

Improving Soil Fertilizer Through Application of Organic Fertilizer Humic Acid and Mikoriza in Supporting Growth and Production of Chilli Plants In Sand Land

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Abstract. Availability of agricultural land has decreased, especially fertile rice fields and potential with technical irrigation caused by the use of land into non-agricultural land. Therefore, it is necessary to expand the area of agriculture by utilizing marginal land such as sand land. The purpose of this study is to get the best treatment combination of organic fertilizer, humic acid and mycorrhiza to support the growth and production of chili on sand land. This research activity was carried out in May to November 2018 in the greenhouse, Plant laboratory of the State Polytechnic of Jember, East Java at an altitude of 90 m above sea level. The research design used in this study was a non factorial complete randomized block design with twelve treatment combinations of doses from organic fertilizer, humic acid and mycorrhizae with three replications. Data from observations were analyzed by variance analysis with SAS version 9.0 software. If there is a real effect from treatment, the results are further tested using Duncan multiple range test at the level of 5%. The experimental results show that application of combination of organic fertilizer + humic acid + mycorrhizae can increase plant growth at 14 days to 35 days after planting. The best growth results of the best plants were found in organic fertilizer at a dose of 20 tons / ha + humic acid with a concentration of 200 ppm + mycorrhizae with a dose of 30 g/plant.

1. Introduction

Land is one of the basic needs in agricultural cultivation. The availability of agricultural land at this time has decreased, especially fertile rice fields with technical irrigation systems caused by changes in land use to non-agricultural land. According Istiyanti [1] in the period 1991 to 2020 is estimated at about 680,000 hectares of agricultural land in Java will be transformed into non-agricultural land. Therefore, it is necessary to expand the area of agriculture by utilizing marginal land. One land that has potential is sand land near the beach with almost 95% sand content. The main constraint of cultivation in sandy land is that it is very easy to drain water with loose structures, poor in nutrients and has strong wind conditions, with a high rate of evaporation that contains lots of salt. The advantage is that the amount of land is wide, flat, close to ecotourism, rarely floods with shallow water surface, and abundant sunlight [2]. According to Istiyanti *et al.* [1]; Sutardi and Wirasti [3] that the



introduction of technology packages for cultivation in sand land is technically easy to implement, economically profitable and socially culturally easy to be accepted by farmers.

The use of sand land for cultivation has been carried out, including for onion cultivation [2], [4], corn [5], sesame [6], and watermelon [7]. Increasing soil fertility in sandy land is a major aspect that must be immediately improved to optimize agricultural production. These improvements include through application of organic fertilizer, humic acid and mycorrhizae. Application of organic matter will improve soil fertility, both physical and chemical. Application of organic matter also provides a source of energy for soil microorganisms so that the population of microorganisms increases.

The results of research by Purwaningsih *et al.* [7] and Nurhayati *et al.* [8] reported that the application of cow manure at a dose of 10 tons / ha can increase the yield of sesame crops on sand land in Purworejo. Application of organic fertilizer also needs to be supplemented with the addition of humic acid. Humic acid is the active ingredient from the extraction of organic matter that has passed the humification process and its function as a growth stimulating agent for plants [9]. The application of humic acid has been able to increase the growth and yield of some plants, including spinach [10]; corn, rice [9], and tomatoes [11]. Arbuscular Mycorrhizal Fungi (AMF) is one of the fungi groups that play a role in improving soil quality [12]. Mycorrhizal fungi live in the rhizosphere by forming a symbiotic mutualism relationship through intensive hyphae production [13] so as to increase host plant resistance to drought conditions [14], increasing the ability of plants to absorb nutrients including elements P [15], [16], [17], and increased resistance to plant diseases [18]. One of the horticultural plants that has great prospects to be developed and cultivated in the sandy land of Puger Sub-district is the Chili Plant. This plant is one of the plants that has broad adaptability that can be planted in the lowlands to the highlands and can grow and produce in the rainy and dry season [19]. Chili plants also have a short life and have high economic value with good market opportunities so that attention to chili commodities becomes very important [19]. The consumption of chili every year is always increasing, therefore high chili production is needed. Through the application of amelioration technology on sandy land in the form of organic matter, humic acid and mycorrhizae will be able to increase land productivity so that it will be able to improve the economy of the community in Puger sub-district based on recommendations from the results of the research.

2. Methods

This research activity was carried out from May to November 2018 in a greenhouse from the plant laboratory, Jember State Polytechnic, East Java. The tools used in this study were rulers, shovel runners, scissors, colling boxes, calipers, stationery, sprayers, cameras, hoes, buckets, analytic scales and knives. The research materials used were chili seeds, organic fertilizer, urea, SP36 and KCL, mycorrhizal, humic acid, pesticides, raffia, bamboo and black silver plastic. The design used in this study was a complete randomized block design with twelve dose treatment combinations of organic fertilizer, humic acid and mycorrhizae with three replications. The treatment combination i.e.:

The experimental observation variable from chili growth refers to research conducted by Hapsoh *et al.* [20], Ernawati *et al.* [21], and Zakia *et al.* [22]. Observation variables include plant height measured starting from the base of the stem to the point of growing plants from the soil surface. The plant height variable is measured when the plant has flowered. Observation of the stem diameter is done by measuring the diameter of the plant stem at a position of 5 cm from the surface of the soil by using calipers. Data were analyzed by variance analysis (Anova) with SAS version 9.0 software. If there is a significant effect, then proceed with the Duncan multiple range test (DMRT) at the level of 5%.

Tabel 1. Combination of treatment

No.	Code	Treatment
1	P0 A0 M0	Organic Fertilizer 0 ton / ha + Humic Acid 0 ppm + Mycorrhizae 0 g / plant
2	P0 A0 M1	Organic Fertilizer 0 ton / ha + Humic Acid 0 ppm + Mycorrhizae 30 g / plant
3	P0 A1 M0	Organic Fertilizer 0 ton / ha + Humic Acid 200 ppm + Mycorrhizae 0 g / plant
4	P0 A1 M1	Organic Fertilizer 0 ton / ha + Humic Acid 200 ppm + Mycorrhizae 30 g / plant
5	P1 A0 M0	Organic Fertilizer 10 ton / ha + Humic Acid 0 ppm + Mycorrhizae 0 g / plant
6	P1 A0 M1	Organic Fertilizer 10 ton / ha + Humic Acid 0 ppm + Mycorrhizae 30 g / plant
7	P1 A1 M0	Organic Fertilizer 10 ton / ha + Humic Acid 200 ppm + Mycorrhizae 0 g / plant
8	P1 A1 M1	Organic Fertilizer 10 ton / ha + Humic Acid 200 ppm + Mycorrhizae 30 g / plant
9	P2 A0 M0	Organic Fertilizer 20 ton / ha + Humic Acid 0 ppm + Mycorrhizae 0 g / plant
10	P2 A0 M1	Organic Fertilizer 20 ton / ha + Humic Acid 0 ppm + Mycorrhizae 30 g / plant
11	P2 A1 M0	Organic Fertilizer 20 ton / ha + Humic Acid 200 ppm + Mycorrhizae 0 g / plant
12	P2 A1 M1	Organic Fertilizer 20 ton / ha + Humic Acid 200 ppm + Mycorrhizae 30 g / plant

3. Result and Discussion

Analysis data from the experiment showed that the treatment of the combination of organic fertilizer, humic acid and mycorrhizae significantly affected the variables of plant height at 14, 21, 28 and 35 days after transplanting with the best combination treatment found in organic fertilizer application with a dose of 20 tons / ha + humic acid with a concentration of 200 ppm + mycorrhizae with a dose of 30 g / plant (**Table 2**).

Table 2. Results of variance analysis of experimental data

No.	Variables observed	Treatment
1	Height of plants 7 Dat (cm)	Not significant
2	Height of plants 14 Dat (cm)	significant
3	Height of plants 21 Dat (cm)	Very significant
4	Height of plants 28 Dat (cm)	Very significant
5	Height of plant 35 Day (cm)	significant
6	Height of plant 42 Day (cm)	Not significant
7	Height of plants 49 Day (cm)	Not significant
8	Diameter of stem (cm)	Not significant
9	The time to start flowering (Day)	Not significant

Note:

Day = The Day after transplanting

The use of organic fertilizer on critical land such as coastal sand land is used to improve soil structure which affects the increase of water infiltration into the soil, the ability to bind water increases, and the use of chemical fertilizers is more efficient [5]. application of organic fertilizer, humic acid and mycorrhizae can increase plant height, allegedly due to an increase in soil fertility so that the soil is able to supply nutrients for the needs of plants that were not previously available. Increased nutrients will affect the production of chlorophyll in plants so that they can produce proteins and enzymes. The chlorophyll content will stimulate metabolism in plants so that there is also a process of increasing photosynthesis rate which affects vegetative growth such as plant height. According to Heil [23] and Ferrara and Brunetti [24] and Victolica *et al.* [11] that the administration of humic acid will be able to improve metabolic processes in plants, such as improving the process of

photosynthetic rate of plants due to increased chlorophyll content in leaves. In the experiments conducted by Sarno et al 2015 the application of humic acid at a dose of 150-200 mg / liter was able to increase the growth of tomato plants at a concentration of 150-200 mg L⁻¹. The symbiosis between FMA with high-level plants that occur in the root area and outside the plant roots also causes an improvement in soil structure [25] which is beneficial for plants. In addition to the height of plants aged 14 to 35 after transplanting is a condition where plants occupy the peak of growth in the sigmoid curve, so that the additional intake of nutrients is thought to also affect the high increase in that age.

Variable of stem diameter and flowering start time did not show a significant influence after various treatments were applied. This is presumably because the influence of the combination treatment is still not optimal for plant growth because the initial purpose of the combination is to improve the soil fertility level of the Puger District which is classified as very low. Soil in Puger District based on the results of soil analysis that has been carried out has a soil texture in the form of clay sand, very fast soil drainage, effective depth is very shallow to moderate, salinity is very low, has a low cation exchange capacity (CEC), base saturation (KB) high to very high, pH slightly sour and neutral, C-Organic is very low, total N is very low, P content is moderate. These characteristics are thought to cause the need to add a combination of organic fertilizer, humic acid and mycorrhizae with a higher dose than before so that the effects of the treatment will show better results not only to only add to the high growth of the chili plant.

Table 3. Results of DMRT analysis influence the combination of organic fertilizer, humic acid and mycorrhiza on the growth of chili

No.	Treatment	Variables of Growth								
		HoP 7 Day (cm)	HoP 14 Day (cm)	HoP 21 Day (cm)	HoP 28 Day (cm)	HoP 35 Day (cm)	HoP 42 Day (cm)	HoP 49 Day (cm)	DoS (cm)	TF (Hst)
1	P0 A0 M0	15,38	16,42 c	18,03 cd	22,00 bcd	26,64 ab	30,43	47,28	2,76	46,78
2	P0 A0 M1	13,26	14,54 abc	17,91 cd	21,90 bcd	26,41ab	28,83	43,89	2,51	44,17
3	P0 A1 M0	11,80	13,71 abc	16,73 abc	20,86 abc	26,26 ab	29,70	47,11	2,83	44,83
4	P0 A1 M1	11,18	13,80 abc	17,89 cd	22,76 cd	28,72 abc	30,66	49,72	2,81	44,11
5	P1 A0 M0	9,99	11,98 a	14,28 a	18,77 a	24,54 a	27,70	46,06	2,70	44,22
6	P1 A0 M1	12,31	14,21 abc	16,87 abc	22,13 bcd	28,19 abc	29,07	50,11	2,69	43,33
7	P1 A1 M0	12,08	15,09 bc	18,36 cd	23,02 cde	28,92 abc	29,74	47,67	2,86	41,50
8	P1 A1 M1	11,00	14,57 abc	17,50 bcd	23,34 cde	30,07 bc	30,53	55,17	2,98	42,56
9	P2 A0 M0	10,86	12,89 ab	14,72 ab	19,44 abc	24,44 a	27,81	46,39	2,81	45,33
10	P2 A0 M1	13,46	15,00 abc	17,34 bcd	22,36 bd	27,47 abc	29,73	49,56	2,80	44,00
11	P2 A1 M0	13,63	16,70 c	19,21 cd	24,36 de	30,66 bc	31,56	55,44	2,99	42,78
12	P2 A1 M1	13,81	16,66 c	19,98 d	25,89 e	30,48 c	31,88	57,44	3,03	41,06
	F Hitung P	1,87	2,64*	3,50**	4,20**	2,47*	0,71	2,32	1,95	1,27

Note:

HoP= Height of plant (cm); DoS= Diameter of stem (cm); TF= The time to start flowering; Day= The day after transplanting. The numbers followed by the same letter in the same column are not significantly different in the 5% DMRT and (**) shows very real differences and (*) shows significantly different

4. Conclusion

Application of combination of organic fertilizer + humic acid + mycorrhizae can increase plant growth at 14 days to 35 days after planting. The best growth results of the best plants were found in organic fertilizer at a dose of 20 tons / ha + humic acid with a concentration of 200 ppm + mycorrhizae with a dose of 30 g / plant.

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