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The Effect of Planting Media Composition and Liquid Organic Fertilizer on the Growth and Yield of Celery (*Apium graveolens L.*) in Verticulture

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Abstract: Verticulture system cultivation has the advantage of saving land, water, fertilizer and planting media. This research was carried out in Banjar Dinas Blumbang Kelod, Blumbang Village, Tabanan Regency, Bali, Indonesia, using a factorial randomized block design. The first factorial was the composition of the planting media with 4 treatmens, namely, M0: Soil (100 %), M1: Soil + Vermicompost + Sand (50%: 20%: 30 %), M2: Soil + Vermicompost + Sand (50%: 30 %: 20%) and M3: Soil + Vermicompost + Sand (20%: 50%: 30%). The second factor was the provision of liquid organic fertilizer which consists of 4 treatments, namely: P0: 10 ml/plant, P1: 20 ml/plant, P2: 30 ml/plant and P3: 40 ml/plant. The composition of the planting media provided significantly different plant height in the M2 treatment with the highest values of 24.17 cm and 33.08 cm. At 42 and 70 day after planting (dap) shows values of 79.92 strands and 239.25 strands. The fresh weight was significantly different at 62.42 g at 80 days after planting. The fresh weight of the plants above ground at 112.83 g. At 80 dap, the total dry weight of the plants was 28.42 g. The effect of liquid organic fertilizer was significantly different in the P0 treatment with plant height of 24.50 cm. The interaction at 70 dap and 80 dap of the M2P2 treatment with the number of leaves being 259.67 and 271.33. The highest value of p population microorganisms in the M2 P1 treatment amounted to 100.00 and the lowest was shown by the M0P3 treatment at 39.33, with an increase of 60.67%.

Keywords: celery, factorial; liquid organic fertilizer; planting media; verticulture; vermicompost

1. Introduction

The market demand for celery in Bali is relatively high due to the high demand for tourism and local consumption. The market demand for celery is inversely proportional to the increasingly narrow condition of agricultural land and the relatively low level of productivity of celery plants, so it is necessary to utilize less productive land to meet market demand for celery plants. One way that can be used is the verticulture system.

Verticulture is a planting system in pots / pipes that are arranged / assembled horizontally or vertically or terraced on limited land or home gardens.

Verticulture cultivation systems have been widely applied in home gardens in big cities (Kusumo et al., 2020). The advantages of verticulture system cultivation are (a) saving land, water and fertilizer, and (b) easy to move, (c) easy in terms of maintenance and (d) rarely grow weeds or grass (Surtinah, 2018). Plants used for verticulture system cultivation are fast-harvesting or short-lived plants or annuals, have high economic value and have shallow roots (Surtinah, 2018). Plants are easier to absorb nutrients more evenly because the size of the pot and planting media is adjusted to the needs of plant roots, plants are healthier and production per unit area is higher.

Growth response and yield of celery plants differ due to different compositions of fertilizer and planting media. For example, using vermicompost fertilizer, contains nutrients such as N, P, K, Ca, Mg, S, Fe and other elements needed by plants. The biological components contained in vermicompost fertilizer are the body-regulating hormone gibberallin, cytokinin and the hormone auxin which do not have a negative effect on the environment and are very beneficial for plants (Kartini, 2018). According to Pratama et al. (2018) explained that the effect of using vermicompost fertilizer can affect the yield of plant height, number of leaves, fresh weight and dry weight of mustard greens. Vermicompost fertilizer is able to meet nutrient needs, especially N which is important for fresh weight and dry weight. Increased nitrogen uptake causes nitrogen needs in the vegetative phase of the plant to be fulfilled, thus increasing plant biomass.

The planting media serves as a place for roots to attach to, as well as a nutrient provider for the plant. A mixture of several materials for growing media must produce an appropriate structure because each type of media has a different effect on plants. Planting media can be improved by adding organic materials such as compost, manure or other organic materials. The addition of organic matter can improve chemical properties, physical properties and biological properties in a sustainable manner. Sand-structured soil with a crumbly structure is very good for plant growth and development.

The advantages of sand media are good drainage and drainage capabilities, sand is able to absorb a lot of water but is also easy to dry. Sand will be more suitable if used as an additional media, not as a single media, because it will be very troublesome to manage nutrients and water if sand is used as a single media (Syarif, 2017). The addition of sand to the soil media can improve the physical properties of the soil, such as facilitating the spread of roots in absorbing nutrients contained in the planting media. Sand has larger bottom pores that can store more water and nutrients. The purpose of this study was to determine the response of growth and yield of celery plants due to differences in the composition of planting media and liquid organic fertilizer in verticulture.

2. Methodology

2.1. Research Location

This research was carried out in the Banjar Dinas Belumbang Kelod, Belumbang Village, Kerambitan District, Tabanan Regency, Bali, Indonesia. Geographically, it is located between 08° 32' 55” South Latitude and 114° 52” – 115° 3' 46.6” East Longitude. Analysis of planting media and plants was carried out at the Soil and Environment Laboratory, Faculty of Agriculture, Udayana University. Geographically, it is located between 08° 40' 17.6 South Latitude and 114° 52” – 115° 13' 7.5” East Longitude. Figure 1 shows the research location.

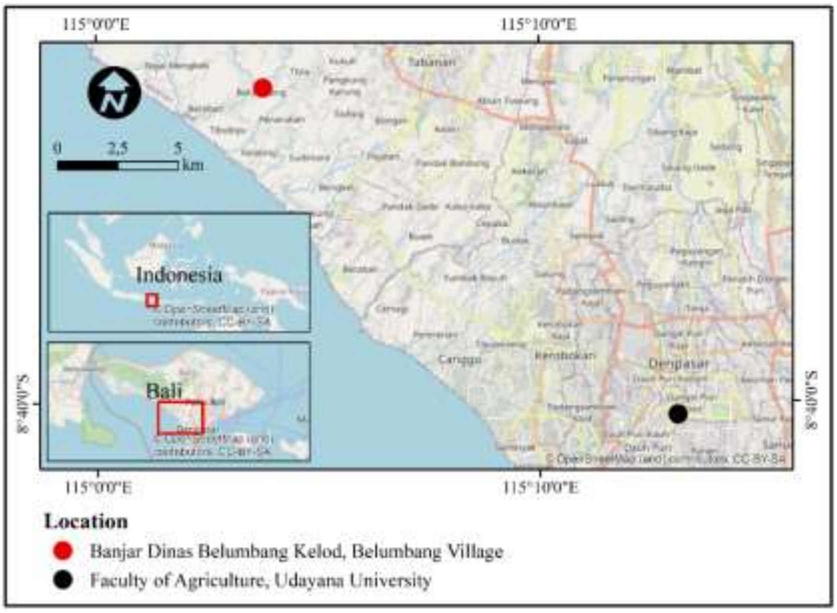

Figure 1. Research Location

2.2 Research Design

The research design used was a factorial Randomized Group Design. The first factor is the provision of planting media composition consisting of 4 treatments, namely:

M0= Soil (100%)

M1= Soil + vermicompost + Sand (50%: 20%: 30%)

M2 = Soil+ vermicompost + Sand (50%: 30%: 20%)

M3 = Soil+ vermicompost + Sand (20%: 50%: 30%)

The second factor is the provision of liquid organic fertilizer (POC) which consists of 4 treatments, namely:

P0=10 ml/plant

P1=20 ml/plant

P2=30 ml/plant

P3=40 ml/plant

Overall there are 16 treatment combinations. Each treatment combination was repeated 3 times, resulting in 48 experimental units. Each plant was placed in a pipe with a length of 480 cm and a width of 14 cm, with a distance between planting holes of 30 cm and a distance of 40 cm from the height of the gutter pipe. Each gutter pipe was labeled with the treatment located in replicates 1-3. The west and east directions indicate the length of the gutter pipe and the north and south indicate the height distance in replication 1-3.

2.3 Research Sequence

2.3.1 Initial Soil Analysis

Soil analysis begins with soil sampling using the composite method. Soil samples were then air-dried and analysed for total N content using the Kjeldahl method, C-organic content using the Walkley and Black method, air dry content using the gravimetric method, and soil pH using a glass electrode.

2.3.2 Seed Procurement

The seeds used are celery seeds obtained from agricultural stores and have passed seed certification from BPTH as a credible institution for seed certification.

2.3.3 Preparation of Gutter Pipes and Planting Media

The research media soil was taken from the garden location ± 20 cm deep and cleaned of dirt (stones, plants, etc.) then the soil, vermicompost fertilizer, and sand were sieved first and air dried for ± 1 week and then sieved using a 2 mm sieve. Then ± 50 g of soil was taken as a sample to be analyzed at the Soil Science Laboratory, Faculty of Agriculture, Udayana University. The application of organic fertilizer began at the beginning of planting adjusted to the treatment.

Preparing gutter pipes with a total of three pipes that have a length of 480 cm and a width of 14 cm, with a distance between planting holes that is 30 cm with a distance of 40 cm high gutter pipes. Each gutter pipe is labeled with the treatment first, then the media mixture is made according to the media composition treatment given. The way to make the composition of planting media by comparing soil: vermicompost fertilizer: sand that has been determined composition then mixed and stirred evenly using a shovel and hoe.

2.3.4 Seed Preparation and Seed Sowing

The treatment of celery seeds before the germination process is very important. The first step is to select the seeds to be planted by soaking them in water, discarding the floating seeds and selecting the sinking seeds. Then celery seeds will germinate for 3-4 days after sowing.

2.3.5 Planting seedlings

Seedling planting is carried out after the filling stage of the gutter pipe is completed, with the age of the seedlings 14 days after sowing. Two seedlings were planted in each hole of the gutter pipe at a depth of 2/3 of the way into the soil/media in each gutter pipe (48 gutter pipe holes). Seedlings were transplanted in a standing/vertical position. Prepare 48 spare/replacement seedlings with the same treatment to anticipate if any of the seedlings in the experiment die.

2.3.6 Liquid Organic Fertilizer Treatment

Liquid organic fertilizer was applied every 7 days after planting (hst) until the end of the study/approaching harvest. The application of liquid organic fertilizer was adjusted according to the dose in each treatment and replicate. Liquid organic fertilizer was obtained from PT Bali Organik Internasional.

2.3.7 Maintenance

After the seedlings in the gutter pipe grew, it was necessary to remove one of the seedlings and choose the one with better growth. Seedling maintenance includes regular watering and weeding if weeds are likely to grow.

2.3.8 Harvesting

Harvesting was done at the end of the experiment when the plants were 90 days after planting (dap). Harvesting was done to observe the parameters below the soil and above the soil or planting media.

2.4. Observed Variables

Observed variables included, plant height (cm), number of leaves (strands), root length (cm), fresh weight of plants below ground (g), fresh weight of plants above ground (g), total fresh weight of plants (g), oven dry weight of plants above ground (g), underground plant oven dry weight (g), total plant oven dry weight (g), determination of microorganism population (spk.g-1 x 107), analysis of soil chemical properties (pH, N, C-Organic). Observations of plant height and number of leaves began when the plants were conducted on days 14, 28, 42, 56, 70 and 80. While observations of other parameters were made at the end of the study. Determination of the total population of microorganisms is carried out at the end of the research with the pouring cup method. Calculation of bacterial colonies in each Petri dish can be calculated by the formula: CFU/ml (g) = Number of colonies / Number of inoculated samples.

The final soil analysis includes N-total with Kjeldahl method, C-organic with Walkley and Black method, soil pH with glass electrode, microorganism population with pour cup method. Determination of C-organic content was carried out at the end of the study. Calculation of C-organic content can be obtained by the formula: C = (B-A) x 3.596 x N $FeSO_4$ x 100 + KU/100. Determination of N-total levels was carried out at the end of the study. Calculation of N-total content can be obtained by the formula: % N = ml Sample-ml Blanko x N H_2SO_4 x 1.4 x 100 + KU/100. Calculation of pH can be obtained by reducing the pH (H_2O) with pH (KCL). Calculation of pH can be obtained by the formula: pH = pH (H_2O) - pH (KCl). All data from the observations were then analyzed statistically using a Randomized Group Design. If the variance analysis shows the effect of factorial treatment that is real or very real, then it is continued with the Ducan Test at the 5% level (Raupong and Anisa. 2011).

3. Results and Discussion

The Effect of planting media and liquid organic fertilizer and the interaction of planting media and liquid organic fertilizer on the growth and yield of celery shows that there were differences in the average height of celery based on the planting medium. The observations that were made on the 14th day after planting (dap), showed the highest height of celery, was found in the M0 treatment. But at the last observation on the 80th dap it was found that the plant height was lowest in M0 treatment and the highest in the M2 treatment. Overall it was found that in the soil + vermicompost + sand plant media with various compositions showed no different average height of celery. It indicates that planting media with a combination of soil + vermicompost + sand significantly affects celery height. Liquid organic fertilizer did not significantly affect celery height. Table 1 shows the significance of the effect of planting media (m) and liquid organic fertilizer (f) and the interaction of planting media and liquid organic fertilizer (m×f).

Results of statistical analysis explains that the composition of the media for plant height parameters of 42 days and 56 days gave significantly different results. Day 42 after planting showed that the treatment composition M1 and M2 shows the highest values of 24.17 cm and 33.08 cm which are significantly different compared to other treatments. Table 2 shows the effects of planting media composition and liquid organic fertilizer on the celery height.

Table 1. Significance of the Effect of Planting Media (M) and Liquid Organic Fertilizer (F) and the Interaction of Planting Media and Liquid Organic Fertilizer (M×F)

No	Parameter	M	F	M*F
1.	Plant Height (14 dap)	*	NS	NS
2.	Plant Height (28 dap)	*	NS	NS
3.	Plant Height (42 dap)	*	*	*
4.	Plant Height (56 dap)	*	NS	NS
5.	Plant Height (70 dap)	*	NS	NS
6.	Plant Height (80 dap)	*	NS	NS
7.	Number Leaves (14 dap)	NS	NS	*
8.	Number Leaves (28 dap)	*	NS	NS
9.	Number Leaves (42 dap)	*	NS	NS
10.	Number Leaves (56 dap)	*	NS	NS
11.	Number Leaves (70 dap)	*	NS	*
12.	Number Leaves (80 dap)	*	NS	*
13.	Root	NS	NS	NS
14.	C-Organic	NS	NS	NS
15.	N-Total	*	NS	NS
16.	Soil pH	*	NS	NS
17.	Fresh Weight of Plants above Ground	*	NS	NS
18.	Fresh Weight of Plants below Ground	*	NS	NS
19.	Total Fresh Weight of Plants	*	NS	NS
20.	Dry Weight of Plants above Ground	*	NS	NS
21.	Dry Weight of Plants below Ground	*	NS	NS
22.	Total Dry Weight of Plants	*	NS	NS
23.	Population of Microorganisms	*	*	*

Information:
** : Very real influence
* : Have a real impact
NS : Has no real effect

Treatment of M2 with 30 % vermicompost fertilizer gave the highest average plant height of 33.08 cm. This is because vermicompost fertilizer is able to provide nutrient. The proteins formed were used to form growth hormones, namely auxin, gibberellins and cytokinins (Sari et al., 2016). According to Suprapto et al. (2021) vermicompost fertilizer contains nutrients such as N, P, K in large quantities that help with the photosynthesis process so that the photosynthate produced is greater (Hasibuan, 2018).

The application of liquid organic fertilizer had a significant difference on plant height on the 42nd dap and 56th dap. Treatment with a liquid organic fertilizer concentration of 10 ml/ t of plants (P0) produced the highest average plant height of 24.50 cm and 32.00 cm compared to other treatments. Liquid organic fertilizer has a percentage of N nutrient content of 5.24%, P2O5 3.36% and K2O4 of 37%. The application of liquid organic fertilizer contains banana peel and water hyacinth containing N (1.24%); P (1.03%); K (1.22%) and C-Organic (12.68%) which considered a very high criteria (Susanto and Rahayu, 2023). The 42 dap showed that the composition treatment of M1 could break down the sand and retain water (Febriani et al ., 2021). The addition of 30 % sand or 20% sand could controlling the plastic properties of clay soil. The addition of sand reduces the liquid limit (LL) value of clay soil, because sand can absorb water and has large cavities so it takes a little to change clay soil that has been mixed with sand from a plastic condition to a liquid condition (Prasenda , 2015).

Table 2. The Effects of Planting Media Composition and Liquid Organic Fertilizer on the Celery Height.

Treatment	Number of Leaves					
	14 dap	28 dap	42 dap	56 dap	70 dap	80 dap
	Growing media					
M0	12.92a	27.42a	64.58b	125.83b	166.58b	174.75b
M1	12.75a	26.67a	68.25a	152.92a	209.00a	220.25a
M2	12.25a	25.92a	79.92a	182.67a	239.25a	250.67a
M3	11.50a	17.17b	43.33c	121.33b	187.50b	197.33b
Sig.	0.146	0.000	0.000	0.001	0.001	0.000
	Liquid Organic Fertilizer					
P0	12.75a	25.25a	67.67a	144.08a	204.50a	214.67a
P1	12.42a	25.42a	62.58a	153.67a	209.17a	219.17a
P2	12.25a	24.42a	64.33a	141.67a	204.92a	215.00a
P3	12.00a	22.08a	61.50a	143.33a	183.75a	194.17a
Sig.	0.704	0.492	0.766	0.865	0.394	0.415

Note: numbers followed by the same letter indicate treatments that are not significantly different from the 5% Duncan test; Sig indicates the significance value of factorial analysis; dap = day after planting.

Media treatment 42nd dap in treatment M3 got the lowest value of 19.67 cm. Treatment of P1 liquid organic fertilizer on the 42nd dap has the lowest value of 29.08 cm. According to Hernita et al. (2012) NH4+ in excessive amounts can cause poisoning which is characterized by necrosis at the root tip and damage to the xylem tissue. Low photosynthesis rates result in stunted plant growth. The canopy (especially the leaves) acts as a supplier of carbon (photosynthetic) to the roots as well as a recipient (sink) of water and nutrients from the roots. On the other hand, roots act as suppliers of water and nutrients to the shoot as well as recipients of photosynthesis from the shoot (White et al., 2015). Based on Duncan's test, the average value obtained from the last observation was that the number of plant leaves was the lowest with M0 treatment and the highest on the M2 treatment.

Providing 30 % vermicompost fertilizer has met the nutrient requirements needed for celery during the vegetative growth period. The results of vermicompost fertilizer analysis explains that the nutrient content of vermicompost fertilizer, namely, the elements N (0.8939 %), P (0.3075%) and K (0.7594%) (Pratama, 2021). Because, the release of N contained in vermicompost and also the performance of the bacteria Azotobacter sp.. Vermicompost can fix free N elements in the air symbiotically. The use of vermicompost also increases P-available due to the humic acid contained in vermicompost. The P element itself can stimulate the formation of new roots, by having more root branching.

Related to number of leaves, treatment P0 then P1 gave insignificantly different results with the highest number of leaves, namely, 67.67 strands and 209.16 strands. Amino acids have the function of chelating metal ions, and are easy to carry medium and trace elements (calcium, magnesium, iron, manganese, zinc, copper, molybdenum, boron and selenium). Table 3 shows effects of planting media composition and liquid organic fertilizer on the number of plant leaves.

The high increase in the number of leaves in the M2 treatment at 42 DAP and 70 HST (Soil + Vermicompost + Sand (50 %: 30 %: 20 %) showed values of 79.92 pieces and 239.25 pieces due to differences in the composition of the planting media in this treatment. Sand media has good aeration (availability of air cavities) and drainage. According to Musnamar (2010), the quality and quantity of corn (*Zea Mays*) growth is closely related to the adequacy of nutrients originating from the plant media.

Providing optimal liquid organic fertilizer with a concentration of 10 ml/ t plants and 20 ml/ t plants at 42 days after planting and 70 days after planting. Treatment P0 (Liquid Organic Fertilizer, 10 ml/t plant) then P1 (Liquid Organic Fertilizer, 20 ml/t plant) gave insignificantly different results with the highest number of leaves, namely 67.67 strands and 209.16 strands. Amino acids have the function of chelating metal ions, and are easy to carry medium and trace elements (calcium, magnesium, iron, manganese, zinc, copper, molybdenum, boron and selenium).

Treatment M2 Day 42 DAP (Soil + Vermicompost Fertilizer + Sand (50 % : 30 % : 20%) of 33.08 cm and 56 DAP treatment M2 (Soil + Vermicompost + Sand (50 % : 30 % : 20 %) is significantly different, showing the highest value of plant height of 34.58 cm at pH 6.68, not significantly different. Application of vermicompost fertilizer resulted in a decrease in the pH of H_2O of Regosol and Latosol due to the release of organic acids from the fertilizer. According to Setiawan et al. (2015) explaining that the application of vermicompost affects the chemical properties of the soil, namely through the process of decomposition of organic matter by soil microbes which can increase soil pH, organic C and total soil N. In Grumusol, the pH of H 2 O increases due to the release of ammonium in the soil. When it gets wet and expands, the pores of Grumusol will fill with water, resulting in little oxygen in the soil (anaerobic) and causing denitrification in the soil. The lower the oxygen content in the soil, the greater the denitrification will occur. Apart from being absorbed in the inter-lattice space, low N in Grumusol can also occur due to high denitrification, namely the reduction of NO_3 - to N_2 in anaerobic conditions (Hanafi et al ., 2023).

Table 3 Effects of Planting Media Composition and Liquid Organic Fertilizer on the Number of Plant Leaves

Treat ment	Number of leaves (pieces)					
	14 dap	28 dap	42 dap	56 dap	70 dap	80 dap
	Growing media					
M0	12.92a	27.42a	64.58b	125.83b	166.58b	174.75b
M1	12.75a	26.67a	68.25a	152.92a	209.00a	220.25a
M2	12.25a	25.92a	79.92a	182.67a	239.25a	250.67a
M3	11.50a	17.17b	43.33c	121.33b	187.50b	197.33b
Sig.	0.146	0.000	0.000	0.001	0.001	0.000
	Liquid Organic Fertilizer					
P0	12.75a	25.25a	67.67a	144.08a	204.50a	214.67a
P1	12.42a	25.42a	62.58a	153.67a	209.17a	219.17a
P2	12.25a	24.42a	64.33a	141.67a	204.92a	215.00a
P3	12.00a	22.08a	61.50a	143.33a	183.75a	194.17a
Sig.	0.704	0.492	0.766	0.865	0.394	0.415

Treatment M3 at pH 6.57 (Soil + Vermicompost + Sand (20 % : 50 % : 30 %) on root length obtained the lowest value with an insignificant difference of 29.00 cm. This was due to the low content of the nutrient P absorbed by plants cause Al and Fe stress, making it difficult for them to be absorbed by plant roots. The P element will react with iron ions (Fe^{2+}) and aluminum (Al^{2+}) to form iron phosphate and aluminum phosphate, at high or alkaline pH phosphorus will react with Calcium ions (Ca^{2+}) form calcium phosphate which is difficult to dissolve in water (Dhage et al ., 2014). According to Masriah (2020), explaining that low phosphate content in nutrient solutions results in less than optimal plant root growth . According to Purba (2021), explains that phosphorus functions in the formation of roots, seeds, flowers and fruit. Plants will experience optimal root growth if the nutrient element phosphorus is met.

Value of C-organic was not significantly different from treatment P2 (as much as Liquid Organic Fertilizer (30 ml/t plant) 2.76. According to Chuan-chuan et al. (2017) adding organic material will increase soil organic C levels because one source of soil organic carbon comes from the decomposition of living things. The main source of P in soil solutions comes from weathering of rocks or parent materials and the mineralization process of organic P resulting from the decomposition of plant and animal remains (Afandi et al., 2015). One source of total soil N comes from the mineralization of organic matter so that the application of organic fertilizer and N fertilizer will increase the total N element of the soil (Utami and Handayani, 2003).

According to Erizilina (2019), explains the relationship between physical and chemical properties of soil, based on experimental results that low organic C means that the material contains a lot of N and is easily decomposed, so it quickly supplies N to plants. C-organics can react with water and form organic acids which can lower soil pH. Low soil pH can affect the base saturation value and nutrient availability for plants.

The value of N-total was significantly different shown in treatment M3 (Soil + Vermicompost + Sand (20 %: 50 %: 30 %) of 0.15. The highest value of N-total which was not significantly different was shown in treatment P2 (30 ml/ t plant) of 0.14. The N-total data had the lowest value which was not significantly different in treatments P 0 (10 ml/plant), P1 (20 ml/plant), P2 (30 ml/plant) and P3 (40 ml /t crop) of 0.12 p at 80 DAP shows that the N-total value is relatively low. According to Hardjowigeno (2015), explained that the ability of the soil to provide N is largely determined by the amount of soil organic matter because the main source of N in the soil is organic matter. Nitrogen is a mobile nutrient (can be translocated) to the tips of plants, especially young leaves, very quickly (Kurniawan et al ., 2017). According to Firmansyah and Sumarni (2013), explained that plant N uptake is determined by nitrogen in the form of NO_3^- and NH_4^+ , the presence of which is influenced by total soil N. The availability of nutrients in the soil and the ability of plant roots to absorb nutrients, especially nitrogen, can influence the value of plant nutrient uptake (Setiawati et., 2021). Its existence is influenced by soil N-total. The nitrogen content in the soil can be reduced by rainwater (leaching), evaporation (volatilization), use by microbes, and absorption by plants (Hardjowigeno, 2010). According to Yuniarti et al. (2019) explaining that adding compost can increase the concentration of nitrogen in the soil, however, the availability of nitrogen also depends on the activity of microorganisms and evaporation of nitrogen.

Treatment M2 at 80 DAP with a pH of 6.68, the difference was not significant (Soil + Vermicompost + Sand (50 %: 30 %: 20 %) is significantly different, getting an N-total value of 0.12 which is relatively low. This nitrification process is also assisted by a group of nitrifier bacteria which speed up the nitrification process (Saidy et al., 2018). The N-fixing bacteria produced from applying vermicompost fertilizer will work optimally if N conditions in the soil are low. Low N conditions will trigger N binding by N-fixing bacteria, thereby increasing total soil N- (Indriani et al., 2017). Table 4 shows effects of planting media composition and liquid organic fertilizer on soil chemical properties.

Table 4 Effects of Planting Media Composition and Liquid Organic Fertilizer on Soil Chemical Properties

Treatment	Plant Fresh Weight (g)		
	Fresh Weight of Plants Under Soil	**Fresh Weight of Plants on Soil**	**Total fresh plants**
Growing media			
M0	42.17 b	64.08 b	106.25 b
M1	49.67 b	95.08b	144.75b
M2	62.42 a	112.83 a	175.25 a
M3	1.75 b	105.75 a	157.50 a
Sig.	0.003	0.000	0.000
Liquid Organic Fertilizer			
P0	51.17a	96.00a	147.17a
P1	56.00 a	93.42a	149.42a
P2	44.08a	88.17a	132.25a
P3	54.75 a	100.17a	154.92a
Sig.	0.084	0.479	0.479

M2 vermicompost fertilizer at 80 hst (Soil + Vermicompost + Sand (50 % : 30 % : 20 %) and M1 (Soil + Vermicompost + Sand (50 % : 20 % : 30 %) on root length got the highest value which was not significantly different at 32.17 and 31.50 cm. Vermicompost fertilizer contains 0.35% P which can help root formation and increase the ability of roots to absorb nutrients and water for celery plants. P content has a role in plant root formation (Nurhaeni et a,, 2020). The planting medium for oil palm seeds contains the element N which influences the growth in wet and dry weight (roots and crown). According to Hidayat et al. (2020). The increase in biomass in plants is caused by plants absorbing more water and nutrients. The role of nutrients Nitrogen, phosphorus and potassium stimulate root growth in carrying out photosynthesis, increase carbohydrate translocation so that they can form strong stems and carry out cell division to form new cells.

The population of microorganisms differed between planting media with the highest average treatment being M2 (Soil + Vermicompost + Sand (50 %: 30 %: 20 %) amounting to 64.33 CFU g-1. The liquid organic fertilizer treatment which gave the highest average was P1 (20 ml/plant) significantly different by 65.08 CFU g-1. In microbial cells, NH_3 is converted into ammonia (NH_3) and releases H^+ protons (Rawat et al., 2020). In the Paenibacillus polymyxa GOL 0202 strain, EPS production was shown to be related to phosphate solubilization efficiency (Cherchali et al., 2019). Exopolysaccharides (EPS) are produced by microbes in response to stress or during biofilm formation. EPS produced by microbes forms a complex with metal ions in the soil ($Al^{3+} > Cu^{2+} > Zn^{2+} > Fe^{3+} > Mg^{2+} > K^{+}$), thus dissolving phosphate (Ochoa-Loza et al., 2001). According to Ferreira et al. (2019) explaining that in alkaline conditions, some phosphate solvents such as Bacillus megaterium, Bacillus subtilis, Rhizobium radiobacter, and Pantoeaallii produce siderophores.

Providing optimal liquid organic fertilizer with a concentration of 10 ml/t of plants and 30 ml/t of plants at 42 DAP and 70 DAP in the M 2 P0 treatment (Soil + Vermicompost + Sand (50 % : 30 % : 20 %) + Liquid Organic Fertilizer (10 ml/t plant) then M2 P2 (Soil + Vermicompost + Sand (50 % : 30 % : 20 %) + Liquid Organic Fertilizer (30 ml/t plant) gave significantly different results with the highest number of leaves, namely 88 pieces and 259.67 pieces. The addition of vermicompost fertilizer to the planting medium will create a more crumbly structure, so that root development is better and the function of the roots in absorbing nutrients is increased The combination of treatment with the composition of the planting media in the form of soil + chicken manure with a ratio of 2:1 and the interaction with the application of liquid organic fertilizer (POC) at a dose of 30 ml/liter of treated water (M1 P3) resulted in higher plant growth and flowering. faster, and the number of fruits is greater. According to Lakitan (2007), explains the function of P as also a source of energy in the form of ATP for plants for assimilation and respiration processes. P encourages the formation of plant roots and increases the absorption of nutrients in the soil. Table 5 shows effects of planting media composition and liquid organic fertilizer on root length and microorganism population.

Table 5. Effects of Planting Media Composition and Liquid Organic Fertilizer on Root Length and Microorganism Population

Root Length (cm) and Population of Microorganisms (CFU $^{g-1}$)		
Treatment	**Root Length**	**ɔulation of Microorganisms**
Growing media		
M0	30.33a	40.00 b
M1	32.17a	58.83 a
M2	31.50a	64.33 a
M3	29.00a	42.50 b
Sig.	0.380	0.000
Liquid Organic Fertilizer		
P0	31.75a	47.42 b
P1	30.83a	65.08 a
P2	29.33a	50.75a
P3	31.08a	42.42 b
Sig.	0.638	0.002

Note: numbers followed by the same letter indicate treatments that are not significantly different using the 5% Duncan test; sig shows the significance value of factorial analysis

Application s Soil (100%) + (Liquid Organic Fertilizer) has not increased the role of soil microorganisms, thereby potentially dissolving nutrients. The lowest value is significantly different from the population microorganisms shown in the treatment M0 P3 (Soil (100 %) + Liquid Organic Fertilizer (4 0 ml/ t plant) of 39.33 CFU g-1. According to Al-Batania et al. (2016) the decrease in total N values can be influenced by compost, as the compost ages and is influenced by the amount of input and loss of N cycles. According to Izzudin . (2012) , explains The number of soil microorganisms in land is greatly influenced by organic matter, because more organic matter indicates more energy sources for soil organisms . The low activity of soil microorganisms is greatly influenced by the amount of substrate, soil temperature, and also the affinity of enzymes for substrates and nutrients. Figure 6 shows interaction of planting media composition and liquid organic fertilizer population of microorganisms.

Table 6. Interaction of Planting Media Composition and Liquid Organic Fertilizer Population of Microorganisms

Treatment	**Microorganism Population (CFU $^{g-1}$)**			
M/P	P0	P1	P2	P3
M0	40.67b	40.00 b	40.00b	39.33 b
M1	42.00a	79.67 a	71.33a	42.33b
M2	67.00a	100.00a	47.00b	43.33a
M3	40.00b	40.67b	44.67b	44.67a

M2 treatment at 80 hst (Soil + Vermicompost + Sand (50 % : 30 % : 20 %) total plant dry weight was significantly different at 28.42 g. Root dry weight is closely related to root biomass, so the higher the root biomass, the heavier the root dry weight. The K nutrient functions to form starch, activate enzymes, open stomata, influences the absorption of other elements, apart from that it also plays a role in root development. The K nutrient also acts as an enzyme activator, has a direct effect on the carbohydrate metabolism process, stimulates the translocation of photosynthesis results from the leaves to other parts which can increase the size, number and yield of tubers (Anisyah et al, 2014).

4. Conclusions

The composition of the planting media provided significantly different growth and results in the M2 treatment showed the highest values of 24.17 cm and 33.08 cm. P at 42 DAP and 70 HST shows values of 79.92 strands and 239.25 strands. The fresh weight of plants underground was significantly different at 62.42 g at 80 days after planting. The fresh weight of the plants above ground was significantly different at 112.83 g. At 80 DAP the total dry weight of the plants was significantly different at 28.42g. Population The highest microorganisms were significantly different by 64.33 CFU g -1 .

Liquid organic fertilizer provided significantly different growth and yield in the P 0 treatment plant height of 24.50 cm. Treatment P1 population The highest microorganisms were significantly different at 65.08 CFU g -1 .

Interaction testing at 70 dap and 80 dap of M2 P2 treatment gave significantly different growth and results with the highest number of leaves, namely 259.67 and 271.33 . Population microorganisme treatment M2 P1 is 100.00 CFU g -1 and plant height 42 dap M2 P0 treatment gave the highest significantly different results of 26.33 cm. Using a planting medium with Soil + Vermicompost + Sand (50 % : 30% : 20%) gives the best results, so the use of this composition can be continued.

Author Contributions

Conceptualization, N.L.K. and I.K.S.; methodology, N.L.K., I.K.S., I.G.K.W.; validation, I.G.K.W.; formal analysis, I.G.K.W.; investigation, I.G.K.W.; resources, N.L.K., I.K.S., I.G.K.W.; data curation, I.G.K.W.; writing—original draft preparation, I.G.K.W.; writing—review and editing, N.L.K., I.K.S.,I.G.K.W.; visualization, I.G.K.W.; supervision,N.L.K., I.K.S.,. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest (Style: Times New Roman, 10 Points, Title Case, Bold)

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Nomenclature

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Appendix

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