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Growth of Red Chili in Early Generative Stage to Application of Ameliorants and Mycorrhizal Biofertilizer During Shallow Water Table

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Abstract
Indonesia has a lot of swamp land that is still classified as marginal and has not been optimally utilized for its development. One of the efforts that can be made to increase the productivity of Lebak swamp land is by providing amelioran and mikorza biofertilizer. Red chili is a plant that can be cultivated in swampland. The purpose of the study was to determine the growth response and high level of resilience of red chili plants (Capsicum annuum L.) by applying a combination of mycorrhizal and amelioran biofertilizers in shallow groundwater table conditions in the early generative phase. This research was carried out in the Laboratory and Experimental Garden of the Agrotechnology Study Program, Faculty of Plant and Animal Sciences, Bina Insan University, from July to November 2024. The research design applied was a two-factor complete randomized design with the treatment of the first factor of shallow groundwater level condition (S), the second factor of a combination of ameliorant and mycorrhizal biofertilizer (M). The results showed that the treatment of shallow groundwater surface conditions had a significant effect on plant height, stem diameter, number of leaves, root length, and dry weight of chili plants, while the treatment of amelioran and mycorrhizal biofertilizer showed no significant effect on all observation variables. Shallow groundwater table conditions and the combination of ameliorant + mycorrhizal biofertilizer showed that the results of different interactions were very real only at plant height.

Keywords: Ameliorant; Chili Pepper; Mycorrhiza; Shallow Water Table

1. INTRODUCTION

Indonesia has a lot of swamp land that is still classified as marginal and has not been optimally utilized for its development. The area of swamp land in South Sumatra reaches 3.05 million hectares, of which the land area of Rawa Lebak reaches 1.36 million hectares and the tides are 1.69 million hectares, Ogan Komering Ilir and Ogan Ilir Regencies are areas that have the largest swampland typology in South Sumatra (BSIP, 2023).

Lebak swamp land usually has a higher amount of water than other optimal lands. This excess water can have various impacts on plants, such as decreased productivity to plant death. Inundation in the land makes many farmers reluctant to plant in swampy land that is flooded, either because of shallow water inundation or submerged water. In general, vegetable crops are particularly sensitive to shallow water, which can inhibit growth and significantly decrease yields (Meihana et al., 2017). One of the efforts that can be made to increase the productivity of Lebak swamp land is by providing mikoriza biofertilizer.

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Mycorrhizal biofertilizer is a fungus that can symbiosis with plant roots that can be used as an alternative to increase plant growth and productivity in soils that do not have potential, mycorrhizal fungi are able to symbiosis with the root ecosystem which plays a role in increasing plant resistance to pathogen attacks and increasing plant growth (Syafruddin et al., 2016). In addition to the use of mycorrhizal biofertilizer, to increase the productivity of Lebak swamp land is by providing amelioran.

Ameliorant is a soil amendment material that can improve soil conditions and reduce dependence on inorganic fertilizers, some commonly used ameliorants are manure, biochar rice husk, dolomite, and guano. The application of manure and biochar to the soil can improve soil quality and plant productivity (Muharam and Saefudin, 2016). Application of ameliorants can also increase the ability of plants to grow in oxygen-deficient conditions (Meihana et al., 2023). Red chili is one of the plants that is suitable for cultivation in swamps.

Red chili plants are not only cultivated in optimal land conditions, but also on suboptimal land. One of them is on wet suboptimal land, namely swamps. The red chili plant (*Capsicum Annuum* L.) is often used as a food spice by the community. The spicy taste in chili peppers is caused by the capsaicin content contained in chili. Chili peppers also contain vitamins A, B1, C, protein, fat, carbohydrates, calories and calcium (Ahmad et al., 2021).

This study aims to find out whether red chili plants (Capsicum annuum L.) with the application of mycorrhizal and Amelioran biofertilizers have a high level of resistance to shallow water table conditions in the early generative phase, so that later it can be one of the recommended solutions for lebak swamp farmers in the practice of red chili cultivation in shallow water conditions.

This study uses a factorial Complete Random Design (RAL) with 2 factors. The first factor is the condition of shallow groundwater level (S) with 3 treatment levels, while the second factor is a combination of ameliorant and mycorrhizal biofertilizer (M) with 3 treatment levels, so there are 9 treatment combinations. In each treatment, it was repeated 6 (six) times, so that the total number of plants was 54 plants.

2. LITERATURE REVIEW

Based on research conducted by (Siaga et al., 2024), it is known that shallow water levels can accelerate the growth of three varieties of chili peppers, namely in terms of crown length, root length, and number of leaves. However, its growth declined after the recovery process was carried out. The Selling Varieties, F1 Profit, and F1 Rate are varieties that are resistant to shallow water table conditions. These three varieties of chili have great potential to be developed by farmers in the Lebak swamp area as an additional commodity, especially at the beginning of the rainy season.

The results of a study conducted by Siaga et al. (2024), showed that the administration of mycorrhiza at a dose of 10 g/plant and 20 g/plant under conditions of shallow water table stress can increase leaf area growth from day 0 to day 6. After the recovery process, the application of mycorrhiza at a dose of 20 g/plant showed a better increase in leaf area growth compared to a dose of 10 g/plant, which actually experienced stagnation in growth.

The results of the study Meihana et al. (2023), stated that eggplant plants are able to adapt to shallow water table conditions and inundation by forming aerenchyme tissue in root organs and accumulating proline in leaf organs so that eggplants are fruit and vegetable plants that have a fairly high tolerance to water level 3 cm below soil surface and inundation.

3. METHODS

Materials and Tools

The materials used are polybags measuring 35 cm x 35 cm, MZ2000 mycorrhizal biofertilizer, top soil, amelioran (rice husk biochar and goat manure), Laju F1 variety chili seeds, Bayfolan leaf fertilizer, NPK Mutiara fertilizer (16:16:16), infarm liquid organic fertilizer, furadan insecticide, Coco Peat and Vermi Compost. The tools used are tubs/containers, seedling trays, calipers, meters, digital cameras, digital scales, and ovens.

Place and Time

This research was carried out in the laboratory and experimental garden of the Agrotechnology Study Program, Faculty of Plant and Animal Sciences, Bina Insan Lubuklinggau University. This research was carried out from July to November 2024.

4. RESEARCH METHODS

This study uses a Factorial Complete Random Design (RAL) with 2 factors. The design of the method to be used in this study is a factorial Complete Random Design (RAL) with 2 factors. The first factor is the condition of shallow water level (S) with 3 levels of treatment: S0 : Field capacity S1 : Low shallow water level (10-15 cm below ground level) S2 : High shallow water level (5 cm below ground level), while the second factor is a combination of ameliorant and mycorrhizal biofertilizer (M) with 3 levels of treatment: M0 : Top soil + Ameliorant (Goat manure 200 g/plant + rice husk biochar 80 g/plant) M1 : Top soil + Ameliorant (Goat manure 200 g/plant + rice husk biochar 80 g) + Mycorrhiza 10 g/plant M2 : Top soil + Ameliorant (Goat manure 200 g + rice husk biochar 80 g) +

Mycorrhiza 15 g/plant. So there are 9 combinations of treatments. In each treatment, it was repeated 6 (six) times, so that the total number of plants was 54 plants.

Data Analysis

The data was analyzed by analyzing the Analysis of Variance (ANOVA) using the Statistical Analysis System (SAS) program, then further tests were carried out using the honest real difference test (BNJ) at the level of 5% if the results showed real differences or very real differences.

5. RESULTS

Analysis of Variance (ANOVA) Plant Height, Stem Diameter, Number of Leaves and Root Length of Chili Plants

Based on the results of the research that has been carried out, the results of diversity analysis were obtained which showed that the treatment of shallow water table conditions had a real effect on plant height, stem diameter, number of leaves and root length while the application of a combination of ameliorant and mycorrhizal biofertilizer had no real effect on all observation variables. Shallow water table conditions and the application of amelioran and mycorrhizal biofertilizer showed that the interaction results only had a real effect on plant height (Table 1).

Table 1. Fingerprint recapitulation of ANOVA
variety crop height, stem diameter, number of leaves and root length of chili plants

Variable Observati on	Shallow Water Condition (S)	Mycorrhiza + Amelioran Biofertilizers (M)	S X M	KK (%)
Plant Height	221,457**	21,723tn	76,226**	8,507
Rod Diameter	3,152**	0,007tn	0,195tn	7,049
Number of Leaves	5944,148**	538,814tn	418,703tn	29,953
Root Length	472,060**	8,927tn	24,712tn	26,121

Description:

** = very real difference (P<0.01), tn = unreal difference, KK = diversity coefficient

BNJ Follow-up Test (@= 0.05) on Plant Yield Height

The results showed that the plant height from the highest to the lowest in the treatment of shallow water surface conditions was found in S0, S1 and S2, while the yield of plant height from the highest to the lowest in the treatment of the application of a combination of ameliorant and mycorrhizal biofertilizer was found in M0, M1 and M2. The height of S0-treated plants showed a non-significant difference in results with S1, but significantly different from S2, while the height of M0-treated plants was not significantly different from M1 and M2. The interaction of shallow water table conditions treatment and the application of combination and ameliorant and mycorrhizal biofertilizer showed insignificant results at plant height (Table 2).

Table 2. Height of chili plants in shallow water table conditions for the application of a combination of ameliorant and mycorrhizal biofertilizer

Treatment	Plant Height (cm)			Average
	S0	S1	S2	
M0	46,40	38,43	41,57	44,23 a
M1	42,63	47,57	33,40	42,13 a
M2	48,80	48,37	35,53	41,20 a
Average	45,94 a	44,78 a	36,83 b	(-)

Description: Numbers followed by the same letter indicate an unreal difference based on the BNJ honest real difference test (α= 0.05), the sign (-) indicates the absence of interaction between treatment combinations. S0 = field capacity, S1 = low shallow water level, S2 = high shallow water level M0 = ameliorant (goat manure 200 g/plant + rice husk biochar 80 g/plant), M1 = ameliorant + mycorrhizal biofertilizer 10 g/plant, and M2 = ameliorant + mycorrhizal biofertilizer 15 g/plant.

BNJ Advanced Test (@= 0.05) on Stem Diameter

The results showed that the number of leaves from the highest to the lowest in the treatment of shallow water conditions was found in S0, S1 and S2, while the results of the number of leaves from the highest to the lowest in the treatment of the application of a combination of ameliorant and mycorrhizal biofertilizer were found in M0, M1 and M2. The number of leaves treated with S0 showed results that were not significantly different from S1, but significantly different from S2, while the number of leaves treated with M0, M1 and M2 was not significantly different. The interaction of shallow water table conditions treatment and the application of a combination of ameliorant and mycorrhizal biofertilizer showed unnoticeable results in the number of leaves (Table 3).

Table 3. Diameter of chili plant stems in shallow water table conditions for the application of a combination of ameliorant and mycorrhizal biofertilizer

Treatment	Stem Diameter (mm)			Average
	S0	S1	S2	
M0	6,17	6,27	5,60	6,01 a
M1	6,50	6,33	5,03	5,97 a
M2	6,17	6,50	5,27	5,95 a
Average	6,36 a	6,27 a	5,30 b	(-)

Description: Numbers followed by the same letter indicate an unreal difference based on the BNJ honest real difference test (α= 0.05), the sign (-) indicates the absence of interaction between treatment combinations. S0 = field capacity, S1 = low shallow water level, S2 = high shallow water level M0 = ameliorant (goat manure 200 g/plant + rice husk biochar 80 g/plant), M1 = ameliorant + mycorrhizal biofertilizer 10 g/plant, and M2 = ameliorant + mycorrhizal biofertilizer 15 g/plant.

BNJ Follow-up Test (@= 0.05) on Leaf Count

The results showed that the number of leaves from the highest to the lowest in the treatment of shallow water conditions was in S0, S1, S2 and S3, while the results of the number of leaves from the highest to the lowest in the treatment of the application of a combination of ameliorant and mycorrhizal biofertilizer were found in M0, M1 and M2. The number of leaves treated with S2 showed a significant difference with S0 and S1, while the number of leaves treated with M2 was significantly different from M0 and M1. The interaction of shallow water table conditions treatment and the application of a combination of ameliorant and mycorrhizal biofertilizer showed unnoticeable results in the number of leaves (Table 4).

Table 4. Number of leaves of chili plants in shallow water table conditions for the application of a combination of ameliorant and mycorrhizal biofertilizer

Treatment	Number of Leaves (sheet)			Average
	S0	S1	S2	
M0	76,00	53,70	37,30	70,77 a
M1	77,30	86,30	34,70	66,11 a
M2	93,70	86,30	32,30	55,66 a
Average	82,33 a	75,44 a	34,77 b	(-)

Description: Numbers followed by the same letter indicate an unreal difference based on the BNJ honest real difference test (α= 0.05), the sign (-) indicates the absence of interaction between treatment combinations. S0 = field capacity, S1 = low shallow water level, S2 = high shallow water level M0 = ameliorant (goat manure 200 g/plant + rice husk biochar 80 g/plant), M1 = ameliorant + mycorrhizal biofertilizer 10 g/plant, and M2 = ameliorant + mycorrhizal biofertilizer 15 g/plant.

BNJ Advanced Test (@= 0.05) Root Length

The results showed that the root length from the highest to the lowest in the treatment of shallow water surface conditions was found in S0, S1 and S2, while the results of root length from the highest to the lowest in the treatment of the application of a combination of ameliorant and mycorrhizal biofertilizer were found in M0, M1 and M2.

Table 5. Root length of chili plants in shallow water table conditions for the application of a combination of ameliorant and mycorrhizal biofertilizer

Treatment	Root Length (cm)			Average
	S0	S1	S2	
M0	30,57	30,17	21,37	28,26 a
M1	30,57	29,67	18,60	27,36 a
M2	37,30	30,17	17,33	26,27 a
Average	32,81 a	30,00 a	19,10 b	(-)

Description: Numbers followed by the same letter indicate an unreal difference based on the BNJ honest real difference test (α= 0.05), the sign (-) indicates the absence of interaction between treatment combinations. S0 = field capacity, S1 = low shallow water level, S2 = high shallow water level M0 = ameliorant (goat manure 200 g/plant + rice husk biochar 80 g/plant), M1 = ameliorant + mycorrhizal biofertilizer 10 g/plant, and M2 = ameliorant + mycorrhizal biofertilizer 15 g/plant.

The root length of S0 treatment showed that the results were not significantly different from S1, but significantly different from S2, while the root length of M1 and M2 treatment was not significantly different from M0 (without mycorrhizal biofertilizer). The interaction of shallow water table conditions treatment and the application of a combination of ameliorant and mycorrhizal biofertilizer showed insignificant results on root length (Table 5).

Analysis of Variance (ANOVA) Dry Weight Biomass of Roots, Stems, Leaves and Flowers of Chili Plants

Based on the results of the research that has been carried out, the results of diversity analysis were obtained which showed that the treatment of shallow water surface conditions had a real effect on the dry weight yield of roots, stems, leaves, flowers and total dry weight while the treatment of the application of a combination of ameliorant and mycorrhizal biofertilizer had no real effect on all observation variables. Shallow water table conditions and application of ameliorant and mycorrhizal biofertilizer showed results of insignificant different interactions on all observed growth variables of chili plants (Table 6).

Table 6. Recapitulation of ANOVA
variety dry weight results of roots, stems, leaves, and flowers of chili plants

Variable Observation	Shallow Water Condition (S)	Mycorrhizal + Amelioran Biofertilizers (M)	S X M	KK (%)
Root	5,116**	0,733tn	0,567tn	37,932
Stem	79,437**	9,100tn	3,289tn	50,548
Leaves	52,637**	1,037tn	1,031tn	46,150
Flower	0,687**	0,195tn	0,053tn	90,149
Total	369,131**	27,639tn	11,102tn	42,668

Description:

** = very real difference (P<0.01), tn = unreal difference, KK = diversity coefficient

BNJ Advanced Test (@= 0.05) Root Dry Weight

The results showed that the dry weight of roots from the highest to the lowest in the treatment of shallow water surface conditions was found in S0, S1 and S2, while the dry weight of roots from the highest to the lowest in the treatment of the application of a combination of ameliorant and mycorrhizal biofertilizer was found in M1, M2 and M3. The dry weight of the roots of the S0 treatment showed that the results were not significantly different from S1, but were significantly different from S2, while the dry weight of the roots of the M0 treatment was not significantly different from that of M1 and M2. The interaction of shallow water table conditions treatment and the application of a combination of ameliorant and mycorrhizal biofertilizer showed insignificant results on the dry weight of the roots (Table 7).

Table 7. Dry weight of chili plant roots in shallow water table conditions for the application of a combination of ameliorant and mycorrhizal biofertilizer

Treatment	Dry Weight Roots (g)			Average
	S0	S1	S2	
M0	1,34	1,50	0,74	1,76 a
M1	2,25	1,24	0,58	1,35 a
M2	2,62	2,15	0,53	1,21 a
Average	2,08 a	1,62 a	0,61 b	(-)

Description: Numbers followed by the same letter indicate an unreal difference based on the BNJ honest real difference test (α= 0.05), the sign (-) indicates the absence of interaction between treatment combinations. S0 = field capacity, S1 = low shallow water level, S2 = high shallow water level M0 = ameliorant (goat manure 200 g/plant + rice husk biochar 80 g/plant), M1 = ameliorant + mycorrhizal biofertilizer 10 g/plant, and M2 = ameliorant + mycorrhizal biofertilizer 15 g/plant.

BNJ Advanced Test (@= 0.05) Dry Weight of Stem

The results showed that the dry weight of roots from the highest to the lowest in the treatment of shallow water surface conditions was found in S0, S1 and S2, while the dry weight of roots from the highest to the lowest in the treatment of the application of a combination of ameliorant and mycorrhizal biofertilizer was found in M0, M1 and M2.

Table 8. Dry weight of chili plant stems in shallow water table conditions for the application of a combination of ameliorant and mycorrhizal biofertilizer

Treatment	Dry Weight Stem (g)			Average
	S0	S1	S2	
M0	5,16	5,46	1,38	5,96 a
M1	6,59	5,73	1,45	4,58 a
M2	9,38	6,92	1,58	4,00 a
Average	7,04 a	6,03 a	1,46 b	(-)

Description: Numbers followed by the same letter indicate an unreal difference based on the BNJ honest real difference test (α= 0.05), the sign (-) indicates the absence of interaction between treatment combinations. S0 = field capacity, S1 = low shallow water level, S2 = high shallow water level M0 = ameliorant (goat manure 200 g/plant + rice husk biochar 80 g/plant), M1 = ameliorant + mycorrhizal biofertilizer 10 g/plant, and M2 = ameliorant + mycorrhizal biofertilizer 15 g/plant.

The dry weight of the roots of the S0 treatment showed that the results were not significantly different from S1, but were significantly different from S2, while the dry weight of the roots of the M0 treatment was not significantly different from that of M1 and M2. The interaction of shallow water table conditions treatment and the application of a combination of ameliorant and mycorrhizal biofertilizer showed unnoticeable results on the dry weight of the roots (Table 8).

BNJ Advanced Test (@= 0.05) Leaf Dry Weight

The results showed that the dry weight of leaves from the highest to the lowest in the treatment of shallow water conditions was found in S0, S1 and S2, while the dry weight of leaves from the highest to the lowest in the treatment of the application of a combination of ameliorant and mycorrhizal biofertilizer was found in M0, M1 and M2.

Table 9. Dry weight of chili plant leaves in shallow water table conditions for the application of a combination of ameliorant and mycorrhizal biofertilizer

Treatment	Leaf Dry Weight (g)			Average
	S0	S1	S2	
M0	4,36	4,17	0,78	3,77 a
M1	5,92	3,70	4,17	3,38 a
M2	5,78	4,75	3,70	3,10 a
Average	5,35 a	4,20 a	0,70 b	(-)

Description: Numbers followed by the same letter indicate an unreal difference based on the BNJ honest real difference test (α= 0.05), the sign (-) indicates the absence of interaction between treatment combinations. S0 = field capacity, S1 = low shallow water level, S2 = high shallow water level M0 = ameliorant (goat manure 200 g/plant + rice husk biochar 80 g/plant), M1 = ameliorant + mycorrhizal biofertilizer 10 g/plant, and M2 = ameliorant + mycorrhizal biofertilizer 15 g/plant.

BNJ Advanced Test (@= 0.05) Flower Dry Weight

The results showed that the dry weight of leaves from the highest to the lowest in the treatment of shallow water conditions was found in S0, S1 and S2, while the dry weight of leaves from the highest to the lowest in the treatment of the application of a combination of ameliorant and mycorrhizal biofertilizer was found in M0, M1 and M2.

Table 10. Dry weight of chili plant leaves in shallow water table conditions for the application of a combination of ameliorant and mycorrhizal biofertilizer

Treatment	Dried Flower Weight (g)			Average
	S0	S1	S2	
M0	0,39	0,43	0,00	0,48 a
M1	0,33	0,26	0,00	0,27 a
M2	0,68	0,77	0,00	0,19 a
Average	0,48 a	0,46 a	0,00 b	(-)

Description: Numbers followed by the same letter indicate an unreal difference based on the BNJ honest real difference test (α= 0.05), the sign (-) indicates the absence of interaction between treatment combinations. S0 = field capacity, S1 = low shallow water level, S2 = high shallow water level M0 = ameliorant (goat manure 200 g/plant + rice husk biochar 80 g/plant), M1 = ameliorant + mycorrhizal biofertilizer 10 g/plant, and M2 = ameliorant + mycorrhizal biofertilizer 15 g/plant.

BNJ Advanced Test (@= 0.05) Total Dry Weight

The results showed that the total dry weight from the highest to the lowest in the treatment of shallow water surface conditions was found in S0, S1 and S2, while the total dry weight from the highest to the lowest in the treatment of combination and ameliorant and mycorrhizal biofertilizer were found in M0, M1 and M2.

Table 11. Total dry weight of chili plants in shallow water table conditions for the application of a combination of ameliorant and mycorrhizal biofertilizer

Treatment	Total Dry Weight (g)			Average
	S0	S1	S2	
M0	11,32	11,56	2,90	11,98 a
M1	15,09	10,93	2,57	9,53 a
M2	18,45	14,59	2,91	8,59 a
Average	14,95 a	12,35 a	2,79 b	(-)

Description: Numbers followed by the same letter indicate an unreal difference based on the BNJ honest real difference test (α= 0.05), the sign (-) indicates the absence of interaction between treatment combinations. S0 = field capacity, S1 = low shallow water level, S2 = high shallow water level M0 = ameliorant (goat manure 200 g/plant + rice husk biochar 80 g/plant), M1 = ameliorant + mycorrhizal biofertilizer 10 g/plant, and M2 = ameliorant + mycorrhizal biofertilizer 15 g/plant.

The total dry weight of the S2 treatment showed a markedly different result with S0 and S1, while the total dry weight of the M1 treatment was not significantly different from M2 but was markedly different from M0. The interaction of shallow water table treatment and the application of a combination of ameliorant and mycorrhizal biofertilizer showed unnoticeable results on total dry weight (Table 11).

6. DISCUSSION

The inundation treatment conditions showed that the treatment of field capacity and low shallow water level had a high tolerance level at plant height. This is the same as the statement of Pujiwati *et al*. (2016) stating that the condition of shallow water table has a significant effect on the variables of plant height, leaf area, and dry weight. The treatment of field capacity shows a normal plant growth process, this is because in the state of field capacity, the moisture and water content that is held in the soil are depleted with a downward movement rate due to gravity, but the water content in the soil is still sufficiently absorbed by plants and used to carry out physiological processes such as cell division, water absorption that runs well is able to increase plant height, This is because the water availability capacity has increased more (Farida, 2015).

The results of the study showed that the treatment of mycorrhizal and ameliorant fertilizers was not significantly different on the height and number of plant leaves. This is inversely proportional to the results of research conducted by Milla *et al*. (2016) that the application of mycorrhizal fertilizer to chili plants can increase plant height and number of leaves compared to plants that are not given mycorrhizal fertilizer. Furthermore, according to Jamilah *et al*. (2017) that the application of mycorrhizal fertilizer can increase plant height, stem diameter, and dry weight of the crown of red chili plants.

The results of the study were similar in the variable of observation of the root length of the pepper plants studied did not show a real effect on mycorrhizal and amelioran treatments. This is inversely proportional to the results of the research by Hadianur *et al*. (2016) stating that the application of mycorrhiza to tomato plants has a real effect on the length of vegetative roots at the age of 45 HST and the weight of generative roots. According to (Army, 2019), mycorrhizal plants can extend their root system because mycorrhizal enters the plant tissue and penetrates the cortex to form a mycelium which will spur the extension of the root coat, thus making the roots of the plant longer.

The results of the research on the field capacity and low shallow water table provide water conditions that are not significantly different for root growth because plants can more easily access water that is able to retain water well, providing the necessary moisture for root development. The results of the study Siaga *et al*.(2019) showed that the condition of the roots of chili plants that were not completely submerged allowed to still have enough oxygen available in the root area. Meanwhile, in high water level conditions, plant root growth decreases significantly. This is in line with the research of Elmsehli *et al*. (2015) stating that in a situation when the water surface is shallow with a depth of 3 cm below the soil surface, the soil pore space is almost completely filled with water, which causes oxygen transfer to be slow. Root damage occurs due to low oxygen levels in water-saturated conditions which leads to a decrease in plant growth Siaga *et al*. (2023).

The results of the research on the application of ameliorant and mycorrhizal biofertilizer did not affect the root length of chili plants. This is in line with the results of Yusriandi *et al*. (2018) that mycorrhiza develops at a stable moisture content humidity, if the humidity and moisture content are too high or excessive, it will result in aerobic conditions that hinder the development of mycorrhizae, because all mycorrhiza-forming fungi are aerobic obligate (require oxygen).

Excess water affects the growth of dry weight biomass of plants in this study, including roots, stems, flowers, leaves and total dry weight. Plant fertility cannot be separated from the fulfillment of plant water needs, where water absorption and the results of the photosynthesis process affect plant biomass (Fauzi, 2020). The treatment of field capacity and low shallow water table showed significantly different results on dry weight of stems, flowers and dry weight of leaves. High shallow water face treatment showed a significant effect on the dry weight of roots, leaves, flowers and stem dry weight. According to Liu (2014), the flooded condition results in root damage, decreased absorption of water and nutrients, decreased stomata conductance, CO2 fixation.

The application of amelioran + mycorrhizal biofertilizer showed an insignificant different effect which meant that there was no effect of the treatment on the dry weight biomass of the observed chili plants. This is proportional to research according to Wirawan *et al*. (2015) mycorrhizal fertilizer can increase plant adaptation to biotic and abiotic stresses and increase the solubility and availability of nutrients, especially phosphorus needed by plants, the dry weight of the crown is closely related to plant vegetative growth, in addition to phosphate, nitrogen nutrients are also needed to increase the dry weight of plants.

7. CONCLUSION

Based on the results of the research that has been carried out, it can be concluded that shallow water table conditions provide a real growth response with a significant effect on plant yield, stem diameter, number of leaves, root length, and dry weight of chili plants, while the combination treatment of amelioran + mycorrhizal biofertilizer provides a growth response with no real effect on all observed variables of chili plants. The condition of shallow water table and the combination of mycorrhizal and amelioran biofertilizers showed that the interaction results only had a real effect on the height of chili plants. The application of mycorrhizal and amelioran biological fertilizers did not have a significant effect on the growth of chili plants with high shallow water table conditions.

REFERENCES

Army, D.S., Jeka, W. (2019). Respon Kandungan Logam Berat Dan Pertumbuhan Tanaman Sawi (Brassica juncea) Terhadap Kombinasi Media Tanam Lumpur Lapindo Dan Mikoriza. Jurnal Ilmiah Ilmu-Ilmu Pertanian, 13(2), 16-25.

Ahmad, N.I., Bunga, Y.N., Bare, Y. (2021). Ethnobotany of Curly Red Chili Plants (Capsicum annum L.) in Waiwuring Village, Witihama District, East Flores Regency. Spizaetus: Journal of Biology and Biology Education, 2(2), 8-17

Arsyad, D.M., Saidi, B., Enrizal. (2014). Development of Agricultural Innovation in Tidal Swamp Land Supports Food Sovereignty. In Journal of Agricultural Innovation Development, 7(4), 169-176.

Badan Standardisasi Instrumen Pertanian (BSIP). (2023). Optimasi Lahan Rawa. https://sumsel.bsip.pertanian.go.id/berita/optimasi-lahan-rawa-menteri-pertanian-kunjungi-kaboki-dan-kaboi

Elmsehli, S., Jemail, J., Smiti-Achi, S. (2015). Physiological response of Medicago truncatula growth under prolonged hypoxia pressure. African Journal of Agricultural Research, 10(31)

Farida, N.S., Suedy, S.W.A., Hastuti, E.D. (2015). Field Capacity and Growth of Curly Red Pepper (Capsicum annum L.) on different types and soil improvers. Academic Journal of Biology, 4(1), 36-44.

Fauzi, M. (2020). Growth Response of Cayenne Pepper (Capsicum frutescens L.) Towards the provision of water in the saturation-field capacity cycle (Doctoral dissertation, Hasanuddin University).

Hadianur, H., Syafruddin, S., Kesumawati, E. (2016). Effect of arbuscular mycorrhizal fungi on the growth and yield of tomato plants (Lycopersicum esculentum Mill). Journal of Agrista, 20(3), 126-134.

Jamilah, M., Purnomowati, P., Dwiputranto, U. (2017). Growth of red chili pepper (Capsicum annuum L.) on acidic soil inoculated with mycorrhizal vesicles arbuscula (MVA) Mixed and Phosphate Fertilizer. Scientific Journal of Biosphere Biology: A Scientific Journal, 33(1), 37-45.

Liu, Z., Cheng, R., Xiao, W., Guo, Q., Wang, N. (2014). Effect of off-season flooding on growth, photosynthesis, carbohydrate partitioning, and nutrient uptake in Distylium chinense. PloS one, 9(9), e107636.

Meihana, M., Lakitan, B., Harun, M.U., Susilawati, S.E., Widuri, L.I., and Kartika, K. (2023). Proline accumulation and growth of bean leaf (Phaseolus vulgaris L.) with biochar application in the shallow water table environment. Journal of Tropical Crop Science, 10(1), 46-56.

Meihana, M., Lakitan, B., Harun, M.U., Widuri, L.I., Kartika, K., Siaga, E., Kriswantoro, H. (2017). Steady shallow water table did not decrease leaf expansion rate, specific leaf weight, and specific leaf water content in tomato plants. Australian Journal of Crop Science, 11(12), 1635-1641.

Meihana, M., Siaga, E., Lakitan, B. (2023). Morphophysiological Changes of Eggplant Plants in Shallow and Stagnant Water Table Conditions in the Generative Phase. Indonesian Journal of Agricultural Sciences, 28(2), 235-243.

Milla, Y.N., Widnyana, I.K., Pandawani, N.P. (2016). Effect of mycorrhizal fertilizer application time on the growth and yield of pepper plants (Capsicum annum var grossum L.). Agrimeta, 6(12), 89866.

Muharam, M.A., Saefudin, A. (2016). Effect of Various Soil Amendments on the Growth and Population of Paddy Rice Plants (Oryza sativa L.) Dendang Varieties in the Land of Rice Fields are not new. Indonesian Journal of Agrotech, 1(2), 141-150.

Pujiwati, H., Aziz, S.A., Ghulamahdi, M., Yahya, S., Haridjaja, O. (2016). The productivity of three soybean genotypes with different water and water level depth at various soil conditions at tides. Indonesian Journal of Agronomy, 44(3), 248-254.

Siaga, E., Meihana, M., Lumbantoruan, S.M. (2024). Growth Response of Red Pepper Plant (Capsicum annuum L.) to Mycorrhizal Fertilizer Application in Shallow Water Table Conditions in the Early Vegetative Phase. Journal of Agrotechnology and Agriculture (JURAGAN), 5(2), 42-50.

Siaga, E., Meihana, M., Utami, F.H., Lumbantoruan, S.M. (2024). Morpho-agronomy of Three Varieties of Red Pepper (Capsicum annuum L.) in Shallow Water Table Stress Conditions at the Early Vegetative Phase. Journal of Applied Agricultural Research, 24(3), 355-365.

Siaga, E., Sakagami, J.I., Lakitan, B., Yabuta, S., Hasbi, H., Bernas, S.M., Widuri, L.I. (2019). Morpho-physiological responses of chili peppers ('Capsicum annuum') to short-term exposure of water-saturated rhizosphere. Australian Journal of Crop Science, 13(11), 1865-1872.

Siaga, E., Sakagami, J.I., Lakitan, B., Yabuta, S., Kartika, K., Widuri, L.I. (2023, January). Responses of roots and leaves in nine varieties of chili pepper (Capsicum annuum L.) to water saturated rhizosphere. In AIP Conference Proceedings 2583(1). AIP Publishing.

Syafruddin, S., Hadianur, H., Kesumawati, E. (2016). Effect of arbuscular mycorrhizal fungi on the growth and yield of tomato plants (Lycopersicum esculentum Mill). Journal of Agrista, 20(3), 126-134.

Wirawan, I.W.E.A., Suada, I. K., Susrama, I.G.K. (2015). Identification of arbuscular vesicular mycorrhiza (MVA) from the rhizosphere of chili plants (Capsicum annuum L.) and tomatoes (Solanum lycopersicum L.) and their propagation using zeolite media. E-Journal of Tropical Agroecotechnology, 4(4), 304-313.

Yusriadi, Y., Pata'dungan, Y.S., Hasanah, U. (2018). Kepadatan dan keragaman spora fungi mikoriza arbuskula pada daerah perakaran beberapa tanaman pangan di lahan pertanian Desa Sidera. Agroland: Jurnal Ilmu-ilmu Pertanian, 25(1), 64-73.