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Effect of Various Planting Media on Growth of Thao Yai Mom *(Tacca leontopetaloides* Ktze.)

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Abstract *Thao yai mom* (*Tacca leontopetaloides* Ktze.) is an annual plant and is almost extinct in Thailand. With this reason, the *thao yai mom* starch (a product of the plant) became costly. Its tuber is processed to be used as a source of starch for cooking and various sweets. Its plant grows well in a naturally sandy soil condition. Hence, this study aimed to assess growth of *thao yai mom* plant on various planting media. This study was conducted from May 2014 up to February 2015 at Rajamangala University of Technology Tawan-ok, Chanthaburi campus in the province of Chanthaburi, Thailand. The experiment was laid out in a completely randomized design (CRD), replicated three times. There were eight planting media which composed of sandy soil-only (a controlled treatment); mixed proportion of rice husk ash, sandy soil, and cow dung (1:1:1); mixed proportion of loam soil and rice husk ash (1:1); mixed proportion of rice husk ash and cow dung (1:1); mixed proportion of sandy soil and cow dung (1:1); mixed proportion of sandy soil and rice husk ash (1:1); loam soil-only and; rice husk ash-only. These mixed proportion of planting media were determined by volume. The clay pots containing the abovementioned planting media used to grow the planted tubers of *thao yai mom* and were then exposed under sunlight. The results revealed that the planting medium of rice husk ash: sandy soil: cow dung (1:1:1) gave the tallest plants. Moreover, the number of new tubers per planted tuber, number of new tubers per plant, weight of new tubers per plant and weight per new tuber obtained on rice husk ash: sandy soil: cow dung (1:1:1) were greater than those on sandy soil-only, a controlled treatment. Still, the medium of rice husk ash: sandy soil: cow dung (1:1:1) gave the highest fresh weight of new tubers per pot; followed by the mediums of loam soil: rice husk ash (1:1), rice husk ash: cow dung (1:1), sandy soil: cow dung (1:1), loam soil, sandy soil: rice husk ash (1:1), rice husk ash, and sandy soil-only, respectively. The plant height was positively associated with fresh weight of new tubers per pot. It was concluded that the rice husk ash: sandy soil: cow dung (1:1:1) is the best planting medium for growth of *thao yai mom* due to its contribution of having the tallest plant, highest number of new tubers per planted tuber, highest number of new tubers per plant, greatest weight of new tubers per plant, and greatest fresh weight of new tubers per pot. The sandy soil-only was not a good planting medium as all plant growth parameters were the lowest compared to the rest of the planting media. This study suggested that the planting medium of rice husk ash: sandy soil: cow dung (1:1:1) could replace the use of sandy soil-only as the planting medium for growing *thao yai mom* plant.

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Introduction

Thao yai mom (*Tacca leontopetaloides* Ktze.) is the local name of a plant in Thailand which is also known as east indian arrowroot or thahiti arrowroot. It is also locally known as *mai tao ruesi* or *buk ro*. It is an annual plant (Pattrasudhi, 2000) which has a fibrous root system; the shapes of its tubers are flat and some round shifting from the stem to the tuberous rhizome which is an organ that accumulates food. In the past, *thao yai mom* plant was abundant in the forest and near the seashore of the eastern and southern regions of Thailand. Today, it can still be found in natural forest area of the northeastern region. The plant grows better in the shaded condition and in the sparse forest with sandy, or sandy loam soil conditions. The tubers are preferably extracted by water several times to eliminate the bitter taste element, then dried, and finally be made into a flour (Ritthiruangdej, 2003; Pattrasudhi, 2000). Its flour has light and soft characteristic; the powder form has a property that gives transparent and shiny appeareance, and elastic texture. Because of this, the flour is used as one of the ingredients for cooking (e.g., pan-fried soft shell, fried noodles with pork and kale soaked in gravy, fish stomach soup) (Ritthiruangdej, 2003; Pattrasudhi, 2000). In addition, the flour can be mixed with other flour to make various kinds of sweets (i.e., layer sweet cake is made by combining rice flour and *thao yai mom* flour). As mentioned earlier, *thao yai mom* flour has a property that makes the layer sweet cake to be transparent, shiny, and more gooey (Sinthavalai, 1982; Wongtong and Poonpholkul, 2001). Some researchers reported that *thao yai mom* flour has a property to ease digestion thus, it is also used as food ingredient for patients who are weak and sluggish as well as for children who have problems on food digestion (Ritthiruangdej, 2003; Pattrasudhi, 2000). Moreover, the *thao yai mom* plant has the medicinal properties according to a traditional medicine textbook; its roots can cure fever, insect stings, and poison bites from animals. Its tubers have medicinal properties to cure debility, poor appetite after recovering from an illness, and to improve heart conditions (Ritthiruangdej, 2003; Pattrasudhi, n.d.). Presently, *thao yai mom* plant is seldom grown; the tubers, growing with just a small amount, are only picked up from the natural forest. The low supply and its nearly extinction resulted in an increase price.

The tubers of *thao yai mom* used in the previous study were picked up in a natural condition (i.e., sandy soil area at the seashore in the province of Trat, Thailand) at a physiological maturity stage where leaves were already dried. These tubers were then regrown on 2 planting medium: loam soil under the shade of trees, and on sandy soil in a planting tray under the black salan roof with 50% protection from the sunlight, that is from 2007 up to 2013 at Rajamangala University of Technology Tawan-ok, Chanthaburi Campus. The result showed that those tubers grown in a planting tray on

sandy soil condition under the black salan roof with 50% protection from the sunlight were growing normally and continuous with its life cycle for every year, while those tubers grown on loam soil under shade were growing smaller. However, its growth had declined in the succeeding year until it disappeared thus, planting media have been very significant to growth and yield of *thao yai mom* plants (Koolpluksee, 2013). Planting media for this plant are cheap and easily available in Thailand (e.g.,, fresh rice husk, rice husk ash, coconut coir, and sandy soil). Some of these planting media can be used alone but two or more of these media are mostly used in combination (i.e., mixed proportion of fresh rice husk and sandy soil (1:1), mixed proportion of rice husk ash and sandy soil (1:1), and mixed proportion of coconut coir and sandy soil (1:1). Based on the study of Nuntagij (n.d.), these planting media were used to grow plants for a year; found out that fresh rice husk, rice husk ash, and coconut coir had slightly shrunken and could then be reused as planting media for more than once. Coconut coir had a very good water holding capacity more than the plants actual need, and decayed rapidly after growing thus, water supply and drainage must be carefully managed to the plants. Rice husk ash-only had been one of the good planting media since it could be used as a lone planting medium although it slightly decayed, or it could be mixed with sandy soil. These three planting media were individually mixed to sandy soil with a proportion of 1:1; found that the mixed planting media could increase the plants' chemical and physical properties. Some researchers also studied on other planting media; Luangaram (2006) made use of red sweet cherry tomato and had it grown in a plastic bag with a size of 20 cm x 42.5 cm containing soil, filter cake, and chicken dung in eight treatments with various mixed proportions of 8:4:2, 8:3:2, 8:4:1, 8:3:1, 10:4:2, 10:3:2, 10:4:1, and 10:3:1, respectively, as compared with the soil alone and soil with chemical fertilizer applied as planting media. There were no effects found on fruit weight and flesh thickness in all planting media, but were found on some characteristics (i.e., mixed proportion of soil, filter cake, and chicken dung (8:3:2) gave the greatest flesh firmness; 10:4:2 gave the highest number of branches per plant; 10:4:1 gave the highest number of flowers per plant, highest number of fruits per flower, greatest yield per plant, largest width of fruit, largest length of fruit, highest soluble solid quantity, and quickest blooming of flowers and; 10:3:1 gave the tallest plant). It is therefore important to obtain the proper planting media for the growth of *thao yai mom*. Accordingly, this study aimed to assess the growth of *thao yai mom* (*Tacca leontopetaloides*) on various planting media.

Meterials and Methods

The study was conducted at Rajamangala University of Technology Tawan-ok on Chanthaburi Campus in the province of Chanthaburi, Thailand, from May 2014 up to February 2015. The experiment was laid out in a completely randomized design (CRD), replicated three times or three clay pots per planting medium. Planting media were composed of eight treatments which made up of the mixed proportions by volume of loam soil and rice husk ash (1:1) [or loam soil: rice husk ash (1:1)], rice husk ash-only, sandy soil: rice husk ash (1:1), rice husk ash: cow dung (1:1), rice husk ash: sandy soil: cow dung (1:1:1), sandy soil: cow dung (1:1), sandy soil-only, and loam soil-only. The planting medium of sandy soil-only was assigned to be the controlled treatment. One-year old *thao yai mom* tubers were picked up from the natural field condition; tubers with similar sizes and weights were selected for the study. Clay pots with a diameter of 16 inches and a height of 12 inches were used to regrow the tubers. Three tubers were regrown on each clay pot for every planting medium, with a total of 24 clay pots totaling to 72 planted tubers. All clay pots containing the planted tubers in every planting medium were brought outdoor and exposed to the sunlight for the entire growing season of *thao yai mom.*

The various planting media were analyzed to identify its chemical properties i.e., pH, total nitrogen, total phosphate, total potassium, total calcium, total magnesium, electrical conductivity, moisture content, organic matter, and C/N ratio (Table 1). Hand weeding was consistently done within the clay pots after growing. No irrigation and chemical fertilizer application done for the entire growing period as the planting were made during the early rainy season, in the month of May of 2014. Likewise, no insect and disease attacks were observed during the entire growing period, hence no insecticides and fungicides were used. As the plants reached the physiological maturity, leaves and stems for every plant were observed to have totally dried in the month of February, 2015; and finally, fresh tubers in the pots were harvested.

All growth parameters of *thao yai mom* plant were determined at the physiological maturity and are as follows:

Plant height from the mother plant (or the first plant grew from the planted tuber) in a unit of centimeter (or cm) was measured stretching from the base of the ground to the tip of the plant.

Number of plants per planted tuber in a unit of number per planted tuber (or no/planted tuber) was determined by counting the total plant number and then divided by the total planted tubers.

Number of new tubers per planted tuber in a unit of number per planted tuber (or no./planted tuber) was done by counting the total number of new tubers that grew from the planted tubers and then divided by the total planted tubers.

Number of new tubers per plant in a unit of number per plant (or no./plant) was determined by counting the total number of new tubers that grew from the planted tubers and then divided by the total number of plants that grew also from the same planted tubers.

Weight of new tubers per plant in a unit of gram per plant (or g/plant) was done by weighing the total fresh weight of new tubers and then divided by the total number of plants.

Weight per new tuber in a unit of gram per tuber (or g/tuber) was made by weighing the total fresh weight of new tubers and then divided by the total number of new tubers.

Diameter of a new tuber in a unit of centimeter (or cm) was done by measuring the diameter of each new tuber and then calculated for its diameter mean.

New tuber height was made by measuring all of each new tuber height from the bottom to the top in a unit of centimeter (or cm) then calculated for the mean of new tuber height.

Fresh weight of new tubers per pot in a unit of gram per pot (or g/pot) was calculated by the numerator of the total fresh weight of new tubers from all of the three clay pots per treatment then divided by three.

All growth parameters of *thao yai mom* plant were analyzed using the statistical analysis system (SAS) program. Comparison of treatment means was done using the Duncan's Multiple Range Test (DMRT) at the 0.05 probability level. The relationships between the other plant growth parameters and fresh weight of tubers per pot were analyzed using the correlation analysis program.

Results

The plant height of *thao yai mom* was found to be significantly different ($P<0.05$) under various planting media as the planted tubers grew on the mixed proportion of rice husk ash: sandy soil: cow dung (1:1:1) were the tallest (27.65 cm), while on the planting medium of sandy soil-only were the shortest (15.69 cm) (Table 2).

The number of plants per planted tuber did not differ significantly under various planting media, ranged from 2.67-3.44 no./planted tuber (Table 2 and Figure 1).

The planting medium of rice husk ash: sandy soil: cow dung (1:1:1) gave the highest number of new tubers per planted tuber (5.67 no./planted tuber), highest number of new tubers per plant (1.70 no./tuber), largest weight of new tubers per plant (14.57 g/plant), and heaviest fresh weight of new tubers per pot (145.72 g/pot). However, those growth parameters under sandy soil-only were the lowest (67 no./planted tuber, 0.26 no./tuber, 0.66 g/plant, and 5.20 g/pot, respectively) (Table 2).

Rice husk ash-only medium gave the heaviest weight per new tuber (16.30 g/tuber); loam soil: rice husk ash (1:1) medium gave the widest diameter of a new tuber and the tallest new tuber height (2.77 cm and 2.44 cm, respectively); while these 3 parameter growth values under sandy soil-only were the lighest (3.02 g/tuber), narrowest (0.46 cm), and shortest (0.41 cm), respectively (Table 2).

Fresh weight of new tubers per pot were significantly different ($P<0.05$) under various planting media as the medium of rice husk ash: sandy soil: cow dung (1:1:1) obtained the heaviest fresh weight of new tubers per pot (145.72 g/pot), followed by loam soil: rice husk ash (1:1) (112.50 g/pot), rice husk ash: cow dung (1:1) (93.19 g/pot), sandy soil: cow dung (1:1) (92.22 g/pot), loam soil-only (55.01 g/pot), sandy soil: rice husk ash (1:1) (47.10 g/pot), rice husk ash-only (40.27 g/pot), and sandy soil-only (5.20 g/pot), respectively (Table 2 and Figure 2). Only the plant height was positively associated with fresh weight of new tubers per pot ($r=0.81$) as the correlation coefficient or r symbol had a positive value.

Table 1. Chemical property of various planting media

Planting media	pH	Total nitrogen (%)	Total phosphate (%)	Total potassium (%)	Total calcium (%)	Total magnesium (%)	Electrical conductivity (dS/m)	Moisture content (%)	Organic matter (%)	C/N ratio (%)
loam soil: rice husk ash (1:1)	6.90	0.30	0.20	0.50	0.60	0.30	0.04	13.10	6.30	15/1
rice husk ash-only	8.30	0.10	0.40	0.30	1.80	0.10	0.10	29.40	7.40	31/1
sandy soil: rice husk ash (1:1)	7.80	0.10	ND	0.20	0.40	ND	0.03	2.70	2.40	28/1
rice husk ash: cow dung (1:1)	6.60	0.60	0.30	0.10	1.10	0.10	0.20	31.70	14.60	14/1
rice husk ash: sandy soil: cow dung (1:1:1)	6.70	0.20	0.10	0.10	0.50	0.10	0.05	3.50	5.90	14/1
sandy soil: cow dung (1:1)	6.30	0.20	ND	0.10	0.20	ND	0.03	3.00	3.60	11/1
sandy soil-only	5.30	ND	ND	0.10	0.10	0.20	0.02	2.20	0.70	41/1
loam soil-only	7.90	0.20	ND	0.20	0.80	0.10	1.70	7.80	3.30	10/1

ND (non detectable) in the table means that it is not measurable due to having a negligible value.

Table 2. Plant height, number of plants per planted tuber, number of new tubers per planted tuber, number of new tubers per plant, weight of new tubers per plant, weight per new tuber, diameter of a new tuber, new tuber height, and fresh weight of new tubers per pot for *thao yai mom* on various planting media

Planting media	Plant height (cm)	Number of plants per planted tuber (no./planted plant)	Number of new tubers per planted tuber (no./planted tuber)	Number of new tubers per plant (no./plant)	Weight of new tubers per plant (g/plant)	Weight per new tuber (g/tuber)	diameter of a new tuber (cm)	New tuber height (cm)	Fresh weight of new tubers per pot (g/pot)
loam soil: rice husk ash (1:1)	27.02a	3.33a	3.89abc	1.17ab	11.25ab	10.17ab	2.77a	2.44a	112.5ab
rice husk ash-only	19.20ab	3.22a	1.00bc	0.30b	4.11ab	16.30a	1.71ab	1.54ab	40.27ab
sandy soil: rice husk ash (1:1)	20.68ab	3.22a	2.22abc	0.69ab	4.86ab	7.29ab	1.99a	1.84a	47.10ab
rice husk ash: cow dung (1:1)	24.71ab	2.89a	3.33abc	1.13ab	10.47.ab	9.39ab	2.08a	1.85a	93.19ab
rice husk ash: sandy soil: cow dung (1:1:1)	27.65a	3.33a	5.67a	1.70a	14.57a	8.51ab	2.33a	1.92a	145.72a
sandy soil: cow dung (1:1)	24.87ab	3.44a	4.33ab	1.29ab	9.51ab	6.89ab	1.62ab	1.4ab	92.22ab
sandy soil-only	15.69b	2.67a	0.67c	0.26b	0.66b	3.02b	0.46b	0.41b	5.20b
loam soil-only	23.09ab	3.33a	2.55abc	0.77ab	5.00ab	5.86b	1.96a	1.62a	55.01ab
F-test	*	NS		*	*	*	*	*	*
C.V. (%)	15.50	15.43	41.97	41.26	53.67	41.15	28.34	24.88	56.16

The different letters and * symbol in each column are significantly different at the 0.05 probability level. Means comparisons were done using Duncan's Multiple Range Test (DMRT). NS (non-significant) in the column, Mean in the same column is not significantly different at the 0.05 proablility level. Means comparisons were done using Duncan's Multiple Range Test (DMRT).

C.V. (coefficient of variation) in the column is the ratio of the standard deviation to the mean; it shows the extent of variability in relation to the mean of the population.

Figure 1. Number of plants per planted tuber of *thao yai mom* on various planting media
A: loam soil: rice husk ash (1:1) B: rice husk ash-only
C: sandy soil: rice husk ash (1:1) D: rice husk ash : cow dung (1:1)
E: rice husk ash: sandy soil : cow dung (1:1:1) F: sandy soil : cow dung (1:1)
G: sandy soil-only H: loam soil-only

Figure 2. Fresh weight of the new tubers of *thao yai mom* on various planting media
A: loam soil : rice husk ash (1:1) B: rice husk ash-only,
C: sandy soil : rice husk ash (1:1) D: rice husk ash : cow dung (1:1),
E: rice husk ash : sandy soil : cow dung (1:1:1) F: sandy soil : cow dung (1:1),
G: sandy soil-only H: loam soil-only

Discussion

The growth of *thao yai mom* on various planting media was found to be better in the medium of rice husk ash: sandy soil: cow dung (1:1:1) as it gave the tallest plants, while the sandy soil-only gave the shortest plants. This was mainly due to the acidity-alkalinity values (or pH values) of planting media as the range from 6.30-6.90 were very suitable for the

growth of *thao yai mom* in terms of plant height. This pH value was compatible with the report from Soil, Fertilizer, and Environment Academic Development Programme (n.d.) that cited suitable soil pH could release the elements of nitrogen, phosphorus, potassium, calcium, and magnesium as these elements are important and essential to the plants. While soil pH was equivalent to and more than 7.80, these could impede the release of the abovementioned elements, except potassium (Figure 1). The width of the black strip in the figure represents the quantity of nutrient availability for each element at different pH levels. The study was agreed with that of Yuvaniyama (n.d.) who reported that the high soil pH caused the negative effect on plant growth as it reduced the nutrient availability to the plants (i.e,. the soil pH of 6 and 7 would had phosphorus available and useful to the plants, but the soil pH that had more than 7 reduced the available micronutrients such as iron, manganese, zinc, copper, and cobalt, while sodium, boron, molybdenum became toxic nutrients. As a result, calcium and magnesium elements were sediment; consequently lacked zinc, nitrogen, and organic matter on the soil.

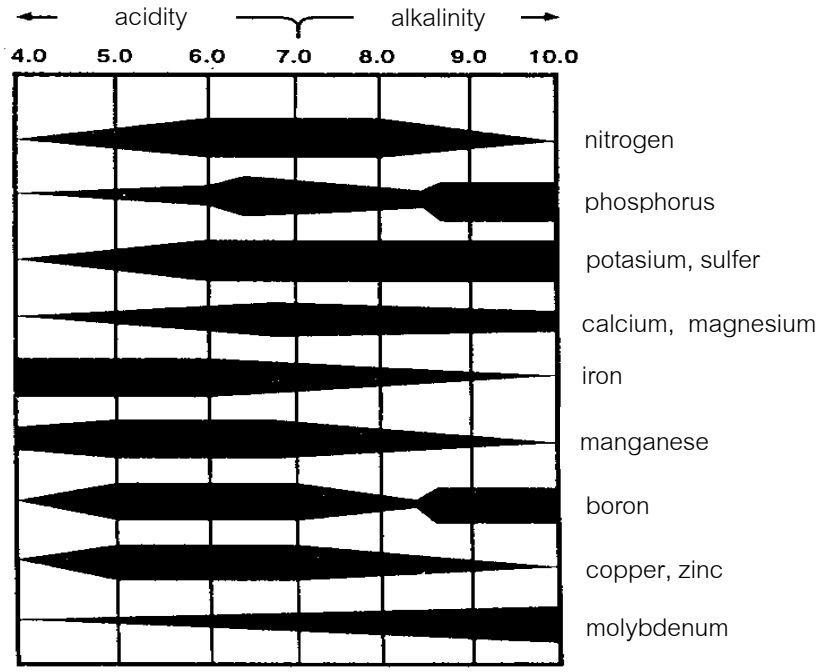

Figure 3. Relationship of the soil pH and soil nutrient availability [Soil, Fertilizer and Environment Academic Development Programme (n.d.)]

Tuberous plant like *thao yai mom* when grown on planting media with high soil pH levels found no effect on starch accumulation on its new

tuber as well as on its weight per new tuber (Tables 1 and 2). The sandy soil was a planting medium that had a pH of 5.30 which was classified as medium acidic. This acid level could impede the nutrient release of nitrogen, phosphorus, potassium, calcium, and magnesium. As a result, *thao yai mom* plant had an insufficient uptake of the said nutrients. Consequently, a reduce on the plant height, number of plants per planted tuber, number of new tubers per planted tuber, number of new tubers per plant, weight per new tuber, diameter of a new tuber, new tuber height and, fresh weight of new tubers per pot were also observed. As explained earlier, the pH for rice husk ash: sandy soil: cow dung (1:1:1) was the most suitable planting medium for the growth of *thao yai mom* as compared with the sandy soil-only (Tables 1 and 2).

The electrical conductivity (EC) of various planting media ranged from 0.02-1.70 dS/m. The electrical conductivity was a measure of the electric current that a solution carries (Hershey and Sand, 1993). EC was an indicator of a normal or not-normal plant growth. The EC of various planting media in the study did not affect the growth and fresh weight of new tubers per pot of *thao yai mom* plants (Table 1). The study was agreed with the FAO (1976), which classified EC levels affected the plant growth as EC with less than 2.00 dS/m had no effect, while EC ranged from 2-4 dS/m had. EC between 4-8 dS/m affected the growth of several plant species; only salt-tolerant plants could be yielded with EC of 8-15 dS/m; while only the most extreme salt-tolerant plants could be yielded with EC of more than 15 dS/m.

The moisture content of various planting media ranged from 2.20-31.70% (Table 1). These moisture content did not affect the growth of *thao yai mom* plant in terms of plant height, number of plants per planted tuber, number of new tubers per planted tuber, number of new tubers per plant, weight of new tubers per plant, weight per new tuber, diameter of a new tuber, new tuber height, and fresh weight of new tubers per pot. The moisture content of the rice husk ash: sandy soil: cow dung (1:1:1) was similar to that of sandy soil-only, but the plant growth on these 2 planting media were very different. Hence, the difference on the growth was not mainly due to the moisture contents of these various planting media.

Organic matter (OM) of the eight planting media ranged from 2.40-14.60% (Table 1). OM of the 7 planting media [rice husk ash: sandy soil: cow dung (1:1:1), loam soil: rice husk ash (1:1), rice husk ash: cow dung (1:1), sandy soil: cow dung (1:1), sandy soil: rice husk ash (1:1), loam soil-only, and rice husk ash-only] was greater than that of sandy soil-only. Ratneetoo (2012) reported that OM supplied better chemical, physical, and biological soil properties. OM helped in the improvement of planting media, especially in the physical properties (i.e., water holding capacity, porosity, friability, and nutrients of planting media). OM of the rice husk ash: sandy soil: cow dung (1:1:1) was 5.90% while it was only 0.70% for sandy soil-

only. Based on the basic knowledge of soil composition, the general soil composition suitable for plant growth was 25% air, 25% water, 45% mineral, and 5% organic matter (Lecturers from the Department of Soil Science, 1998). The study found that the rice husk ash: sandy soil: cow dung (1:1:1) was a good quality planting medium, suitable for the growth of *thao yai mom* plant; while the sandy soil-only was not a good planting medium having had very low organic matter, thus not suitable.

The carbon-to-nitrogen ratio (or C/N ratio) was an indicator for the velocity in organic matter decomposition and the speed of nitrogen release that were useful to the plants. The study found that rice husk ash: sandy soil: cow dung (1:1:1) had a C/N ratio of 14/1 which was lower than that of sandy soil-only with 41/1 (Table 1). The nitrogen in the said C/N ratio had a very low quantity resulted in the high C/N ratio on the sandy soil-only. This meant that the microorganisms competed for the nitrogen as their food source, and as a result the nitrogen became a limited factor of velocity in organic matter decomposition (Yingjajaval, 2011). With this, it should be noted that the C/N ratio for organic matter must not be more than 20/1, as it is a good indicator to estimate the use of nitrogen from the organic matter source. If the organic matter had the high C/N ratio, which is more than 20/1, nitrogen fertilizer should be applied to the organic matter to have enough nitrogen for organisms that make up the organic matter composition. However, a high C/N ratio for a planting medium like sandy soil-only, which also had very low organic matter, should be used as soil covering (mulching material) rather than applying more nitrogen fertilizer as it was suitable to keep the soil surface from being washed away by the rain.

In general, the mixed proportion of rice husk ash: sandy soil: cow dung (1:1:1) was the best planting medium for the growth of *thao yai mom* plant as it promoted the best plant growth and fresh weight of new tubers per pot. The said planting medium was the only medium that had the most suitable chemical properties (i.e., pH, total nitrogen, total phosphate, total potassium, total calcium, magnesium, electrical conductivity, moisture content, organic matter, and C/N ratio) for the growth and fresh weight of new tubers per pot of the *thao yai mom* plant as compared with the rest of the planting media.

The relationship between the other plant growth parameters (i.e., plant height, number of plants per planted tuber, number of new tubers per planted tuber, number of new tubers per plant, weight of new tuber per plant, weight per new tuber, diameter of a new tuber, and new tuber height) and fresh weight of new tubers per pot found that only the plant height was positively associated with the fresh weight of new tubers per pot. This meant that as the plant height increased, the fresh weight of new tubers per pot also increased. Tall plants might had accumulated more assimilates storage organs on their stems than the short plants, and later on translocated

to the new tubers resulted in an increase of fresh weight of new tubers per pot.

Conclusion

The growth of *thao yai mom* plant was the best in the medium of rice husk ash: sandy soil: cow dung (1:1:1) as it gave the tallest plants. This plant species grown on the rice husk ash: sandy soil: cow dung (1:1:1) gave better number of new tubers per planted tuber, number of new tubers per plant, weight of new tubers per plant, and weight per new tuber than those on sandy soil-only. The diameter of a new tuber and new tuber height were significantly different ($P<0.05$) on various planting media as these 2 plant growth parameters grown on the sandy soil-only had the lowest values compared to the other planting media. The rice husk ash: sandy soil: cow dung (1:1:1) promoted the heaviest fresh weight of new tubers per pot, followed by the loam soil: rice husk ash (1:1), rice husk ash: cow dung (1:1), sandy soil: cow dung (1:1), loam soil-only, sandy soil: rice husk ash (1:1), rice husk ash-only, and sandy soil-only, respectively. The plant height was positively associated with the fresh weight of new tubers per pot. This meant that as the plant height increased, the fresh weight of new tubers per pot also increased. In conclusion, the rice husk ash: sandy soil: cow dung (1:1:1) was the most suitable planting medium for the growth of *thao yai mom* plant, mainly due to the obtained tallest plant, highest number of new tubers per planted tuber, highest number of new tubers per plant, heaviest weight of new tubers per plant, and heaviest fresh weight of new tubers per pot. On the other hand, the sandy soil-only was not a good planting medium as all plant growth parameters were in their lowest, as compared to those with the rest of the planting media.

Suggestions

The rice husk ash: sandy soil: cow dung (1:1:1) was the best planting medium for the growth and fresh weight of new tubers per pot of *thao yai mom* plant. This planting medium could replace the use of sandy soil-only in growing the plant. The rice husk ash, sandy soil, and cow dung is the recommended proportion of planting medium that is locally available, and is, therefore, not necessary to buy for materials, hence the cost of production is low. The preparation of this planting medium is easy, convenient, and time-saving.

Thao yai mom plant could grow well in the planting clay pots hence it was not necessary to wait for its tubers to grow on sandy soil from the natural condition. This study suggested that the medium of rice husk ash: sandy soil: cow dung (1:1:1) was the most suitable for its growth. It could also be suitable to use as a planting medium for propagation of plants that

are almost extinct, like *thao yai mom*, for agricultural sustainability. The producers and any interested people can grow *thao yai mom* plant as an additional source of income for their families.

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