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The Effect of the Proportion of Vermicompost Fertilizer in Planting Media on the Growth of Papaya (*Carica papaya L.*) Calina Cultivar

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Abstract. Papaya is in great demand by the public because of its sweet taste and abundant vitamin and mineral content. The problem is that in recent years papaya productivity has fluctuated due to poor soil structure and lack of nutrients in the soil, which results in poor seed growth and unqualified seedlings, so efforts need to be made to find the right type of planting media to support papaya nurseries, one of which is with vermicompost fertilizer. This experiment aims to determine the effect of the proportion of vermicompost fertilizer in the planting medium on the growth of china cultivar papaya seedlings. The research method used was a completely randomized design with six treatments consisting of K0 = 100% soil and 0% vermicompost fertilizer (control), K1 = 80% soil and 60% vermicompost fertilizer, K2 = 60% soil and 40% vermicompost fertilizer, K3 = 40% soil and 60% vermicompost fertilizer, K4 = 20% soil and 80% vermicompost fertilizer and K5 = 0% soil and 100% vermicompost fertilizer. The experimental results showed a significant effect on the proportion of vermicompost fertilizer on plant growth rate and root length of plants aged 15, 30, and 45 DAP, as well as root volume, stem diameter, plant height, number of leaves, fresh weight and dry weight of plants aged 30, 45 and 60 DAP but not significantly different from the observation of plant growth capacity aged 7 and 14 DAP.

Keywords: Planting media, papaya cultivar calina, proportion, vermicompost fertilizer

INTRODUCTION

Papaya is a horticultural product that is highly demanded by most Indonesians. Apart from its delicious taste, papaya is also a favorite food of many people because of its high vitamin and mineral content. According to statistics on land area, production and productivity of papaya plants in 2017 – 2021, the land area and production of papaya plants tend to experience a considerable increase from 2017 – 2020 buta decrease in 2021. It is also not matched by its fluctuating productivity, which means that Indonesia's papaya fruit production has not been able to keep up with the increasing consumption needs of the community. Papaya production is hampered by a number of problems, including poor soil structure and nutrient deficiencies in the soil. This results in poor growth of papaya seeds and low quality seedlings (Rukmana, 1995).

Good growing media components, such as soil, air, organic matter and water help plant growth. The optimal soil component is 45% inorganic or mineral material, 5% organic material and 50% pore space (Pratiwi et al., 2017). The growth and development of papaya plants can be assisted by using the right planting media. Because different types of planting media can affect plant growth and development, it is necessary to choose the right planting media for papaya nurseries. Good planting media must be able to maintain moisture in the root area, increase the availability of nutrients for plants and provide sufficient air for plants (Karnilawati, 2017).

The organic fertilizer kascing contains all the macro and micro nutrients for plant growth. It also contains vitamins, minerals and elements necessary for plants including nitrogen and phosphorus. Vermicompost fertilizer is an organic material that contains various components and compounds that are physically and chemically important for plant growth and development, especially at the seedling stage when plants need sufficient nutrients to thrive (Triastuti Febrianti, 2016). Adding vermicompost fertilizer to the soil as organic matter is one technique to improve the soil environment, especially soil structure. The main component used to make kascing fertilizer is *Lumbricus rubellus* worm faces. Compost that has been made by earthworms decomposing organic waste is used to make vermicompost fertilizer. Besides being mor profitable than compost, kascing is an environmentally friendly organic fertilizer (Oktaviani & Ekawati, 2023).

According to the result of research by Rianto and Kusumawati (2021), vermicompost fertilizer combined with soil and applied to *Mucuna bracteata* plants with a composition of 40% soil and 60% vermicompost fertilizer gave good results, especially in the parameters of plant height and stem diameter. On the other hand, the combination treatment of 20% soil with 80% vermicompost fertilizer can increase the number of leaves although the difference with other treatments is not statistically significant.

The use of organic fertilizer kascing as planting medium provides many benefits because it contains various nutrients and growth regulators. The presence of *Azotobacter sp* bacteria that function as non-symbiotic N-fixing bacteria found in organic fertilizer kascing, growth stimulating substances such as auxins, cytokinins and gibberellins and various nutrients inluding N,P,K, Mg and Ca can contribute to the enrichments of the N component needed by plants (Lidar et al., 2021). Kascing is an organic fertilizer that can improve soil structure, prevent plant diseases, increase bacteria that are beneficial to plant roots and fertilizer the soil, all of which can improve soil health and increase crop yields (Mulat, 2003).

In connections with these things, to support the growth of papaya cultivar calina plants both in quantity and quality, it is necessary to have the right cultivation and maintenance and fertilization methods. In order not to interfere with the absorption of nitrogen by the roots and inhibit plant growth and development, fertilization must be given in a balanced and appropriate manner (Tisdale et al., 1985). Composting of vermicompost fertilizer is based on the basic principle of using earthworm to berak down organic matter. Along with vitamins, enzymes and microorganism, this fertilizer also contains plat-available nitrogen, phosphorus, potassium and magnesium. Earthworm used in the process of making vermicompost fertilizer also have properties including easy breeding and high preference for various substrates so that it is expected that the use of vermicompost fertilizer can be used as another alternative as a substitute for inorganic fertilizer because of its low-cost method and to combat environmental pollution and produce high-quality organic fertilizer at the same time (Niswati, 2017). The purpose of this study was to determine the effect of the proportion of vermicompost fertilizer in the planting medium on the growth of calina cultivar papaya seedlings and to determine at what proportion of vermicompost fertilizer is the best effect as a planting medium for calina cultivar papaya.

METHOD

The research was conducted from June to August 2023 in Kuningan Regency. The research method used was a completely randomized design (CRD) with 6 treatments that were repeated 4 times so that there were 24 experimental units with 10 polybags per experiment (Table 1). The materialals used were calina cultivar papaya seeds, top soil and vermicompost fertilizer. While the tools used were polybags measuring 20x20 cm, paddles, UV plastic, wire esh, scissors, ruler, vernier, digital hygrometer, lux meter, oven, stationery and camera. Data and the results of the main observations were analyzed using the variance method and to determine differences between treatments, Duncan's Range Test or DMRT was used with a 5% confidence interval using the IBM SPSS Statistic 25 application.

K_0 = 100% soil with 0% vermicompost fertilizer

K_1 = 80% soil with 20% vermicompost fertilizer

K_2 = 60% soil with 40% vermicompost vertilizer

K_3 = 40% soil with 60% vermicompost fertilizer

K_4 = 20% soil with 80% vermicompost fertilizer

K_5 = 0% soil with 100% vermicompost fertilizer

The observation made consisted of main observations including growth power, plant growth rate, root volume, root length, stem diameter, plant height, number of leaves, fresh weight and dry weight of plants. The research fow includes preparation of the research site, preparation of planting media, soaking papaya plant seeds, planting, labeling polybags, plant maintenance which includes watering, weeding and controlling plant disrupting organism (OPT), observation and data analysis.

DISCUSSION

Growing Power (%)

The proportion of vermicompost fertilizer in the growing medium did not have a significant effect on germination (Table 1). Both genetic and environmental factors can affect seed germination. According to the seed information on the packaging, the genetic component comes from the seed itself. This is also due to the fact that the seeds have a uniform germination rate of 85%.

Table 1. Effect of the Proportion of Vermicompost Fertilizer in Planting Media on Growing Power

Treatments	Growing power (%)	
	7 DAP	14 DAP
K_0 (100% soil : 0% kascing)	75,0 a	80,0 a
K_1 (80% soil: 20% kascing)	80,0 a	82,5 a
K_2 (60% soil : 40% kascing)	80,0 a	82,5 a
K_3 (40% soil : 60% kascing)	90,0 a	90,0 a
K_4 (20% soil : 80% kascing)	87,5 a	87,5 a
K_5 (0% soil : 100% kascing)	85,0 a	87,5 a

Description: Mean numbers followed by the same letter in the same column are not significantly different according to Duncan's Multiple Range Test at the 5% level.

Low vigor will results in poor quality plants, so the seeds used for planting must have high vigor because this can produce plants with good quality (Yuniarti et al., 2014).

Growth Rate Plant Relative

The proportion of 40% soil with 60% vermicompost fertilizer in the growing media gave a significant effect on the rate of plant growth (Table 2). Measurement of growth rate can be observed from plant biomass, with increasing plant age, the relative growth rate also increase because needs of plants are met and results in increased plant growth. All plant materials

obtained from photosynthesis, nutrients and water used in biosynthesis can results in the formation of plant biomass (Yurnie Sari Alphiani et al., 2020).

Table 2. Effect of the Proportion of Vermicompost Fertilizer in Planting Media on Growth Rate Plant Relative

Treatments	Growth Rate Plant Relative		
	15 DAP	30 DAP	45 DAP
K_0 (100% soil : 0% kascing)	0,08 a	0,39 b	1,05 a
K_1 (80% soil : 20% kascing)	0,26 a	0,31 a	1,24 b
K_2 (60% soil : 40% kascing)	0,30 a	0,40 b	1,22 b
K_3 (40% soil : 60% kascing)	0,31 a	0,79 d	1,97 d
K_4 (20% soil : 80% kascing)	0,22 a	0,44 d	1,40 c
K_5 (0% soil : 100% kascing)	0,24 a	0,40 c	1,48 c

Description: Mean numbers followed by the same letter in the same column are not significantly different according to Duncan's Multiple Range Test at the 5% level.

Plants can grow faster if the fertilizer contains the element K because potassium can increase the ability of plants to absorbs nutrients, resulting in a faster plant growth rate (Ernawati, 2015). Growth leads to the accumulation of plant dry weight and the process will occur if the assimilation results are sufficiently available and the temperature is favorable (Yurnie Sari Alphiani et al., 2020).

Root Length

The proportion of vermicompost fertilizer in the planting media gave a significant on the length roots since the age of 15 DAP (Table 3). The treatment of the proportion of 40% soil with 60% vermicompost fertilizer is the best treatment of all treatments for plants root length.

Table 3. Effect of Proportion of Vermicompost Fertilizer in Planting Media on Root Length.

Treatments	Root length (cm)			
	15 DAP	30 DAP	45 DAP	60 DAP
K_0 (100% soil : 0% kascing)	3,0 a	7,03 a	11,8 a	12,50 a
K_1 (80% soil : 20% kascing)	4,0 a	11,0 b	22,8 b	24,00 b
K_2 (60% soil : 40% kascing)	5,5, b	11,4 b	25,0 bc	27,75 c
K_3 (40% soil : 60% kascing)	3,3 a	15,8 c	30,8 d	32,75 d
K_4 (20% soil : 80% kascing)	3,5 a	12,0 b	27,3 c	29,00 c
K_5 (0% soil : 100% kascing)	3,8 a	9,06 ab	25,3 bc	27,50 c

Description: Mean numbers followed by the same letter in the same column are not significantly different according to Duncan's Multiple Range Test at the 5% level.

Plants with long roots can indicate that the plants get good nutrition because they are able to reach the nutrients they need (Lokha et al., 2021). The amount of N absorbed by the plant effects the growth of root length. In addition, a good root system is also partly formed by P and K elements found at the root tip which play a role in stimulating root growth, since phosphorus is an immobile nutrients in the soil, it can be satisfied with sufficient water. Nutrients can move more easily to the plant roots and be absorbed by the plant of the nutrients are more mobile (Stasche et al., 1994).

Potassium plays a role in increasing osmotic pressure which allows ions to be secreted into cells and ensures the roots absorb as much water as possible (Aji, 2020).

Root Volume

The proportion of vermicompost fertilizer in the planting media gave a significant effect on root volume (Table 4). The proportion of 40% soil with 60% vermicompost fertilizer gave am effect on root volume when the plants were 30 to 60 DAP but had no real effect when they were 15 DAP because the plants were still very young and did not have many branches so they were not able to absorb nutrients properly (Torey et al., 2014).

Table 4. Effect of the Proportion of Vermicompost Fertilizer in Planting Media On Root Volume

Treatments	Root Volume (ml)			
	15 DAP	30 DAP	45 DAP	60 DAP
K_0 (100% soil : 0% kascing)	0,0 a	0,0 a	1,00a	1,75 a
K_1 (80% soil : 20% kascing)	0,0 a	0,75 ab	3,75 b	4,75 b
K_2 (60% soil : 40% kascing)	0,0 a	1,00 b	4,50 b	5,50 b
K_3 (40% soil : 60% kascing)	0,0 a	1,25 b	6,25 c	7,00 c
K_4 (20% soil : 80% kascing)	0,0 a	0,75 ab	5,75 c	6,75 c
K_5 (0% soil : 100% kascing)	0,0 a	0,75 ab	4,25 b	5,00 b

Description: Mean numbers followed by the same letter in the same column are not significantly different according to Duncan's Multiple Range Test at the 5% level

Root volume is an important component in plant growth that indicates the capacity of plants to absorb nutrients and metabolic processes that take place in the soil and is closely related to macro and micro nutrients (Manahan et al., 2016). Vermicompost fertilizer applied in the right amount can improve soil structure and increase the ability of soil to bind nutrients and water as well as improve drainage and air system and supply nutrients that will increase rapid root growth and large root volume (Dhani et al., 2014). In addition to improving soil structure, aeration and soil physical properties, vermicompost also functions to increase plant hormones such as

gibereline, cytokinin and auxin and nutrients to help plants grow optimally (Asikin et al., 2013). These things are influenced by a large number of highly active bacteria that can accelerate mineralization or the release of nutrients from worm phases into a from that plants cant use (Setiawati et al., 2017).

Plant Height

The proportion of vermicompost fertilizer in the planting media had a significant effect on the height of papaya seedlings (Table 5). At the age of 15 DAP, vermicompost fertilizer did not have a significant effect because at that age the plants were not able to absorb nutrients well so that their food reserves were not maximally fulfilled. The availability of nutrients in an ideal and balanced state has a significant impact on plant growth (D. Dwidjoseputro, 2009).

Table 5. Effect of Proportion of Vermicompost Fertilizer in Planting Media on Plant Height

Treatments	Plant Height (cm)			
	15 DAP	30 DAP	45 DAP	60 DAP
K_0 (100% soil : 0% kascing)	2,88 a	05,60 a	06,75 a	06,94 a
K_1 (80% soil : 20% kascing)	3,88 a	08,88 b	15,56 b	17,69 b
K_2 (60% soil : 40% kascing)	3,75 a	12,88 d	15,69 b	17,44 b
K_3 (40% soil : 60% kascing)	3,25 a	18,44 e	20,25 c	22,50 d
K_4 (20% soil : 80% kascing)	3,63 a	11,03 c	16,38 b	19,81 c
K_5 (0% soil : 100% kascing)	4,13 a	08,06 c	16,31 b	19,06 c

Description : Mean numbers followed by the same letter in the same column are not significantly different according to Duncan's Multiple Range Test at the 5% level.

The increase in plant height is due to the increased levels of N supplied. Nitrogen supply ensures that plants have enough N for the development of new cells. Plants with low nitrogen levels have stunted developments and have a low capacity to reproduce compared to plants with higher nitrogen levels (Asikin et al., 2013). The longer the age of te plants, the effect of the proportion of vermicompost fertilizer in the growing medium gives a better effect. The growth rate begins to slow down whem too much fertilizer is applied because it no longer stimulates more active development (Triastuti Febrianti, 2016).

Stem Diameter

Providing the proportion of vermicompost fertilizer in the planting media has a significant effect on the stem diameter of papaya seedlings (Table 6).

Table 6. Effect on the Proportion of Vermicompost Fertilizer in Planting Media on Stem Diameter

Treatments	Stem Diameter (mm)			
	15 DAP	30 DAP	45 DAP	60 DAP
K_0 (100% soil : 0% kascing)	0,67 ab	0,53 a	0,58 a	0,60 a
K_1 (80% soil : 20% kascing)	1,53 e	1,52 d	1,34 bc	1,37 b
K_2 (60% soil : 40% kascing)	0,83 bc	1,34 c	1,28 b	1,49 b
K_3 (40% soil : 60% kascing)	0,40 a	1,56 d	1,66 d	2,06 c
K_4 (20% soil : 80% kascing)	1,02 cd	1,24 b	1,59 c	1,85 bc
K_5 (0% soil : 100% kascing)	1,16 d	1,29 bc	1,37 bc	1,53 b

Description: Mean numbers followed by the same letter in the same column are not significantly different according to Duncan's Multiple Range Test at the 5% level.

Excessive fertilizer use no longer encourages plant development, but rather produces suboptimal plant growth (Triastuti Febrianti, 2016). Plants will have a better root system, photosynthesis and vegetative growth if nutrients needs are met and balanced so that they can stimulate stem cell length to increase plant height optimally (Yurnie Sari Alphiani et al., 2020).

Number of Leaves

The proportion of vermicompost fertilizer in the planting medium gave a significant effect on the number of leaves of papaya seedlings (Table 7). The quantity of photosynthesis that plants will produce to build reproductive organs and plant tissues is indicated by the number of leaves on the plant and is directly correlated with plant productivity. The availability of nutrients supplied by the plant is what causes the growth of more leaves (Manahan et al., 2016).

Table 7. Effect of Proportion of Vermicompost Fertilizer in Planting Media on Number of Leaves

Treatments	Number of Leaves (strands)			
	15 DAP	30 DAP	45 DAP	60 DAP
K_0 (100% soil : 0% kascing)	3,50 a	03,56 a	05,38 a	06,81 a
K_1 (80% soil : 20% kascing)	4,30 a	07,44 b	10,69 c	12,00 b
K_2 (60% soil : 40% kascing)	4,30 a	09,88 d	10,88 c	12,25 b
K_3 (40% soil : 60% kascing)	3,50 a	11,31 f	12,94 d	14,69 c
K_4 (20% soil : 80% kascing)	4,50 a	10,38 e	11,75 cd	14,44 c
K_5 (0% soil : 100% kascing)	3,50 a	08,06 c	09,19 b	12,88 b

Description: Mean numbers followed by the same letter in the same column are not significantly different according to Duncan's Multiple Range Test at the 5% level.

Applying large amounts of vermicompost fertilizer is not recommended. The availability of other nutrients will be suppressed by the addition of excessive nutrients, resulting in an imbalance in the soil (Triastuti Febrianti, 2016).

The nitrogen content of the soil can be increased after applying vermicompost fertilizer. The presence of ammonifying bacteria, especially *Rhizobium* and *Azotobacter* in the fertilizer accelerates the rate of mineralization and binding of free nitrogen molecules, which contributes to the increase in soil nitrogen content. An increase in nitrogen uptake can lead to an increase in chlorophyll content in plants thus increasing the rate of photosynthesis leading to an increase in carbohydrate synthesis. The production of more carbohydrate as a results of photosynthesis can promote leaf formation and plant height (Meena et al., 2015).

Plant Fresh Weight

The proportion of vermicompost fertilizer gave a significant effect on plant fresh weight (Table 8). When the plants were 15 dap, the proportion did not have a significant effect due to the young age of the plants which resulted in the plants not being able to absorb nutrients optimally, resulting in less than optimal vegetative growth. Vegetative growth has an impact on the fresh weight of plants; if the plants grow well, the fresh weight will also increase (Anjani et al., 2022).

Table 8. Effect of the Proportion of Vermicompost Fertilizer in Planting Media on Plant Fresh Weight

Treatments	Plant Fresh Weight (g)			
	15 DAP	30 DAP	45 DAP	60 DAP
K_0 (100% soil : 0% kascing)	0,26 a	0,46 a	01,57 a	05,41 a
K_1 (80% soil : 20% kascing)	0,29 a	3,21 b	07,62 b	29,09 c
K_2 (60% soil : 40% kascing)	0,30 a	3,37 b	14,11 c	23,34 b
K_3 (40% soil : 60% kascing)	0,39 a	7,82 d	18,,31 e	49,17 e
K_4 (20% soil : 80% kascing)	0,39 a	4,71 c	16,84 d	19,90 d
K_5 (0% soil : 100% kascing)	0,34 a	4,59 c	07,36 b	31,50 c

Description: Mean numbers followed by the same letter in the same column are not significantly different according to Duncan's Multiple Range Test at the 5% level

Adding organic matter to the soil can improve the soil structure, increase microbial activity, water retention, kation exchange capacity and increase nutrient content including nitrogen. In the treatment of vermicompost fertilizer, there is a direct correlation between the increase in nitrogen uptake in the vegetative phase of the plants is met with sufficient nitrogen uptake so as o increase plant biomass (YULIANA et al., 2015).

Plant fresh weight will vary depending on how tall and how many leaves it has. In accordance with the statement that cell division, number and expansion contribute to the process of plant height growth. When plants grow taller and have more leaves, their fresh weight will

increase. This is because more carbohydrate produced during photosynthesis increase the fresh weight of the plant (Lokha et al., 2021).

Plant Dry Weight

The proportion of vermicompost fertilizer in the planting media gave a significant effect on plant dry weight (Tablle 9). When the plants were 15 DAP, the proportion of vermicompost fertilizer gave a significantly different effect because the vegetative growth at that age was not optimal so that it affected the fresh weight of the plants. The fresh weight of the plant will affect the dry weight of the plant because when the plant grows well, it fresh weight will increase in line with its dry weight (Hussain & Abbasi, 2018).

Table 9. Effect of the Proportion of Vermicompost Fertilizer in the Planting Media on Dry Weight

Treatments	Plant Dry Weight (g)			
	15 HST	30 HST	45 HST	30 HST
K_0 (100% soil : 0% kascing)	0,01 a	0,04 a	0,18 a	2,90 a
K_1 (80% soil : 20% kascing)	0,01 a	0,29 b	1,39 b	3,55 ab
K_2 (60% soil : 40% kascing)	0,01 a	0,35 b	1,51 d	3,46 a
K_3 (40% soil : 40% kascing)	0,01 a	0,73 d	2,19 e	7,53 d
K_4 (20% soil : 80% kascing)	0,01 a	0,56 c	1,43 c	4,21 bc
K_5 (0% soil : 100% kascing)	0,01 a	0,66 d	1,25 b	4,53 c

Description : Mean numbers followed by the same letter in the same column are not significantly Different according to Duncan's Multiple Range Test at the 5% level.

Increasing the dosage of vermicomposting fertilizer can increase plant dry weight. Each time the dose is increased, it is assumed that the plant can obtain all the nutrients it needs. However, the proportion of vermicompost fertilizer will have a negative effect on the growth of the plant (Hussain & Abbasi, 2018).

CONCLUSION

Based on the results of the study can be concluded:

The proportion of vermicompost fertilizer in the planing media gives a significant effect on the growth of papaya (*Carica papaya L*) Calina Cultivar.

The proportion of 40% soil with 60% vermicompost fertilizer in the planting mediim is the best treatment for relative plant growth rate, root volume, root length, stem diameter, plant height, number of leaves, fresh weight and dry weight of papaya (*Carica papaya L*) Calina Cultivar.

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