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Effect of Several Liquid Bioameliorant Concentrations to Increase the Growth and Yield of Glutinous Corn in Sandy Soil

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Abstract:- Sandy soil has low organic matter content, low adsorption capacity, low cation exchange capacity, high permeability, and a high sensitivity to erosion. Such situations often cause crop failure, and efforts to improve growth, crop yields, and soil productivity become a major problem. However, how much influence the addition of liquid bioameliorant in sandy soil on the growth and yield of glutinous corn plants has not yet been revealed. The research aimed to study the effect of several liquid bioameliorant concentration on increase growth and yield of glutinous corn in sandy soil. The experiment was carried out in Telaga Wareng Hamlet, West Winner Village, West Winner District, North Lombok Regency, from May to August 2023. The experiment was conducted using a randomized block design with five bioameliorant concentrations, namely 100, 200, 300, 400, and 500 ml l^{-1}. The best liquid bioameliorant concentration for glutinous corn production is 500 ml l^{-1}, which can increase plant height, number of leaves, the concentration of available P and total soil N, uptake of N and P by plants, number of spores, colonization of roots, as well as the weight of wet and dry plant stems in sandy soil. Liquid bioameliorant concentrations of 500 ml l^{-1} produce the highest root dry weight, shoot dry weight, and yield.

Keywords:- *Liquid Bioameliorant, Soil Fertility, Plant Growth and Yield.*

I. INTRODUCTION

Management of sandy soil in a dry climate has various obstacles, including uneven rainfall distribution and low soil fertility quality, which can affect yield reduction and crop failure (Yazar and Ali, 2017). This sandy soil has characteristics, among others, that it has a coarse structure, does not have a diagnostic horizon, and has a sand fraction content of 60% or more at a depth of between 25 and 100 cm (Kabala et al., 2019). Apart from that, sandy soil also has low organic matter content, low adsorption capacity, low cation exchange capacity (CEC), high permeability, and a high sensitivity to erosion (Rachim and Arifin, 2013). One of the efforts made is adding liquid bio-ameliorative materials to the soil

Ingredients for liquid bioameliorant mixtures include compost. Compost is an organic ameliorant material that is vital in improving soil's physical, chemical, and biological properties. Its role in soil physics includes, among others, acting as an adhesive between soil particles to unite into soil aggregates, improving soil structure, increasing soil porosity, increasing the soil's ability to water holding capacity, and reducing the rate of erosion (Atmojo, 2003). Adding liquid bioameliorant material is expected to change the soil structure from single-grained to blocky, thus increasing the degree of structure and aggregate size or increasing the structure class from fine to medium or coarse. Apart from that, the provision of organic materials such as compost can make a real contribution to the CEC of the soil. Around 20–70% of soil CEC generally comes from colloids, so there is a correlation between organic matter and soil CEC (Uzoma et al., 2011). The CEC of organic materials is obtained from the negative charge of humus. The main source of the negative charge of humus mostly comes from carboxyl and phenolic groups (Priyadi et al., 2018). Research results (Dariah et al., 2015) show that adding 10 tons of straw ha^{-1} Ultisol increased 15.18% soil CEC from 17.44 to 20.08 cmol $^{(+)}$ kg^{-1}. Related to sandy soil, which can hold low water levels, apart from adding organic material in the form of cow drum fertilizer, this research also utilized rice husk charcoal waste. Rice husk charcoal contains activated charcoal whose carbon atom configuration is freed from bonds with other elements, and the cavities or pores are cleaned from other compounds or dirt so that the surface and active centre become wider or increase the adsorption capacity of liquids and gases. Seeing the ability of rice husk charcoal, it is hoped that sandy soil can retain water through its large adsorption capacity. Apart from that, charcoal is hygroscopic, so it can reduce leaching that occurs in sandy soil.

Apart from that, the interaction between roots and beneficial soil microbes also plays a vital role in increasing the soil fertility of Sandy Soil. One of the beneficial soil microbes is Arbuscular Mycorrhiza (AM), which can increase the supply of nutrients for plants and form a symbiotic relationship with plant roots to absorb nutrients (Walder et al., 2012). Menge et al. (2015) research show that AM inoculation can increase corn growth and yield. Mycorrhizal inoculation can also increase the efficiency of plant roots to absorb nutrients by 2.3 times. Astiko et al. (2019) stated that inoculation with seed coating with indigenous mycorrhizae can increase growth, plant production, plant N and P uptake, and nutrient availability in corn-sorghum planting patterns in sandy soil in North Lombok. Next, Astiko et al. (2019a) also reported that increasing corn productivity on dry land can be done by applying a fertilizer package mixed with inorganic fertilizer, mycorrhizal biofertilizer, and organic material on dry land. Based on this, this research was conducted to find out " The Effect of Several Liquid Bioameliorant Concentrations on Increase Growth and Yield of Glutinous Corn in Sandy Soil".

II. MATERIALS AND METHODS

➢ *Research Plase and Design*

The experiment was carried out in Telaga Wareng Hamlet, West Pemenang Village, Pemenang District, North Lombok Regency, from May to August 2023. The experiment was conducted using a randomized block design with five bioameliorant concentrations, namely D1: liquid bioameliorant concentration of 100 ml/l, D2: liquid bioameliorant concentration of 200 ml/l, D3: liquid bioameliorant concentration 300 ml/l, D4: liquid bioameliorant concentration 400 ml/l, D5: liquid bioameliorant concentration 500 ml/l. The treatment was repeated four times, so there were 20 experimental plots with a plot size of 5.2 m x 1.5 m each.

➢ *Implementation of Experiments*

The application of liquid bioameliorant is carried out according to the respective treatment at planting time. Making bioameliorant is done by mixing 25% drum fertilizer, 25% compost, 25% rice husk charcoal, and 25% mycorrhizal biofertilizer. The four ingredients are then mixed until homogeneous, then put into a 10 kg polybag pot. This pot is also a culture pot for the propagation of bioameliorant plus mycorrhiza, which is then planted with corn-feed plants and maintained for 50 days. After age 50, the soil and plants are dismantled, and the roots and soil are air-dried for a week. After drying, the bioameliorant mixture is sieved using a sieve with a diameter of 2 mm, and the roots are blended until smooth and mixed evenly into the bioameliorant resulting from the sieve. The final product of this bioameliorant is in the form of flour. Liquid bioameliorant is made by thoroughly mixing 1 kg of bioameliorant flour with 1 L of water (w/v); this mixture is then left for 24 hours. This liquid bioameliorant, aged for 24 hours, is the source of the liquid bioameliorant applied in the field. The bioameliorant concentration for each plant is given as 100 ml taken from each bioameliorant treatment concentration (100 ml/l, 200 ml/l, 300 ml/l, 400 ml, and 500 ml liquid bioameliorant/l water) and given at the time of plant.

Planting corn seeds is done by immersing the seeds 5 cm deep in the soil. Each hole is filled with two corn seeds with a planting distance of 60 x 40 cm. Embroidery is carried out by replanting corn seeds at the age of 7 days after planting (dap) to replace dead or abnormally growing plants. After the plants grow, thinning is carried out leaving one plant 14 dap.

Fertilization is carried out by applying inorganic fertilizer with half the recommended dose, namely 175 kg ha^{-1} of urea fertilizer and Phonska 125 kg ha^{-1}. As a basic fertilizer, inorganic fertiliser is given 1/2 concentration at the age of 7 dap, and the remaining 1/2 concentration is given at 14 dap. The planting distance for sweet corn is 60 x 40 cm, with two seeds per planting hole.

Plant maintenance includes weeding every time weeds grow by pulling them out. Irrigation of plants is carried out depending on rainfall in the field or by watering using a water sprinkler.

➢ *Observation Variables*

The variables observed in this study were: (1) soil nutrient concentration variables N and P at the age of 42 and 65 dap, and plant nutrient uptake (N and P) at the age of 42 dap; (2) growth variables included: plant height and a number of leaves at 14, 28, 42, and 56 dap; and (3) wet and dry weight of root and shoot stove per plant at 42 dap; and (3) mycorrhizal population variables including a number of spores and percentage of root colonization at 42 dap and 65 dap, (4) yield variables include: wet and dry stover weight per plot, as well as fresh cob weight per plot at harvest age of 65 dap.

➢ *Data Analysis*

The observation data were analyzed using analysis of variance and followed by the least significant difference (LSD) test at a level of 5% using the program costat for Windows.

III. RESULTS AND DISCUSSION

➢ *Height and Number of Leaves*

The analysis of variance showed that the liquid bioameliorant concentration treatment of 500 ml/l water had a significant effect on plant height compared to other liquid bioameliorant concentration treatments when the plants were 14-56 dap (Table 1)

Table 1 Average Height Growth of corn Plants in the Liquid Bioameliorant Treatment

Concentration Treatment	Plant height (cm)			
	14 dap	28 dap	42 dap	56 dap
D1: Concentration 100 ml/l	14.50^{e}	35.73^{d}	74.50^{d}	79.83^{e}
D2: Concentration 200 ml/l	16.17^{d}	37.77^{d}	78.83^{d}	86.33^{d}
D3: Concentration 300 ml/l	18.60^{c}	44.77^{c}	85.57^{c}	94.33^{c}
D4: Concentration 400 ml/l	23.17^{b}	56.87^{b}	92.53^{b}	116.33^{b}
D5: Concentration 500 ml/l	26.83^{a}	63.83^{a}	113.57^{a}	128.17^{a}
LSD 5%	1.24	2.19	3.64	1.85

- Note: Mean values followed by the same letter in the same column are not significantly different according to the 5% LSD test

In Table 1 above, it can be seen that the plant height given a liquid bioameliorant concentration of 500 ml/l of water has the highest value at the age of 14 dap to 56 dap, namely 26.83 cm to 128.17 cm. Meanwhile, the concentration of liquid bioameliorant at a concentration of 100 ml/l of water had the lowest value from 14 dap to 56 dap, namely 14.50 cm to 79.83 cm. Giving a liquid bioameliorant with a concentration of 500 ml/l of water significantly affects the height of corn plants. Different plant heights are significantly influenced by giving different concentrations of liquid bioameliorant, so corn plants also give the best growth response to a concentration of liquid bioameliorant of 500 ml/l water. Providing a higher concentration of liquid bioameliorant provides better plant growth. This shows that administering liquid bioameliorant with a concentration of 500 ml/l of water can provide sufficient nutrient availability and be used by plants for their growth processes.

Providing liquid bioameliorant with a high concentration can increase the uptake of nutrients in plants so that it affects stimulating and dividing cells. Apart from that, the high nitrogen content in manure is very influential in stimulating cell enlargement and division and affects increasing the growth rate of plant height. Providing liquid bioameliorant affects plant height because organic material derived from manure contains a number of nutrients and organic materials that can improve soil's physical, chemical, and biological properties (Fitri et al., 2022).

The same results were also seen in the number of leaves; giving a liquid bioameliorant concentration of 500 ml/l of water made a significant difference in the 5% LSD test when the plants were 14 until 56 dap. When the plants were 56 dap, it was seen that the number of leaves of glutinous corn plants in the liquid bioameliorant concentration treatment of 500 ml/l water gave the highest results and was significantly different compared to other liquid bioameliorant concentration treatments (Table 2).

Table 2 Average Growth in the Number of Corn Leaves in the Liquid Bioameliorant Treatment

Concentration	**Number of Leaves (pieces)**			
	14 dap	**28 dap**	**42 dap**	**56 dap**
D1: Concentration 100 ml/l	3.67^{b}	5.33^{d}	6.67^{c}	7.33^{c}
D2: Concentration 200 ml/l	4.01^{b}	6.67^{cd}	8.01^{bc}	8.33^{bc}
D3: Concentration 300 ml/l	4.67^{b}	7.67^{bc}	8.67^{b}	9.01^{bc}
D4: Concentration 400 ml/l	6.33^{a}	8.67^{ab}	9.33^{ab}	9.67^{ab}
D5: Concentration 500 ml/l	7.01^{a}	9.67^{a}	10.33^{a}	11.01^{a}
LSD 5%	0.90	0.97	1.00	1.16

In Table 2 above, it can be seen that the concentration of liquid bioameliorant given at 500 ml/l water had a significant effect on the number of leaves compared to administering a liquid bioameliorant concentration of 100 ml/l water. Giving liquid bioameliorant with a concentration of 500 ml/l water has the highest average value, while the liquid bioameliorant concentration of 100 ml/l water has the lowest average value.

Providing a liquid bioameliorant with a concentration of 500 ml/l water significantly affected the number of leaves of glutinous corn plants. Corn plants also provide the best growth response when given a liquid bioameliorant concentration of 500 ml/l water, so they produce the most significant number of leaves. This is due to differences in nutrients absorbed by plants. A higher concentration of liquid bioameliorant provides better plant growth. This shows that giving a higher concentration of liquid bioameliorant provides sufficient availability of high nutrients, which plants use for their growth processes. This is in accordance with the research results Kartahadimaja (2009) and Yati (2016), who argue that a large number of leaves is influenced by the nutritional content available due to the provision of bioameliorant so that it can make a significant contribution to plants because leaves are plant organs that function as a place for photosynthesis. High concentrations of bioameliorant can increase the growth rate and the number of leaves.

- *Soil Nutrient Concentration and Plant Nutrient Uptake*

The results of the analysis of variance showed that the liquid bioameliorant concentration treatment of 500 ml/l water had a significant effect compared to other liquid bioameliorant concentration treatments on changes in soil nutrient concentrations and nutrient uptake by plants (Table 3 and Table 4). The results of the LSD test at the 5% level show that treatment with a liquid bioameliorant concentration of 500 ml/l of water can increase the total N concentration from 1.87 $g.kg^{-1}$ at 42 dap to 1.99 $g.kg^{-1}$ at 65 dap and available P concentration of 48.63 $mg.kg^{-1}$ at 42 dap to 70.32 $mg.kg^{-1}$ at 65 dap (Table 3). The highest and significantly different increase occurred in the liquid bioameliorant concentration treatment of 500 ml/l water.

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Table 3 The Average Concentration of Total N and Available P Nutrients at Various Concentrations of Liquid Bioameliorant aged 42 And 65 Dap

Concentration Treatment	N total (g.kg^{-1})		P available (mg.kg^{-1})	
	42 dap	65 dap	42 dap	65 dap
D1: Concentration 100 ml/l	1.06^{d}	$1.23^{It\ is}$	17.58^{d}	37.45^{d}
D2: Concentration 200 ml/l	1.06^{d}	1.27^{d}	17.70^{d}	37.65^{d}
D3: Concentration 300 ml/l	1.12^{c}	1.29^{c}	36.62^{c}	60.62^{c}
D4: Concentration 400 ml/l	1.66^{b}	1.78^{b}	40.24^{b}	64.97^{b}
D5: Concentration 500 ml/l	1.87^{a}	1.99^{a}	48.63^{a}	70.32^{a}
LSD 5%	0.025	0.025	1.86	0.374

If you look at Table 3 above, there is a significant difference in the concentration of total N and available P when administering several bioameliorant concentrations of 500 ml/l of water and administering liquid bioameliorant 100 ml/l water. The provision of bioameliorant liquid containing more mycorrhiza increases the amount of P available in the soil. This is in accordance with the statement by Mengel & Kirkby (2007) that increasing the P concentration in the soil solution will also increase the absorption of P by plants. Rahman et al. (2020) said that the manure contained in bioameliorant with a higher concentration also contains higher levels of macro and micronutrients, thereby increasing the availability of nutrients and increasing the efficiency of nutrient absorption by roots compared to bioameliorant with a low concentration. Liquid bioameliorant with a concentration of 500 ml/l of water containing cow drum fertilizer also has quite a high N content.

Apart from the availability of nutrient concentrations in the soil, the air structure and air conditioning also greatly influence plant roots' growth and development. Developing a good plant root system greatly determines plant nutrient uptake, ultimately determining plant vegetative growth. By administering liquid bioameliorant with a higher concentration containing mycorrhiza, soil available P tends to increase. The concentration of nutrients in the soil can be determined by the nutrient content in the plant tissue that grows on it. This is because the nutrient content in the soil is correlated with the nutrient content in plant tissue (Suharto, 2018). Increasing soil fertility status can be done through several methods, such as adding phosphorus fertilizer and arbuscular mycorrhiza (AM). The substance that is widely used as a source of phosphorus for soil is phosphate aid. The use of phosphate aids for soil fertilization often has a better effect on phosphorus availability compared to the use of SP-36 because the release of P from phosphate aids increases significantly. The positive effect of root-AM infection is that it can increase nutrient and water retention, nutrient uptake, growth, and yield of plants grown in dryland farming systems (Smith et al., 2010). Astiko (2009) reported that giving fertilizer packages with half the concentration of inorganic fertilizer accompanied by mycorrhizal inoculation on corn resulted in the highest degree of infection, number of spores, growth, and yield compared to plants without mycorrhizal inoculation.

Phosphorus (P) is an essential macronutrient that plays an important role in the growth process of glutinous corn. Adding liquid bioameliorant with a higher concentration containing mycorrhiza in the soil can increase the development of microorganisms and provide nutrients in the soil. One of the roles of bioameliorant is as a habitat for the growth of beneficial microorganisms. The higher the activity of soil microorganisms, the greater the availability of nutrients in the soil so that plants can absorb nutrients well and can also increase plant yields (Chan et al., 2008).

The results of the LSD test at the 5% level showed that giving liquid bioameliorant can significantly increase plant N and P nutrient uptake when compared with other liquid bioameliorant concentration treatments at 42 dap. Plant nutrient uptake of N and P initially at a concentration of 100 ml/l water was 28.32 g.kg^{-1} and 2.28 g.kg^{-1} at 42 dap; it increased to 39.32 g.kg^{-1} and 3.70 g.kg^{-1} at 65 dap (Table 4).

Table 4 Average Plant N and P Nutrient Uptake at Several Liquid Bioameliorant Concentrations Age 42 dap

Concentration Treatment	N uptake (g kg^{-1})	P uptake (g kg^{-1})
	42 dap	42 dap
D1: Concentration 100 ml/l	28.32^{d}	2.28^{d}
D2: Concentration 200 ml/l	32.83^{c}	2.34^{d}
D3: Concentration 300 ml/l	33.63^{c}	2.65^{c}
D4: Concentration 400 ml/l	36.46^{b}	2.80^{b}
D5: Concentration 500 ml/l	39.32^{a}	3.70^{a}
LSD 5%	1.28	0.079

If you look at Table 4 above, there are significant differences in N uptake and P uptake when given several liquid bioameliorant concentrations of 500 ml/l of water compared to a liquid bioameliorant concentration of 100ml/l water. Giving liquid bioameliorant with a concentration of 500 ml/l water has the highest value, while administering bioameliorant with a concentration of 100 ml/l of water has the lowest value. Giving liquid bioameliorant with a concentration of 500 ml/l water can increase N uptake by 39.32 g kg^{-1} and P uptake by as much as 3.70 g kg^{-1} at the age of 42 dap. This is in accordance with the research results of Kasno and Tia (2013), who stated that NPK fertilization accompanied by the provision of bioameliorant can increase N and P. Organic fertilizer, with the help of microbes during the decomposition process, produces organic acids that play a role in releasing P, which is fixed into P-Available which plants can absorb. P can accelerate plant growth and speed up flowering. Phosphorus can accelerate the growth of plant tissue that forms growing points and can stimulate plant generativegrowth by accelerating the formation of flowers and the ripening of seeds, thereby speeding up the harvest period. This is because the provision of bioameliorant can also improve the performance of solvent bacteria so that the availability of P fertilizer is sufficient to be given to plants (Herlina & Fitriani, 2017).

The application of bioameliorants containing mycorrhiza at higher concentrations can increase symbiotic interactions, which can increase P uptake by plants. This may result in increased effectiveness in acquiring relatively immobile nutrients such as P (Gahoonia and Nielsen 2004). In addition, producing exudates containing organic acids by cluster roots can increase the availability of insoluble P and ultimately become available to plants increasing the proliferation of corn roots planted in sandy soil. Mycorrhizae produce external mycelium in the rhizosphere, increasing the amount of water and nutrient retention due to increased organic matter and other physical properties of the soil. This phenomenon occurs due to better nutrient availability and root proliferation (Drew et al., 2003; Smith and Read, 2008).

➢ *Mycorrhiza Development*

The results of the analysis of variance showed that the effect of the treatment with a liquid bioameliorant concentration of 500 ml/l water was significantly different according to the 5% LSD test compared to other bioameliorant concentration treatments on the parameters of the number of mycorrhizal spores and the percentage of root colonization at 42 and 65 dap (Table 5).

If you look at Table 5 above, there are significant differences in the number of spores and colonization at several bioameliorant concentrations. The number of spores increases with increasing plant age. Meanwhile, colonization in the treatment with a liquid bioameliorant concentration of 100 ml/l of water aged 42 dap and 65 dap did not show a high increase; however, when the bioameliorant liquid concentration was given at 500 ml/l of water, there was an increase. This indicates that there is a significant difference between the administration of several higher concentrations of liquid bioameliorant and the administration of a liquid bioameliorant concentration of 100 ml/l of water. This is in line with the working principle of mycorrhiza, mycorrhiza infects the root system of the host plant, producing an intensive network of hyphae so that plants that contain more mycorrhiza have higher growth (Iskandar, 2001).

Table 5 The average number of spores (spores per 100 g of soil) and colonization value (%-colonization) at various concentrations of liquid bioameliorant aged 42 and 65 dap

Concentration	Number of spores		Colonization	
	42 dap	**65 dap**	**42 hst**	**65 dap**
D1: Concentration 100 ml/l	1548.67[e]	1748[e]	20.23[e]	40.40[e]
D2: Concentration 200 ml/l	2328.33[d]	3048[d]	60.33[d]	60.46[d]
D3: Concentration 300 ml/l	4508.67[c]	5885[c]	70.50[c]	70.53[c]
D4: Concentration 400 ml/l	6858.67[b]	7020[b]	80.33[b]	80.46[b]
D5: Concentration 500 ml/l	3778.33[a]	8630[a]	90.43[a]	93.50[a]
LSD 5%	1.97	5.02	0.22	0.20

This research shows that administering various concentrations of bioameliorant plus mycorrhiza significantly affects roots infected with mycorrhiza. This shows that administering a liquid bioameliorant concentration of 500 ml/l of water-containing fertilizer can significantly increase infected roots when compared to a liquid bioameliorant concentration of 100 ml/l of water. This is because bioameliorant materials with higher concentrations have a role in the soil to increase soil fertility. Plants given bioameliorant containing mycorrhiza at a concentration of 500 ml/l water grew better than plants given a liquid bioameliorant concentration of 100 ml/l water. The main cause is the mycorrhiza contained in bioameliorant with higher concentrations, which can effectively increase the absorption of both macronutrients and micronutrients. Apart from that, mycorrhizal roots can absorb nutrients in bound form, which are not available to plants. The main benefit of symbiosis between mycorrhiza and plants is its ability to increase phosphorus nutrient uptake and improve plant growth. Mycorrhiza can help improve plant nutrition and increase plant growth and yield (Subandi et al., 2017).

➢ *Wet and Dry Weight Root and Shoot per Plant*

The analysis of variance showed that the liquid bioameliorant concentration treatment of 500 ml/l water significantly increased the wet and dry weight of root and shoot stem per plant compared to other liquid bioameliorant concentration treatments (Table 6). The results of the LSD test at the 5% level showed that the liquid bioameliorant concentration treatment of 500 ml/l water compared to the liquid bioameliorant treatment of 100 ml/l water could increase the wet stover weight of plant roots and shoots from 6.63 g and 47.23 g per plant to 37.1 g and 112.93 g per plant at 42 days after planting and at 65 dap from 25.93 g per plant and 72.1 g per plant increased to 73.13 g per plant and 221.93 g per plant. Meanwhile, the weight of dry stover of roots and shoots from 3.03 and 20.62 g per plant to 22.95 and 36.77 g per plant at 42 dap and from 13.77 g per plant and 20.77 g per plant to 35 .83 g per plant and 119.15 g per plant at 65 dap.

Table 6 The Average Weight of wet and Dry Shoots and Roots per Plant at Several Concentrations of Liquid Bioameliorant at 42 and 65 Dap

Concentration	Shoots (g)		Roots (g)	
	42 dap	65 dap	42 dap	65 dap
Wet Stove				
D1: Concentration 100 ml/l	47.23[e]	72.10[e]	6.63[e]	25.93[e]
D2: Concentration 200 ml/l	56,60[d]	103.90[d]	21.80[d]	36.86[d]
D3: Concentration 300 ml/l	79.27[c]	118.26[c]	28.40[c]	55.06[c]
D4: Concentration 400 ml/l	108.23[b]	214.56[b]	32.80[b]	59.10[b]
D5: Concentration 500 ml/l	112.93[a]	221.93[a]	37.10[a]	73.13[a]
LSD 5%	2.25	3.62	1.72	2.17
Dry Stove				
D1: Concentration 100 ml/l	20.62[e]	20.77[e]	3.03[e]	13.77[d]
D2: Concentration 200 ml/l	24.81[d]	39.64[d]	12.45[d]	19.58[c]
D3: Concentration 300 ml/l	28.85[c]	49.41[c]	16.85[c]	24.09[b]
D4: Concentration 400 ml/l	32.76[b]	76.82[b]	18.74[b]	24.86[b]
D5: Concentration 500 ml/l	36.77[a]	119.15[a]	22.95[a]	35.83[a]
LSD 5%	1.23	0.93	1.10	1.11

In Table 6 above, it can be seen that there is a significant difference in the weight of shoot and root stover when given a liquid bioameliorant concentration of 500 ml/l of water. Compared to giving liquid bioameliorant at 100 ml/l water, giving different concentrations of bioameliorant can affect the weight of wet stover and the weight of dry stover. Giving liquid bioameliorant with a concentration of 500 ml/l water had the highest average values for both wet and dry shoots and roots. This increase in stover weight is caused by a higher concentration of bioameliorant, which will affect the availability of different nutrients so that the nutrients absorbed by plants are different. The role of mycorrhiza is also very influential in increasing the weight of the shoot and root stover. This is in line with the statement by Kung'u (2008) that increased mycorrhizal colonization causes an increase in fresh root weight. This is because plants associated with mycorrhizae can translocate carbon into the roots at a higher rate than plants that do not have mycorrhizae. Added by Hartoyoet et al. (2011), roots infected with mycorrhizae have root hyphae that grow longer than those not infected with mycorrhiza, causing root weight to increase.

If we look in more detail at the age of 40 dap and 65 dap, root weight increased in fresh and oven-dried stovers as time increased weight of fresh stover and oven-dried stover. An increase in plant dry weight indicates increased plant growth. Plant dry weight indicates plant growth, and the amount of nutrients absorbed per unit weight of stover produced increases. This is because the administration of liquid bioameliorant with a higher concentration provides sufficient nutrition so that the wet and dry weights of the shoots and roots are also higher. The more nutrients absorbed by the plant, the better the plant growth, so the dry weight of the plant also increases (Musfal, 2010).

E. Crop Yield

Based on the results of the analysis of variance and tests with LSD 5%, it can be seen that the liquid bioameliorant concentration treatment with a concentration of 500 ml/l of water had a significant effect on the weight of wet stover, the weight of dry stover, and the weight of wet cob per plot and was significantly different from the treatment. liquid bioameliorant concentration 100 ml/l water (Table 7). The yield increased from 4.03, 2.01, and 4.38 kg per plot to 7.96, 6.5, and 7.55 kg per plot.

Table 7 Wet Stove Weight, Dry Stove Weight, and Wet Cob Weight Per Plot in the Liquid Bioameliorant Concentration Treatment

Concentration	WSW (kg)	DSW (kg)	WCW (kg)
D1: Concentration 100 ml/l	4.03[d]	2.01[e]	4.38[c]
D2: Concentration 200 ml/l	5.38[c]	3.96[d]	5.56[bc]
D3: Concentration 300 ml/l	5.81[bc]	4.66[c]	5.82[bc]
D4: Concentration 400 ml/l	6.63[b]	5.43[b]	7.02[ab]
D5: Concentration 500 ml/l	7.96[a]	6.5[a]	7.55[a]
LSD 5%	0.54	0.43	1.09

WSW=Wet Stove Weight, DSW=Dry Stove Weight, and WCW=Wet Cob Weight

If you look at Table 7 above, the application of a liquid bioameliorant concentration of 500 ml/l water has a significant effect on the weight of wet stover, dry stover, and wet cob per plot compared to a liquid bioameliorant concentration of 100 ml/l water. The weight of wet and dry stover and wet cob per plot in the treatment with a liquid bioameliorant concentration of 100 ml/l of water had the lowest value, while the treatment of liquid bioameliorant with a concentration of 500 ml/l of water had the highest value.

The above fact is because there are more nutrients available in plants that are given liquid bioameliorant with a higher concentration, so that it can increase nutrient uptake in plants and can increase wet weight, dry cob weight of the stover, and fresh cob weight per plot. Based on reset results, Santosa et al. (2016) found that increasing total P uptake by plants can increase the weight of corn cobs. Nugroho (2015) also explained that if the nutrient requirements for corn plants are met, it will cause the plant's metabolism to run optimally. There will be an increase in the accumulation of metabolites during seed formation, and as a result, the weight of the cobs formed will be maximum. Next, Taufik et al. (2010) also stated that meeting plant nutrient needs causes the metabolism to run optimally so that the formation of proteins, carbohydrates, and starch is not hampered. As a result, the accumulation of metabolic products during seed formation will increase so that the seeds formed have the maximum size and weight. The effect of providing biological fertilizer contained in liquid bioameliorant at a higher concentration has a significant effect on the weight of planted corn kernels. Providing liquid bioameliorant at 500 ml/l of water can increase the weight of fresh cobs per plot compared to low bioameliorant concentrations. Hariani and Sasli (2021) concluded from their research that the ameliorant type of chicken manure can increase plant height 2, 4, and 6 weeks after planting (wap), ear diameter, ear length, weight per ear, and ear weight per plot. The best NPK fertilizer concentration for glutinous corn production is 200 kg ha^{-1} on cob length and weight per cob, and a concentration of 100 kg ha^{-1} can stimulate plant growth, namely at a plant height of 4 wap. Combining an ameliorant type of chicken manure and NPK fertilizer (400 kg ha^{-1}) produces the highest root dry weight, shoot dry weight, and relative growth rate. Furthermore, Soelaeman et al. (2017) said that the application of inorganic fertilizer accompanied by biochar, P-dissolving microbes, and manure to corn plants on acidic dry land caused an increase in the growth and yield of corn plants.

IV. CONCLUSION

The best concentration of liquid bioameliorant for glutinous corn production is 500 ml l^{-1}, which can increase plant height, number of leaves, the concentration of available P and total N in the soil, uptake of N and P by plants, number of spores, colonization of roots, as well as the weight of wet and dry plant. A liquid bioameliorant concentration of 500 ml l^{-1} produces the highest dry root weight, shoot dry weight, and fresh cob yield.

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