



PENGARUH KEDALAMAN TANAM BENIH DAN KOMPOSISI MEDIA TANAM TERHADAP PERTUMBUHAN BIBIT KAKAO

THE INFLUENCE OF SEED PLANTING DEPTH AND PLANTING MEDIA COMPOSITION ON COCOA SEEDLING GROWTH

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Article Info

Article history
 Received :
 15 – 06 – 2024
 Received in revised :
 21 – 06 – 2024
 Accepted :
 28 – 06 - 2024
 Available online :
 15 – 07 - 2024

Abstract

This research aims to determine the depth of seed planting and the appropriate composition of planting media as well as the interaction between these two factors on the growth of cocoa seedlings. The research was carried out at the experimental garden of the Faculty of Agriculture, Universitas Iskandar Muda Surien, Banda Aceh, from October to December 2023. This research used a randomized block design with a 3*3 factorial pattern with three replications to obtain 27 experimental units. There were two factors studied, namely: seed planting depth (2, 4, and 6 cm) and the composition of the manure: soil planting medium (1: 1; 1:2; 1:3). The parameters observed were seedling height and stem base diameter at 45, 60, 75 days after planting, and number of leaves at 75 days after planting. The results showed that the depth of seed planting was very significantly different from the height of seedlings aged 45, 60 and 75 dap, but was not significantly different from the diameter of the stem base aged 45, 60, 75 dap and the number of leaves aged 75 dap. The composition of the planting media was not significantly different for seed height and stem base diameter at 45, 60, 75 days after planting and the number of leaves at 75 days after planting. There was a real interaction between the depth of seed planting and the composition of the planting media on the height of cocoa seedlings at 75 days after planting.

Keywords: *Seedlings, Cocoa, Planting Depth, Planting Media*

Abstrak

Penelitian ini bertujuan untuk mengetahui kedalaman tanam benih dan komposisi media tanam yang tepat serta interaksi antara kedua faktor tersebut terhadap pertumbuhan bibit kakao. Penelitian dilaksanakan di kebun percobaan Fakultas Pertanian Universitas Iskandar Muda Surien Banda Aceh, mulai Oktober sampai dengan Desember 2023. Penelitian ini menggunakan rancangan acak kelompok pola faktorial 3x3 dengan tiga kali ulangan sehingga diperoleh 27 satuan percobaan. Ada dua faktor yang diteliti yaitu: kedalaman tanam benih (2, 4, dan 6 cm) dan komposisi media tanam pupuk kandang: tanah (1: 1; 1:2; 1:3) . Parameter yang diamati adalah tinggi bibit dan diameter pangkal batang umur 45, 60, 75 hst, dan jumlah daun umur 75 hst. Hasil penelitian menunjukkan kedalaman tanam benih berbeda sangat nyata terhadap tinggi bibit umur 45, 60, dan 75 hst, tetapi berbeda tidak nyata dengan diameter pangkal batang umur 45, 60, 75 hst dan jumlah daun umur 75 hst. Komposisi media tanam berbeda tidak nyata terhadap



tinggi bibit dan diameter pangkal batang umur 45, 60, 75 hst serta jumlah daun umur 75 hst. Terdapat interaksi yang nyata antara kedalaman tanam benih dan komposisi media tanam terhadap tinggi bibit kakao pada umur 75 hst.

Kata Kunci: Bibit, Kakao, Kedalaman Tanam, Media Tanam

INTRODUCTION

Cocoa (*Theobroma cacao* L.) is one of Indonesia's plantation commodities that plays a role in the economy to increase farmers' income and foreign exchange. Indonesia is the third country with the largest cocoa crop area after Ivory Coast and Ghana. Its production reaches 1,315,800 tons/year with a cocoa plantation area of 1,426,000 ha (90% smallholder plantations). The productivity of the cocoa crop in Indonesia is low at 1 ton/ha with a target of 2 tons/ha. This low productivity is due to cultivation methods, especially seed selection and less than optimal handling of pests and diseases (Tyasmoro et al., 2021).

One of the efforts to increase cocoa production is by providing quality seedlings. To produce quality cocoa seedlings, it is necessary to use superior clones and seedlings with optimal growth. The growth of cocoa seedlings is influenced by several factors, including seed planting depth and planting media composition (Sitompul et al., 2014 and Wydiastuti et al., 2021).

The depth of seed planting greatly affects the growth of the sprouts. Planting too deep causes the sprouts to run out of energy before the hypocotyl appears on the soil surface, on the other hand, if planted too shallow, it causes the risk of drought before the seeds grow (Sutopo, 2002). Santoso and Bambang (2008) stated that seeds are sown with a depth of 1-2 cm, where the seeds will germinate faster and easily grow optimally because the light intensity obtained is sufficient. If the seeds are planted too deep with a depth of 5-7 cm, the seeds will be slow to grow and may even rot. Furthermore, Ahmad (2016) concluded that candlenut seeds planted 2 cm deep have the highest germination percentage. In addition to the seed planting depth factor, the composition of the planting medium also affects the quality of cocoa seedlings.

Planting media is the main component that can affect the quality of the seedlings produced. In general, a good planting medium must be able to maintain optimal humidity in the area around the roots, provide sufficient oxygen, and be able to provide nutrients for seedling growth. The availability of nutrients, water and oxygen in the planting media can be increased by using planting media that contain organic materials (Sari, 2015).

Manure is organic material resulting from waste products from domestic animals that can improve the physical, chemical and biological properties of soil. Manure contains macro and micro nutrients, namely nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, manganese (Nurhayati, 2021). Furthermore, Widodo (2008) added that manure can increase cation exchange capacity (CEC), form complex compounds that react with metal ions so as to reduce metal ions that inhibit the supply of nutrients such as Al, Fe and Mn or metal ions that poison plants. This study aims to determine the depth of seed planting and the right composition of planting media for the growth of cocoa seedlings.



RESEARCH METHODS

Place and Time

This research was conducted in the experimental garden of the Faculty of Agriculture, Universitas Iskandar Muda Surien Banda Aceh, from October to December 2023.

Tools and Materials

Tools used in this research are: scales, meters, paddles, hoes, machetes, paranet, stationery. Materials used are cocoa seeds of Upper Amazon Hybrid variety, cow manure, polybags with a size of 15 cm wide and 21 cm long from the ground.

Research Methods

This study used a 3*3 factorial pattern Randomized Group Design (RGD) with three replications, so there were 27 experimental units. There were two factors studied: planting depth and planting media composition. Planting depth consists of three levels, namely: K_1 = planting depth of 2 cm, K_2 = planting depth of 4 cm, K_3 = planting depth of 6 cm. The composition of planting media consists of three levels, namely: $M_1=1:1$ (1 part manure: 1 part soil), $M_2=1:2$ (1 part manure: 2 parts soil), $M_3=1:3$ (1 part manure: 3 parts soil).

Research Implementation

Top soil was cleaned from grass and garbage. The soil was mixed with manure according to the treatment then filled into polybags of 4 kg each and arranged according to the experimental chart. Shade was made from paranet as a shade facing east. Seeds were taken in the center, then rubbed with husk ash until the pulp disappeared completely and then washed with water. Seeds were planted upright in polybags with prospective roots at the bottom with the depth according to the treatment. Maintenance includes: watering, weeding and weed control. Watering was done twice a day in the morning and evening. Weeding was done at the age of 30 and 60 days after planting (dap). Weed control was done manually by pulling weeds that grew on the inside and outside of the polybag.

Parameters observed included:

1. Seedling Height (cm)
Seedling height was measured at 45, 60 and 75 days after planting (dap). The measurement starts from the base of the stem that has been marked to the highest growing point.
2. Diameter of stem base (cm)
Diameter of the stem base was measured at the age of 45, 60 and 75 dap. Measured at the base of the stem that has been marked.
2. Number of Leaves (strands)
The number of leaves was calculated at the age of 75 dap, by counting all the number of leaves present.



RESULTS AND DISCUSSION

Effect of Planting Depth

The results of the F test in the analysis of variance showed that the planting depth treatment was significantly different from the height of seedlings at 45, 60, and 75 dap, but not significantly different from the diameter of the base of the stem at 45, 60, and 75 dap and the number of leaves at 75 dap. The average growth of cocoa seedlings due to soil depth can be seen in Table 1.

Table 1. Average Growth of Cocoa Seedlings at Various Planting Depths

Observed Parameters	Planting Depth			BNJ _{0,05}
	K ₁	K ₂	K ₃	
Seedling Height (cm)				
45 dap	19,53 ^c	16,92 ^b	14,19 ^a	1,73
60 dap	21,84 ^c	18,99 ^b	16,98 ^a	1,41
75 dap	23,19 ^c	20,86 ^b	18,09 ^a	1,44
Stem Base Diameter (cm)				
45 dap	0,30	0,28	0,28	-
60 dap	0,36	0,35	0,35	-
75 dap	0,42	0,38	0,37	-
Number of Leaves at 75 dap (leaves)	10,22	9,44	9,11	-

Notes: Numbers followed by the same letter in the same row are not significantly different at the 5% level (BNJ test).

Table 1 shows that the growth of cocoa seedlings, namely plant height, stem base diameter and number of leaves, was highest in treatment K₁ (planting depth of 2 cm) because at that depth environmental conditions such as temperature, oxygen and humidity were optimal. This is in accordance with the results of research by Yasin et al. (2022) that planting mahogany seeds with a depth of 2 cm is faster to germinate because it gets enough water, there is also more oxygen, humidity and water reserves needed so that seedling growth is more optimal. Fitriani and Basir, (2015) added that trembesi seeds with the highest percentage of germination were seeds planted 2 cm deep.

At a seed planting depth of 2 cm, the hypocotyl is easier to penetrate the soil, the seeds also receive sunlight more quickly as a source of energy. Cocoa is an epigeal type, so the shallower the seed planting, the faster the cotyledon reaches the soil surface and the faster it gets sunlight so that the plant will be faster to carry out the photosynthesis process. One of the effects of the quality and intensity and duration of sunlight is morphological and physiological changes in plants (Geise, 1973; Hartle, 1977 in Sastrosayono, 2005).

The growth of cocoa seedlings really needs the right light and temperature because sufficient light intensity for plants will spur plant growth, both height and stem base diameter (Hartati et al., 2021).



Leaves are plant organs where photosynthesis takes place, as well as a place to store the results of photosynthesis in the form of organic matter which is energy in carrying out metabolism for plants. The number of leaves in plants is basically influenced by genotype and growing environment (Rosniawaty, 2005).

Planting depth is related to plant vigor, normal seedlings from seeds that have good growing power at an optimal depth, but on the contrary if the depth is less than optimal the seeds will not grow well because the seeds need optimal space in order to germinate and grow optimally (Imansyah and Ahmad, 2019).

Effect of Planting Media Composition

The results of the F test in the analysis of variance showed that the planting media composition treatment differed significantly on seedling height and stem base diameter at 45, 60, 75 dap, and number of leaves at 75 dap. The average growth of cocoa seedlings due to planting media composition can be seen in Table 2.

Table 2. Average Growth of Cocoa Seedlings on Various Compositions of Planting

Observed Parameters	Various Compositions of Planting		
	M ₁	M ₂	M ₃
Seedling Height (cm)			
45 dap	16,87	17,61	16,15
60 dap	18,83	20,23	18,74
75 dap	20,10	21,44	20,59
Stem Base Diameter (cm)			
45 dap	0,31	0,31	0,28
60 dap	0,35	0,35	0,36
75 dap	0,39	0,40	0,38
Number of Leaves at 75 dap (leaves)	8,88	10,50	9,33

Table 2 shows that the growth of cocoa seedlings, namely plant height, stem base diameter and number of leaves, was highest in the M₂ treatment (1 part fertilizer: 2 parts soil) because the mixed planting medium with soil as the main ingredient is a planting medium with sufficient nutrients, loose texture, or not too hard. The use of top soil in nursery media produces good plant growth, this is because top soil contains sufficient nutrients, good air and water management, has a stable aggregate and good water retention ability (Manullang and Silalahi, 2019).

The use of planting media with the appropriate composition for a type of plant will provide a good response and influence on plant growth. Planting media must be able to support plant growth and development (Yusuf et al., 2019). The main planting medium is the main component that can affect the quality of the seedlings produced. In general, a good planting medium must be able to maintain optimal humidity in the area around the roots, provide sufficient oxygen and nutrients for seedling growth. The availability of nutrients, water and oxygen in the planting medium can be increased by using organic fertilizers, one of the organic fertilizers is manure, either



in solid or liquid form which can provide macro and micro nutrients, improve the physical, chemical and biological properties of the soil (Sari, 2015).

Manure plays a role in improving the physical properties of the soil, which has a fairly high porosity but can be adjusted in density so that the planting medium becomes loose and can store nutrients. In general, the application of manure can increase soil fertility, increase humus levels, improve soil structure and encourage soil microorganism activity by increasing the availability and uptake of nutrients N, P and K from manure which can trigger plant growth (Widyastuti et al., 2021). Anindyawati (2010) stated that fertilization is one way to meet the needs of nutrients in a balanced amount to support vegetative and generative growth of plants. Nutrients and minerals that exist and are available to plants from manure, especially N, have the most prominent influence on plant growth and development because they can increase the phyto-hormone cytokinin, which affects plant vegetative growth (Mutryarny, 2007).

Interaction

The results of the F test in the analysis of variance show that there is a significant interaction between seed planting depth treatment and the composition of planting media on the height of cocoa seedlings at the age of 75 dap. The average height of cocoa seedlings in various combinations of seed planting depth treatment and planting media composition at the age of 75 days can be seen in Table 3.

Table 3. Average Height of Cocoa Seedlings at Various Combinations of Seed Planting Depth and Planting Media Composition Treatments

Treatment	M ₁	M ₂	M ₃
K ₁	20,43 ^{bc}	24,47 ^{de}	24,67 ^e
K ₂	22,03 ^{cd}	21,03 ^{bc}	19,50 ^{ab}
K ₃	17,83 ^a	18,83 ^{ab}	17,60 ^a
BNJ _{0,05}		2,49	

Notes: Numbers followed by the same letter in the same column are not significantly different at 0.05 (BNJ test).

Table 3 shows that the best treatment combination of seed planting depth and planting media composition is found in treatment K₁M₃ (seed planting depth of 2 cm and planting media composition of 1: 2 (1 part kendang fertilizer: 2 parts soil) this is because in this treatment combination the nutrients are in an optimum state and supported by the seed planting depth that is suitable for the growth of cocoa seedlings. To grow well, plants not only need adequate and balanced nutrients but also need a suitable soil physical environment so that plant roots can develop well.

It is very important to know the depth of the seed when planting to determine the appropriate planting depth level so that the development of seedlings can develop well which is characterized by the length of the part that appears on the surface of the soil (Imansyah and Ahmad, 2019).



Manure increases soil organic matter content, available P and soil CEC (Mutammimah at all., 2020). The application of cow manure also increases the solubility of soil organic P, this is because during the decomposition process of manure, microbes produce organic acids such as citric, oxalic, malic, and lactic acids that can chelate Al and Fe metals to form organic ligands, thus freeing up available P in the soil (Bhat at all., 2017). The presence of nitrogen in manure with sufficient amounts plays a role in accelerating overall plant growth (Lingga and Marsoso, 2013).

CONCLUSION

The seedling depth test gave a very significant effect on seedling height but did not give a significant effect on stem base diameter and number of leaves. The composition of planting media did not affect the growth parameters of cocoa seedlings. There is a significant interaction between seedling planting depth and planting media composition on cocoa seedling height at 75 dap. It is recommended to plant cocoa seeds with a planting depth of 2 cm and the composition of planting media with a ratio of 1 part manure: 2 parts soil.

ACKNOWLEDGMENTS

We would like to express our thanks to the academic community of Iskandar Muda University who have contributed to the research and publication of this scientific work.

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