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Influence of Ameliorant and Mycorrhiza Application on Growth Performance and Yield of Glutinous Maize

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Abstract:- The application of ameliorants combined with mycorrhizal inoculants can enhance the fertility of sandy soil by improving its physical, chemical, and biological properties. This research aims to evaluate the influence of ameliorant and mycorrhiza application on growth performance and yield of glutinous maize. A randomized block design was employed, consisting of five treatments: F1: 75% cow manure + 25% mycorrhizal inoculant; F2: 75% compost + 25% mycorrhizal inoculant; F3: 75% 'Subur' organic fertilizer + 25% mycorrhizal inoculant; F4: 75% rice husk biochar + 25% mycorrhizal inoculant; and F5: a mixture of 20% cow manure, 20% compost, 20% 'Subur' organic fertilizer, 20% rice husk biochar, and 20% mycorrhizal inoculant. The results indicate that the use of a balanced organic ameliorant mixture with 20% mycorrhiza can significantly improve sandy soil fertility, as well as the growth and productivity of glutinous maize. The F5 treatment, which consists of 20% cow manure, 20% compost, 20% 'Subur' organic fertilizer, 20% rice husk biochar, and 20% mycorrhizal inoculant, is recommended as the best practice for cultivating glutinous maize on sandy soils.

Keywords:- *Ameliorant, Sandy Soil, Glutinous Maize Production.*

I. INTRODUCTION

Glutinous maize (*Zea mays* var. ceratina) is a corn variety with significant potential for development, because seeds are rich in protein, fiber, fat, and carbohydrates, making it an important food ingredient [1]. However, corn productivity in certain regions, such as West Nusa Tenggara, remains low. Corn productivity in this region reached only 3.26 tons per hectare, compared to the national average of 5.3 tons per hectare. This situation has led to efforts to intensify corn production, particularly on sandy soils [2].

Sandy soils, particularly in North Lombok Regency, are a key area for corn cultivation by local communities. One of the primary factors contributing to this decline in productivity plants is the limited use of organic materials in cultivation, which significantly reduces soil fertility and, consequently, crop yields are low [3].

Managing sandy soils in arid areas provides a number of issues, including irregular rainfall distribution and poor soil fertility. Sandy soils exhibit a coarse texture, minimal organic matter, reduced cation exchange capacity (CEC), and elevated permeability, leaving it susceptible to erosion and poor agricultural yields [4];[5]. One successful method is to introduce organic elements as ameliorants [6];[7].

In addition to organic matter, mycorrhizal can enhance nutrient availability to plants through a symbiotic relationship with roots, ultimately improving the growth and yield of corn [8];[9];[10].

This research aims to evaluate the influence of ameliorant and mycorrhiza application on growth performance and yield of glutinous maize.

II. MATERIALS AND METHODS

- *Research Methods*

This research was carried out for three months, namely starting March 17 to May 28, 2024 The treatments tested consisted of: F1: 75% cow manure + 25% mycorrhizal inoculant; F2: 75% compost + 25% mycorrhizal inoculant; F3: 75% “subur” organic fertilizer + 25% mycorrhizal inoculant; F4: 75% rice husk biochar + 25% mycorrhizal inoculant; F5: 20% cow drum fertilizer + 20% compost + 20% “subur” organic fertilizer + 20% rice husk biochar + 20% mycorrhizal inoculant.

- *Administration of Both Mycorrhiza and Ameliorant*

Mycorrhizal culture pots are prepared by mixing sterile cow manure with sterile soil in a 1:1 volume ratio. The inoculum is screened, and the roots are finely milled before mixed with the culture potting soil obtained from the screening process. The final product of this procedure is mycorrhizal inoculum powder [11];[12]. Making ameliorant plus mycorrhizal formulations is carried out by mixing the respective types of ameliorant ingredients with mycorrhizal inoculum with the formulation ratio as in the treatment [13]. Ameliorants mixed with mycorrhiza are introduced into the soil at the time of planting, using a

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dosage of 10 g per plant, and positioned as a layer under the glutinous maize seeds [14];[15].

➢ *Fertilization*

Fertilization is conducted by distributing various ameliorant blends at a rate of 15 tons per hectare, followed by a lower application of inorganic fertilizers (urea at 175 kg/ha and phosphates at 125 kg/ha). The ameliorant is mixed into the soil at planting, while the inorganic fertilizers are applied in two phases: half at 7 days after sowing and the other half at 14 days after sowing.

➢ *Plant Upkeep*

Plant maintenance includes weeding every five days and irrigating the plants which depends on rain; if there is no rain, this is done by spraying with water using a sprinkler.

➢ *Paramater Observation*

Parameters measured included plant height, leaf count at 14, 28, 42, and 56 days after sowing (DAS), wet and dry biomass of roots and shoots per plant at 42 and 65 DAS, wet and dry biomass per plot, and wet and dry cob weights. Additionally, spore counts per 100 g of soil, total nitrogen and soil-available phosphorus concentrations at 42 and 65 DAS, plant nitrogen and phosphorus uptake at 42 DAS, ear length, ear diameter, wet ear weight per plot, and mycorrhizal root colonization at 42 and 65 DAS were also assessed.

III. RESULTS AND DISCUSSION

➢ *Plant Height and Number of Leaves*

Table 1, based on the analysis of variance results, indicates that the 20% mixed ameliorant treatment (F5) had a significant effect on corn plant height from 14 to 65 DAS. Specifically, between 42 and 56 DAS, the 20% mixed ameliorant treatment produced the greatest increase in corn plant height.

Table 1 Height of Maize in Various Ameliorant Formulations

Ameliorative Treatment	Plant Height (cm)			
	14 DAS	28 DAS	42 DAS	56 DAS
F1: 75% CM + 25% M	10.66^{a}	33.00^{a}	77.00^{a}	129.00^{a}
F2: 75% C + 25% M	10.00^{a}	32.66^{ab}	74.00^{ab}	127.66^{ab}
F3: 75% O + 25% M	9.66^{a}	30.33^{ab}	68.00^{bc}	124.66^{b}
F4: 75% HC + 25% M	9.66^{a}	30.00^{b}	66.66^{c}	120.00^{c}
F5: 20% MIX	10.33^{a}	33.00^{a}	78.00^{a}	131.33^{a}
HSD 5%	1.98	2.70	6.80	4.22

Note: CM (cattle manure), M (mycorrhizal biological fertilizer), C (compost), O (organic "fertilizer"), HC (rice husk biochar), MIX (mixture of 20% CL, C, O, HC, and M)

Table 2, based on the analysis of variance results, shows that the 20% mixed ameliorant treatment (F5) significantly affected the number of leaves compared to the 75% rice husk biochar + 25% mycorrhiza (F4) treatment for plants at 14-56 days after sowing (DAS). The 20% ameliorant mixture (F5) yielded the highest average number of leaves, while the 75% rice husk biochar + 25% mycorrhiza (F4) treatment resulted in the lowest average.

Table 2 Number of Maizet Leaves in Various Ameliorant Formulations

Ameliorative Treatment	Number of Leaves			
	14 DAS	28 DAS	42 DAS	56 DAS
F1: 75% CM + 25% M	5.33^{ab}	9.00^{ab}	10.66^{b}	11.00^{ab}
F2: 75% C + 25% M	5.00^{ab}	8.33^{bc}	10.33^{ab}	10.66^{ab}
F3: 75% O + 25% M	4.66^{bc}	9.00^{c}	10.00^{bc}	10.33^{bc}
F4: 75% HC + 25% M	4.00^{c}	8.00^{c}	9.33^{c}	9.33^{c}
F5: 20% MIX	5.66^{a}	9.66^{a}	11.00^{a}	11.66^{a}
HSD 5%	0.80	0.97	0.90	1.16

As shown in Table 1 and Table 2, 20% mixed ameliorant formulation treatment resulted in better growth compared to other treatments. This variation in outcomes can be attributed to differences in the nutrient content of each ameliorant formulation used. Each type of ameliorant has a unique nutritional composition, and the applied dosage influences nutrient availability for plants [16].

The 20% mixed formulation, which includes 20% cow manure, 20% compost, 20% 'Subur' organic fertilizer, 20% rice husk biochar, and 20% mycorrhizal inoculant, showed superior results between 42–56 days after sowing (DAS) compared to the treatments of 75% rice husk biochar + 25% mycorrhiza, 75% cow manure + 25% mycorrhiza, or 75% compost + 25% mycorrhiza. This improvement is likely due

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to the synergistic effect of the various ameliorant components and mycorrhiza, providing more complete and balanced nutrition for the plants [17];[18].

Optimal nitrogen content is crucial for stimulating plant growth. The presence of mycorrhiza and well-adapted soil microbes further enhances nutrient availability, including nitrogen, which supports comprehensive plant growth [19].

Nevertheless, the average measurements for plant height and leaf count among the other treatments were fairly consistent, even with varying doses. This aligns with Meriyanto et al., who observed that different fertilizer doses can affect the nutrient content of the growing medium but do not necessarily guarantee a proportional increase in growth [20]. Revilla et al., also emphasized that environmental factors, such as light and temperature, play a critical role in plant growth [21]. Consistent light intensity, for instance, can lead to relatively uniform growth patterns, highlighting the importance of environmental factors beyond fertilizer application.

➢ *Weight of Corn Crops' Wet and Dry Biomass*

Table 3, shows that the 20% ameliorant mixture (F5) treatment produced the greatest plant shoots and roots at 42 and 65 days after sowing (DAS) in comparison to other ameliorant treatments.

Table 3 Average Shoot and Root Biomass Weight of Corn in Wet and Dry Conditions Across Various Ameliorant Formulations per Plant at 42 and 65 Days After Sowing

Ameliorative Treatment	Shoots (g)		Roots (g)	
	42 DAS	65 DAS	42 DAS	65 DAS
Wet Biomass				
F1: 75% CM + 25% M	109.69^{ab}	113.99^{b}	13.58^{ab}	23.80^{a}
F2: 75% C + 25% M	105.30^{bc}	112.09^{b}	12.21^{bc}	21.79^{ab}
F3: 75% O + 25% M	101.14^{cd}	105.31^{bc}	11.69^{bc}	18.22^{b}
F4: 75% HC + 25% M	96.77^{d}	99.01^{c}	10.35^{c}	14.14^{c}
F5: 20% MIX	111.99^{a}	132.49^{a}	16.54^{a}	25.66^{a}
HSD 5%	5.21	9.63	3.14	3.92
Dry Biomass				
F1: 75% CM + 25% M	13.27^{b}	35.70^{b}	5.88^{b}	12.92^{b}
F2: 75% C + 25% M	12.14^{bc}	35.32^{b}	5.46^{bc}	11.06^{c}
F3: 75% O + 25% M	11.33^{cd}	33.24^{c}	5.25^{bc}	10.43^{cd}
F4: 75% HC + 25% M	10.48^{d}	30.67^{d}	4.60^{c}	9.32^{cd}
F5: 20% MIX	15.72^{a}	38.57^{a}	7.63^{a}	14.71^{a}
HSD 5%	1.43	1.91	0.96	1.27

The findings revealed biomass measurements of maize at 42 and 65 days after sowing (DAS) with the 20% ameliorant formulation treatment provided a significant difference compared to other ameliorant treatments (Table 3). The 20% ameliorant mixture treatment, which consisted of 20% cow manure, 20% compost, 20% "subur" organic fertilizer, 20% rice husk biochar, and 20% mycorrhizal inoculant, produced a higher biomass weight compared to the 75 treatment. % rice husk biochar + 25% mycorrhiza, 75% cow manure + 25% mycorrhiza, or 75% compost + 25% mycorrhiza.

The observed differences are likely due to the more complete and balanced nutrient content in the 20% mixed formulation. This mixed ameliorant provides a range of essential nutrients and can improve soil fertility, supporting the optimal growth of plants. Astiko et al., reported that the application of organic ameliorants can increase root dry weight, which aligns with the findings of this study [22]. Furthermore, Astiko et al., demonstrated that organic ameliorants improve soil structure by making it more crumbly and porous, thereby facilitating root development and enhancing nutrient absorption by plants [23].

Gao et al. reported the availability of adequate nutrients during plant growth plays a crucial role in boosting metabolic activity, which, in turn, promotes cell division and increases plant biomass [24]. Therefore, the success of the 20% ameliorant mixture in increasing the biomass of glutinous maize plants is not only related to nutrient availability but also to improvements in soil structure that support root and shoot growth.

➢ *Wet and Dry Stover Weight Per Plot*

Table 4, shows that the 20% ameliorant mixture treatment significantly affected the wet and dry plant stover weight at 65 days after sowing (DAS) compared to other ameliorant treatments.

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Table 4 Average Wet and Dry Stover Weight per Plot (kg) of Corn Crops with Various Ameliorant Formulations at 65 Days After Sowing

Ameliorative Treatment	Wet Stover Weight	Dry Stover Weight
F1: 75% CM + 25% M	3.32[b]	2.25[b]
F2: 75% C + 25% M	3.15[c]	2.10[c]
F3: 75% O + 25% M	2.74[d]	1.93[d]
F4: 75% HC + 25% M	2.51[e]	1.77[e]
F5: 20% MIX	3.51[a]	2.40[a]
HSD 5%	0.12	0.10

The findings indicated that the stover weight biomass of maize plants at 65 DAS with the 20% mixed ameliorant treatment provided a significant difference compared to other ameliorant treatments (Table 4). This treatment, which consisted of 20% cow manure, 20% compost, 20% "subur" organic fertilizer, 20% rice husk biochar, and 20% mycorrhizal inoculant, showed a higher increase in both wet and dry stover weight compared to other treatments.

This difference can be attributed to the role of mycorrhiza in enhancing the availability of nutrients for plants. Mycorrhiza, through its symbiotic relationship with plant roots in expanding the root absorption area by forming mycelium around the roots. Smith and Smith explained that mycorrhiza increases the root absorption area, enabling plants to absorb more nutrients compared to those without this mycorrhiza [25].

Moreover, mycorrhizae contribute to better growth and higher yields [26]. With the inclusion of mycorrhiza in the 20% mixed ameliorant formulation, corn plants gain improved access to nutrients and benefit from better soil conditions, resulting in an overall increase in stover weight.

➢ *Soil Nutrient and Plant Nutrient Absorption*

Table 5 shows that in comparison to other ameliorant treatments, the 20% ameliorant combination treatment had a substantial impact on soil nutrient concentrations. The 20% ameliorant combination treatment raised the total nitrogen (N) and the available phosphorus (P) concentrations to the highest.

Table 5. Average Concentration of Total Nitrogen and Phosphorus Nutrients Available in Various Ameliorant Formulations per Plant at 42 and 65 Days After Sowing

Ameliorative Treatment	N total (g/kg)		P available (mg/kg)	
	42 DAS	65 DAS	42 DAS	65 DAS
F1: 75% CM + 25% M	1.65[b]	1.75[b]	40.11[b]	61.85[b]
F2: 75% C + 25% M	1.15[c]	1.25[c]	35.61[c]	59.43[b]
F3: 75% O + 25% M	1.02[d]	1.18[d]	16.85[d]	35.64[c]
F4: 75% HC + 25% M	0.98[e]	1.02[e]	15.54[e]	20.02[e]
F5: 20% MIX	1.85[a]	1.95[a]	45.65[a]	69.31[a]
HSD 5%	0.03	0.01	0.02	0.02

In Table 6, 20% ameliorant mixture treatment significantly affected nutrient uptake by plants compared to other ameliorant treatments. The 20% mixture treatment significantly enhanced the plants' uptake of phosphate (P) and nitrogen (N).

Table 6 Average Plant Nitrogen and Phosphorus Nutrient Uptake in Various Ameliorant Formulations at 42 Days After Sowing

Ameliorative Treatment	N Uptake (g/kg)	P Absorption (g/kg)
	42 DAS	42 DAS
F1: 75% CM + 25% M	32.26[b]	3.05[b]
F2: 75% C + 25% M	30.28[c]	2.94[c]
F3: 75% O + 25% M	28.65[d]	2.06[d]
F4: 75% HC + 25% M	20.14[e]	1.93[e]
F5: 20% MIX	35.24[a]	3.83[a]
HSD 5%	0.14	0.05

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The highest concentrations of soil and plants of nitrogen (N) and phosphorus (P) in glutinous maize plants were observed with the 20% ameliorant mixture treatment, as detailed in Tables 5 and 6. This treatment comprised 20% cow manure, 20% compost, 20% 'Subur' organic fertilizer, 20% rice husk biochar, and 20% mycorrhizal inoculant. The observed increase in nutrient concentration and N and P uptake is likely due to the interactions between mycorrhiza and its host plant.

Jeffries et al. reported that mycorrhizal fungi enhance not only phosphorus absorption but also nitrogen, zinc (Zn), copper (Cu), and sulfur (S) [27];[28]. This increased nutrient uptake contributes to improved plant growth and higher yields. Additionally, Ortas reported that mycorrhizal application can enhance soil cation exchange capacity (CEC), phosphorus availability, total soil nitrogen, and phosphorus uptake by plants. An increased soil CEC improves nutrient availability and soil structure, which further supports plant growth [29].

➢ *Mycorrhizal Development*

Table 7 shows that 20% ameliorant mixture treatment showed a significant difference relative to other treatments concerning spore counts and root colonization percentage at 42 DAS and 65 DAS. The highest colonization rate was observed in the 20%mixed ameliorant treatment was 2383 spores/100g soil and 86% colonization at 42 DAS and 3344 spores/100g soil and 100% colonization at 65 DAS.

Table 7 Mycorrhiza Development in Various Ameliorant Formulations

Ameliorative Treatment	Number of Spores		Colonization	
	42 DAS	65 DAS	42 DAS	65 DAS
F1: 75% CM + 25% M	2062^{b}	3212^{ab}	80.00^{ab}	83.33^{b}
F2: 75% C + 25% M	1670^{c}	2898^{bc}	73.33^{b}	80.00^{bc}
F3: 75% O + 25% M	1266^{d}	2642^{c}	60.00^{c}	73.33^{cd}
F4: 75% HC + 25% M	1248^{d}	1980^{d}	53.33^{c}	66.66^{d}
F5: 20% MIX	2383^{a}	3344^{a}	86.66^{a}	100.0^{d}
HSD 5%	123.13	430.24	9.09	6.87

The result showed that, in comparison to other ameliorant treatments, Spore counts and root colonization percentages in the 20% mixed ameliorant treatment had notable impacts (Table 7). This treatment, consisting of 20% cow manure, 20% compost, 20% "subur" organic fertilizer, 20% rice husk biochar, and 20% mycorrhiza, showed a higher number of mycorrhizal spores and colonization percentage. This difference is most likely due to functional compatibility between mycorrhizal fungi and their host plants, which favors increased spore numbers and root colonization percentages.

Mycorrhizal colonization involves the formation of external hyphae that expand the root absorption area, allowing the fungi to penetrate nutrient-poor zones around the roots and enhance nutrient uptake from these areas [30]. This process is crucial for increasing nutrient availability, particularly in low-fertility soils such as sandy soils.

Carrenho et al. demonstrated that mycorrhiza tends to thrive in well-aerated soils like sandy soils. This is due to mycorrhiza's ability to adapt to less-than-ideal environmental conditions, thereby improving its performance under stress [31]. Additionally, research by Smith et al., revealed that mycorrhiza enhances nutrient absorption efficiency in environments with limited nutrient availability by increasing the potential for fungal infection and colonization in plants [32].

➢ *Crop Yield*

Table 8, results indicate that the 20% ameliorant mixture treatment significantly influenced increases in yield crop compared to other treatments. The 20% ameliorant mixture yielded the highest response, with 150 g of wet cob weight, 94 g of dry cob weight, 3 kg of wet cob weight per plot, and a cob length of 24 cm.

Table 8 Average Yield Components of Corn Crops with Various Ameliorant Formulations at 65 Days After Sowing

Ameliorative Treatment	WCW	DCW	WCWP	CL
F1: 75% CM + 25% M	138.41^{a}	86.99^{b}	3.84^{a}	23.45^{ab}
F2: 75% C + 25% M	128.35^{ab}	87.30^{b}	3.67^{ab}	22.83^{abc}
F3: 75% O + 25% M	123.84^{abc}	89.21^{b}	3.36^{bc}	22.49^{bc}
F4: 75% HC + 25% M	114.20^{c}	82.24^{c}	3.20^{c}	21.74^{c}
F5: 20% MIX	150.01^{a}	94.60^{a}	3.97^{a}	24.10^{a}
HSD 5%	22.99	4.60	0.34	1.28

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The 20% ameliorant mixture treatment had a significant impact on increased yield crop compared to other soil amendment treatments (Table 8). This treatment consists of 20% cow manure, 20% compost, 20% "subur" organic fertilizer, 20% rice husk biochar, and 20% mycorrhiza, which has been proven to provide the highest results.

This enhancement in yield is probably attributable to the sufficient nutrient levels in the 20% ameliorant mixture treatment, which supports essential plant physiological processes such as photosynthesis and transpiration. Optimal nutrient levels enhance nutrient utilization efficiency, thereby promoting growth and cob formation. Efficient photosynthesis produces photosynthates, which are then transported to the cobs, resulting in increased size and weight of the cobs [33].

Malhotra et al. highlighted the critical role of phosphorus (P) in the development of healthy flowers and fruit. Phosphorus supports ATP and DNA synthesis, which are vital for cell division and the formation of robust organ structures [34]. An increased number of healthy leaves enhances the photosynthesis process, providing sufficient energy for cob growth. More leaves also support cell metabolism and effective cell division, contributing to greater cob diameter and weight [35].

According to Neumann and Römheld, more active and efficient cell division leads to the formation of larger plant organs, including corn cobs [36]. Therefore, the higher nutrient content in the 20% ameliorant mixture treatment facilitates this physiological process, resulting in heavier and longer cobs [37].

IV. CONCLUSION

The results of this research show that the treatment 20% cow manure, 20% compost, 20% "subur" organic fertilizer, 20% rice husk biochar, and 20% mycorrhizal delivers the best for the growth and yield of glutinous maize, absorption nitrogen and phosphorus in plant tissue, and development of mycorrhizal. The application treatment mixture of 20% cow manure, 20% compost, 20% "subur" organic fertilizer, 20% rice husk biochar, and 20% mycorrhizal inoculant, is recommended as the best practice for cultivating glutinous maize.

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REFERENCES

[1]. Suarni. 2013. Development of traditional corn-based food to support food diversification. J. Planting Science and Technology. Food 8:39-47.
[2]. Ministry of Agriculture. 2022. Report from the Ministry of Agriculture of the Republic of Indonesia: Estimated NTB Corn Production in the First Quarter (January – April) of 2018. Collaboration with the Indonesian Ministry of Agriculture.
[3]. El-Hamid, A., R. Azza, F.A.A. Al-Kamar, M.E. Husein. 2013. Impact of some-organic and biofertilizers soil amendments on the fertility status, some soil properties, and productivity of sandy soils. J. Soil Sci. and Agric. Eng. 4:989-1007.
[4]. Yazar A, Ali A. 2017. Water harvesting in dry environments. In: Farooq K, Siddique (eds). Innovations in Dryland Agriculture.Springer, Germany.
[5]. Rachim, D., Arifin, M., 2013. Land Classification in Indonesia. Design Library, Bogor.
[6]. Yuniarti, A., Solihin, E., & Putri, A. T. A. 2020. Application of organic fertilizer and N, P, K on soil pH, available P, P uptake, and black rice yield (*Oryza sativa* L.) on inceptisol. *Cultivation*. 19 (1): 1040-1046.
[7]. Uzoma, K.C., Inoue, M., Andry, H., Fujimaki, H., Zahoor, A., & Nishihara, E. 2011. Effect of cow manure biochar on maize productivity under sandy soil condition. Soil use and management, 27(2), 205-212.
[8]. Walder, F., Niemann, H., Natarajan, M., Lehmann, M.F., Boller, T.,and Wiemken, A.(2012). Mycorrhizal net-works: common goods of plants shared under unequal terms of trade. *Plant Physiol*. 159, 789–797. doi: 10.1104/pp.112. 195727
[9]. Menge, L., Zhang, A., Wang, F., Han, X., Wang, D., and Li, S. 2015. Arbuscular mycorrhizal fungi and rhizobium facilitate nitrogen uptake and transfer in soybean/maize intercropping system. *Front. Plant Sci*. 6:339. two: 10.3389/fpls. 2015.00339
[10]. Gholamhoseini, M., Ghalavand, A., Dolatabadian , A. , Jamshidi , E. , & Khodaei-Joghan , A. 2013 stress. *Agricultural Water Management*, 117, 106-114.
[11]. Sastrahidayat, I. R. 2011. Rekayasa pupuk hayati mikoriza dalam meningkatkan produksi pertanian. Universitas Brawijaya Press.
[12]. Simarmata, T., 2017. Bioameliorant-Based Planting Media Engineering to Increase the Productivity of Potted and Yard Plants (Case Study in Tersana Village and Pabedilan Kulon Village, Pabedilan District, Cirebon Regency). Journal of Community Service, 1(3).

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP006

[13]. Astiko, W., Isnaini, M., TaufikFauzi, M., & Muthahanas, I. 2022. Application of bioamelioran with local raw materials to the yield of some varieties sweet corn. International Journal of Innovative Science and Research Technology, 7(9), 322-329.
[14]. Astiko, W., & Fauzi, M. T. 2016. Nutrient status and mycorrhizal population on various food crops grown following corn inoculated with indigenous mycorrhiza on sandy soil of North Lombok, Indonesia. Journal of Tropical Soils, 20(2), 119-125.
[15]. Astiko W., MT Fauzi, and Sukartono. 2016a. Mycorrhizal population on various cropping systems on sandy soil in dryland area of North Lombok, Indonesia. Journal of Nusantara Bioscience. 8(1): 66-70
[16]. Rahmayuni, E., & Gustia, H. 2023. Effects of Ameliorant on the Growth and Production of Sweet Corn Plants. Indonesian Journal of Agricultural Sciences/Indonesian Journal of Agricultural Sciences, 28(4).
[17]. Harini, D., & Sasli, I. 2021. Response of growth and development of glutinous corn to the application of ameliorant and NPK fertilizer to ultisol soil. Indonesian Journal of Agronomy, 49(1), 29-36.
[18]. Smith, S. E., & Read, D. J. 2010. Mycorrhizal symbiosis. Academic press.
[19]. Fahmi, A., Utami, S. N. H., & Radjagukguk, B. 2010. Effect of nitrogen and phosphorus nutrient interactions on corn plant growth (*Zea mays* L) in regosol and latosol soils. Biology News, 10(3), 297-304.
[20]. Meriyanto, M., Trinawaty, M., & Grahana, L. G. 2021. Application of chicken manure bokashi fertilizer on glutinous corn plants (*Zea mays* ceratina). Journal of Agroecotechnology, 13(1), 74-81.
[21]. Revilla, P., Anibas, C. M., & Tracy, W. F. 2021. Sweet corn research around the world 2015–2020. Agronomy, 11(3), 534.
[22]. Astiko, W., Fauzi, M. T., & Muthahanas, I. 2023. Growth Response and Nutrient Uptake of Glutinous Corn at Doses of Amelioran Plus Mycorrhiza in Sandy Land. In National Seminar on Suboptimal Land (Vol. 11, No. 1, pp. 33-42).
[23]. Astiko, W., Fauzi, M. T., & Muthahanas, I. 2023a. The effect of several doses of biomeliorant on increasing soil fertility and corn growth on suboptimal land. In National Seminar on Suboptimal Land (Vol. 10, No. 1, pp. 78-87).
[24]. Gao, C., El-Sawah, A. M., Ali, D. F. I., Alhaj Hamoud, Y., Shaghaleh, H., & Sheteiwy, M. S. 2020. The integration of bio and organic fertilizers improve plant growth, grain yield, quality and metabolism of hybrid maize (*Zea mays* L.). Agronomy, 10(3), 319.
[25]. Smith, S. E., & Smith, F. A. 2011. Roles of arbuscular mycorrhizas in plant nutrition and growth: new paradigms from cellular to ecosystem scales. Annual review of plant biology, 62(1), 227-250.
[26]. Rillig, M. C., & Mummey, D. L. 2006. Mycorrhizas and soil structure. New phytologist, 171(1), 41-53.
[27]. Smith, S. E., Jakobsen, I., Grønlund, M., & Smith, F. A. 2011. Roles of arbuscular mycorrhizas in plant phosphorus nutrition: interactions between pathways of phosphorus uptake in arbuscular mycorrhizal roots have important implications for understanding and manipulating plant phosphorus acquisition. Plant physiology, 156(3), 1050-1057.
[28]. Jeffries, P., Gianinazzi, S., Perotto, S., Turnau, K., & Barea, J. M. 2003. The contribution of arbuscular mycorrhizal fungi in sustainable maintenance of plant health and soil fertility. Biology and fertility of soils, 37, 1-16.
[29]. Ortas, I. 2012. The effect of mycorrhizal fungal inoculation on plant yield, nutrient uptake and inoculation effectiveness under long-term field conditions. Field crops research, 125, 35-48.
[30]. Bonfante, P., & Genre, A. 2010. Mechanisms underlying beneficial plant–fungus interactions in mycorrhizal symbiosis. Nature communications, 1(1), 48.
[31]. Carrenho, R., Trufem, S. F. B., Bononi, V. L. R., & Silva, E. S. 2007. The effect of different soil properties on arbuscular mycorrhizal colonization of peanuts, sorghum and maize. Acta Botanica Brasilica, 21, 723-730.
[32]. Smith, S. E., Anderson, I. C., & Smith, F. A. 2015. Mycorrhizal associations and phosphorus acquisition: from cells to ecosystems. Annual plant reviews volume 48: Phosphorus metabolism in plants, 48, 409-439.
[33]. Berger, S., Sinha, A. K., & Roitsch, T. 2007. Plant physiology meets phytopathology: plant primary metabolism and plant–pathogen interactions. Journal of experimental botany, 58(15-16), 4019-4026.
[34]. Malhotra, H., Vandana, Sharma, S., & Pandey, R. 2018. Phosphorus nutrition: plant growth in response to deficiency and excess. Plant nutrients and abiotic stress tolerance, 171-190.
[35]. Marschner, H. 2011. Marschner's mineral nutrition of higher plants. Academic press.
[36]. Neumann, G., & Römheld, V. 2012. Rhizosphere chemistry in relation to plant nutrition. In Marschner's mineral nutrition of higher plant (pp. 347-368). Academic Press.
[37]. Jones, C., & Jacobsen, J. 2005. Plant nutrition and soil fertility. Nutrient management module, 2(11), 1-11.