growth. Root circling incidence was also induced by substrate compaction as shown by Zahreddine *et al.* (2004) ; thus pay attention must be given to the period of plant in the container and method of root control as recommended by Maynard *et al.* (2000) .

The addition of sand or rice hull into the growing media with the volume of ¼ of the media did not improve plant growth; the means of variables' value tended to be lower than those grown in soil-only media. There were two possible causes that resulted in limited growth of *P. sarmentosum*. Firstly, both sand and rice hull are poor nutrient sources (Table 6), hence it cannot support well growth of plant. Secondly, the application of sand and rice-hull into the media, that was initially intended to create better physical characteristics of substrate (increase substrate porosity) and also to provide lighter media than clay soil, had resulted in the increase of water loss from the soil as sand and rice hull retained less water than clayey soil. Comparing the results from plant grown in soil-only media and in sand- or rice hull- added media, from those two reasons, it seems that the availability of water played more roles in affecting the plant growth than the impact of nutrient availability. The result was in accordance with Mathers *et al.* (2007) who summarized that too much porosity of the substrate resulted in more frequent irrigation required to maintain adequate moisture for plant growth.

The numbers of fruit at 16 WAP were higher from plants grown in sand- or rice hull-added media than those in soil or soil with chicken-manure-added media. These results related to the limited growth of plant vegetative parts in sand- or rice-hull-added media, therefore plant growth switched to the generative phase earlier than plants in two other media. On the contrary, larger amount of available nutrients in manure-added soil well supported vegetative growth of plants. It seemed that until 16 WAP, the vegetative growth still continued while the generative growth was delayed, therefore when the experiment ended at 16 WAP, the fruit number was low. There was a possibility that in few more weeks, the fruit numbers in manure-amended soil would be higher than those in other media because there were more leaves, hence more assimilates to form more fruits.

CONCLUSION

The combination of clayey soil and cow manure with the composition of 3:1 (v:v) was the best media for *Piper sarmentosum* growth in pot; it resulted in the highest fresh weight of plant biomass at 16 weeks after planting but delayed the production of fruits. The addition of sand or rice hull, as much as ¼ of total volume of the media, into the soil had resulted in the lowest values of plant performances and yields.

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