Available at : https://ejournal.unib.ac.id/index.php/terrajournal ISSN 2621-0207
DOI : https://doi.org/10.31186/terra.5.1.8-14

TERRA
Journal of Land Restoration

Application of Macro and Micro Fertilizers on Upland Rice Crops Inoculation of Biofertilizers in Bengkulu Coastal Land

Lestari, A[1], Riwandi[2*], Hasanudin[2], Yudhy Harini Bertham[2]

[1]*Agroecotechnology Department, University of Bengkulu*
[2]*Soil Science Department, University of Bengkulu (Corresponding author)*

Corresponding Author : riwandi@unib.ac.id

ABSTRACT

Coastal land located in the lowlands near the coast has a marginal Entisol soil type. Entisols have the following characteristics: loose soil aggregate, sensitive to erosion, and low levels of nutrients, organic matter, water holding capacity, and soil fertility. The nature of this Entisol is less able to produce maximum upland rice production. The technology used to overcome this problem is by applying macro and micro fertilizers to the soil, which is planted with upland rice seeds, inoculated with biological fertilizers so that it is hoped that upland rice production can be maximized. The purpose of this study was to obtain high upland rice production in coastal areas. The research was carried out from June to December 2020 in Beringin Raya Village, Muara Bangkahulu District, Bengkulu City. The research location is located at coordinates S 03˚45'23" E 102˚15'41". The experimental design used was Completely Randomized Block Design (CRBD) with 2 factors, namely types of fertilizers and varieties of upland rice. The first factor consists of no fertilizer; compound micro fertilizer; and fertilizer recommended for upland rice from the Institute for Agricultural Research and Technology). The second factor consists of red upland rice; and white upland rice. The results showed that there was an interaction between the type of fertilizer and upland rice varieties on soil pH (KCl 1:2.5 w/v). the interaction of microfertilizers with white upland rice varieties resulted in the highest soil pH (5.06). The best type of fertilizer is micro-compound fertilizer which produces soil pH (KCl 1:2.5 w/v), P nutrient uptake, the highest root colonization and the highest number of production tillers and the highest grain weight per plant and upland rice yield per plot. The best upland rice variety was the white variety which produced the highest uptake of P nutrients, the number of productive tillers, the weight of grain per plant and the highest yield per plot.

Keywords: entisol, upland rice, biological fertilizer, macro fertilizer, micro fertilizer

INTRODUCTION

Rice (*Oryza sativa* L.) as a staple food for Indonesian people ranks first, therefore rice agriculture, especially upland rice, is very important in supporting food self-sufficiency (Nuraziza *et al*., 2019). Until now, rice production at the national level has not experienced a significant increase (Ulma & Adiredjo, 2018). Meanwhile, the Indonesian population experiences an increase in the number of people each year who demand an increase in rice crop productivity (Meliala *et al*., 2016). Upland rice can be cultivated on dry land and critical land (Supriyanto, 2013). Rice productivity is 46.03 QuintalHa-1 and rice harvested area is 64,406.86 ha^{-1} in Bengkulu Province (BPS 2019). Dry land use for upland rice is low. Upland rice production is lower than lowland rice, because of soil fertility, low water intake, while high attack of upland rice pests (Sukiman *et al*., 2010). Upland rice contains high nutrients such as carbohydrates, fat, fiber, folic acid, magnesium, niacin, phosphorus, protein, vitamins A, B, C, Zn, and B complex (Suardi, 2014). Upland rice cultivation can be an alternative for developing rice productivity on coastal lands with low water availability. Upland rice can be grown on dry land with low water availability. One of the important components in upland rice cultivation is an adaptive superior variety in dry land. Resistance and tolerance to aluminum (Al) poisoning are important characteristics that must be possessed by superior upland rice varieties. Most of the upland rice cultivation areas in Indonesia are classified as areas with a long rainy season with a high level of soil acidity (Hairmansis *et al*., 2016). The limited upland rice varieties in Indonesia that can be cultivated on coastal lands have caused many farmers to still use local varieties with low production levels. The rice breeding program is directed at obtaining superior upland rice varieties that have high yield potential, are resistant to pests and diseases, and are tolerant of various environmental stresses (Nuraziza *et al*., 2019). Upland rice production on dry land is not optimal due to soil fertility, soil organic matter content, soil pH and the availability of very low soil macro/micro nutrients. addition of biofertilizers, Micro and macro fertilizers are an alternative to increase upland rice yields on coastal land. Micronutrients, especially Fe, Zn, are needed by rice plants for vegetative growth (Kaya, 2013). Furthermore, Praba *et al*. (2018) added that the micronutrient Mn plays a role in creating the plant's natural immune system. The provision of microfertilizers is able to meet the needs for the photosynthesis process to run well and more photosynthate is produced so that it can increase the percentage of pithy grain (Alavan *et al*., 2015). Upland rice requires a balanced intake of nutrients, especially for filling rice grains. The nutrients nitrogen (N), phosphorus (P) and potassium (K) are also important in influencing upland rice productivity, because the nutrients N, P, and K are indispensable for the growth and yield of rice plants (Riyani & Purnamawati, 2019). K fertilizer in rice plants can increase the number of grains per panicle, the percentage of pithy grain, and the weight of 1000 grains of grain. The use of potassium fertilizer with the right type and composition is expected to affect growth and increase upland rice production (Norkhalimah *et al*., 2015).

The coastal lands used include Entisol soils, which have loose soil consistency, low soil aggregation levels, are sensitive to erosion and low levels of available nutrients (Utami & Handayani, 2003), organic matter, water holding capacity and low soil fertility (Utami & Handayani, 2003 ; Mayun, 2007). One of the efforts that can be made to increase the productivity of environmentally friendly marginal dry land which has the function of maintaining plant physiological health and nutrient cycles is to utilize potential soil microorganisms such as Arbuscular Mycorrhizal Fungi (AMF). AMF fungi are classified as a very widespread type of mycorrhizal association, which has an important function in agricultural cultivation. The presence of AMF is able to increase the uptake of N, P, K nutrients, water uptake, and plant resistance to drought (Smith & Read, 2008). AMF is also able to protect plants that live on soil contaminated with petroleum, water stress, low pH, and heavy metals (Rizka *et al*., 2013). However, through the right strategy and technology, coastal land can actually be utilized in agricultural cultivation. Several researchers have been able to utilize coastal land for agricultural cultivation, namely soybeans (Bertham *et al*., 2018), chilies (Bertham *et al*., 2016), and shallots (Mayun, 2007).

The formulation of the problem studied is as follows: Coastal land is one of the lands that has great potential to be used in agricultural cultivation, one of which is upland rice that has been inoculated with biological fertilizers. However, upland rice cultivation in coastal areas faces various internal and external obstacles so that the production results obtained are less than optimal. Therefore, it is necessary to make efforts to increase the carrying capacity of coastal land for the growth and yield of upland rice by applying micro and macro fertilizers. The application of micro and macro fertilizers is expected to increase the yield of upland rice in coastal areas.

This study aims to optimize the growth and yield of upland rice plants inoculated with biological fertilizers through the application of micro and macro fertilizers on coastal land.

MATERIALS AND METHODS

The research location is located in Beringin Raya Village, Muara Bangkahulu District, Bengkulu City. The coordinates of the location are at S 03˚ 45' 23" E 102˚15'41". The research time is from June to December 2020. The experimental design used was Completely Randomized Block Design (CRBD) with 2 factors. The first factor is the type of fertilizer consisting of P_1 = No fertilizer; P_2 = compound micro fertilizer, and P_3 = fertilizer based on the recommendation of upland rice from the Center for Agricultural Research and Technology (BPTP 2011), namely Urea 200 kg ha^{-1} or 90 g $plot^{-1}$; SP36 100 kg ha^{-1} or 45 g $plot^{-1}$, KCl 100 kg ha^{-1} or 45 g $plot^{-1}$. The second factor is Bengkulu local upland rice varieties, consisting of V_1 = red upland rice and V_2 = white upland rice). The number of experimental units is 24 plots.

The research stages consisted of 1) Analysis of initial soil samples, 2) Preparation of experimental land, 3) Inoculation of upland rice seeds, 4) Planting of upland rice seeds, 5) Application of fertilizer, 6) Upland rice maintenance, 7) Upland rice harvesting, 8) Observation and measurement of soil and plant variables, 9) Statistical analysis.

Initial soil sample analysis. Soil samples were taken at 5 points in a zigzag (Z-shaped) manner with a soil layer depth of 0-20 cm. Soil samples were taken using a soil drill. Soil samples were collected in plastic buckets, stirred evenly, then 2 kg of soil samples were taken, and packed in plastic bags that had been coded for soil samples. Composite soil samples were brought to the Soil Science Laboratory for analysis of soil properties. The soil properties consist of pH (H_2O 1:2.5 w/v), pH (KCl 1:2.5 w/v), Electrical Conductivity (DHL), Cation Exchange Capacity (CEC), C -organic , N-total, P-available, and K-swapable (K-dd). The analysis method for each soil characteristic was as follows: pH (H_2O 1:2.5 w/v) was determined by using a pH meter and using distilled water with the ratio of soil: distilled water = 1:2.5 weight/volume; pH (KCl 1:2,

The experimental land was cleared of weeds and grass, tilled the soil with a hoe, Experimental plots were made with a size of 1.5 mx 3 m with a distance between plots of 50 cm x distance between experimental replicates of 100 cm.

Before the upland rice seeds were planted, 40% Gum Powder was added, while 2.5 g of AMF fertilizer was added to the planting hole (Bertham 2002). The planting hole is 5 cm deep, made by using tugal wood. Planting distance is 30 cm x 30 cm.

Upland rice seeds of 2 seeds plus 5 grains of Karbufuran were inserted into each planting hole. Basic fertilizer in the form of coffee husk biocompost fertilizer is given 2 weeks before planting. A dose of 10 ton ha^{-1} or 5.4 kg $plot^{-1}$ of biocompost is sprinkled on the soil for each plot, stirring until smooth. Basic inorganic fertilizers and recommended fertilizer treatments were applied at the time of planting. The basic inorganic fertilizer given was 25% of the recommended dose, namely 50 kg ha^{-1} Urea, 25 kg ha^{-1} SP36 and 25 kg ha^{-1} KCl. All experimental units were subjected to basic inorganic fertilization, so the recommended dosage for fertilizer treatment was 125%, namely 250 kg ha^{-1} urea, 125 kg ha^{-1} SP36 and 125 kg ha^{-1} KCl. Half the dose of urea fertilizer was given at planting and the rest when the plants were 1 month after planting. SP36 and KCl fertilizers were applied at the same time at planting (Bertham, 2002). The dose of micro fertilizer used is 75 g ha^{-1} (Trademark Meroke Fitoflex). Microfertilizers were diluted in a ratio between 1 g of microfertilizers and 8 liters of distilled water, so that 75 g ha^{-1} of microfertilizers were diluted to obtain 75 g ha-1 x 8 liters of distilled water/gram = 600 L ha^{-1} of microfertilizers or 270 mL $plot^{-1}$. Microfertilizer solution was sprayed 2 x 135 mL each at the time the plants began to flower and 2 weeks after flowering.

Plant maintenance consists of replanting, weeding weeds, irrigating water, hoarding and control of plant pests and diseases. Crop embroidery is carried out at the age of 2 weeks after planting (WAP) by replacing plants that do not grow with plant seeds that have been prepared at the time of planting. Weeding with a sickle every 2 weeks. Irrigation once a day in the afternoon with well water near the research site. Landfilling is done by loosening the soil near the plant and transferring the soil to the base of the plant stem so that the plant is sturdier. Control of plant pests and diseases by spraying the insecticide Profenofos 500 g L^{-1}, while controlling bird pests by adding netting around the research area and installing silver rope over upland rice plants.

Upland rice harvesting consists of upland rice harvesting vegetative and generative phases. The vegetative phase is carried out at the beginning of the flowering phase (the criteria are 20% of flowering plants). This method of harvesting is by cutting the base of the panicle with scissors and placing it in an envelope. Then the vegetative plant variables were observed. Harvest the generative phase when the upland rice plant reaches 132 days. The signs of the generative phase of upland rice plants are as follows: 85% of rice panicles are golden yellow, flag leaves and 90% of upland rice grains turn yellow and the rice panicles bend, the grain feels hard when pressed by hand, and does not leave marks. How to harvest upland rice in this phase by hoeing the soil near the plant roots, cut and separated between the roots, stems,

Observation and measurement of soil and plant variables. 20% of the 50 upland rice plants per plot = 10 plants (5 samples of vegetative phase plants and 5 samples of generative phase plants). Plant samples from each plot were taken randomly. The soil sample variables were measured as follows: a) Dissolved salt content (mg L^{-1}) = DHL dS m^{-1} x 640 (US Salinity Laboratory Staff. 1954 in Kristiono *et al*., 2013), b) pH (H_2O 1:2,5 b/v) and pH (KCl, 1:2.5 w/v), c) Root colonies (%) by AMF were calculated using the Stanning method (Nusantara *et al*., 2012). Colonized roots (%) = mycorrhizal field of view divided by observed field of view. d) Total soil microorganisms (x 106 CFU g^{-1} using the Plate Count method (Bertham *et al*., 2018).

Plant variables were measured as follows: a) Number of productive tillers, b) Age of flowering, c) Age of harvest, d) Weight of 1000 grains of grain, e) Weight of grain per plant, f) Yield of upland rice plants per plot, g) Elemental uptake phosphorus (P), h) Plant height. The number of productive tillers was counted at the age of 13 weeks. Flowering age was calculated from 20% of the upland rice population that had flowered in each experimental plot, which was measured in days after planting (DAP). Harvest age in days is calculated from the time the rice grains turn yellow, 85% of the upland rice plant population. The weight of 1000 grains of grain is calculated the number of grain seeds up to 1000 seeds and weighed with a balance of 4 decimal places in grams. Grain weight per plant was weighed with a 4 decimal balance. Upland rice yields per plot were weighed by weight of grain per plot with a 4 decimal balance. The uptake of P elements was calculated by the formula: Leaf P content multiplied by the weight of dry stover upland rice plants. Upland rice plant height was measured from the lower stem to the tip of the upland rice flag leaf with a 100 cm cloth meter measuring instrument.

Statistical analysis was performed using analysis of variance at 5%, then further tested with Duncan's Multiple Range Test.

RESULT AND DISCUSSION

Effect of interaction between fertilizer treatment and upland rice varieties on soil pH (KCl 1:2.5 bv)

Fertilizer treatment resulted in a significantly different pH (KCl 1:2.5 w/v), on micro-compound fertilizer (P_1) resulted in a pH (KCl 1:2.5 w/v) of 5.06 (highest) in white upland rice varieties, while the recommended macro fertilizer (P_2) resulted in a pH (KCl 1:2.5 w/v) of 4.93 (the highest) in red upland rice varieties. However, the pH value (KCl 1:2.5 w/v) of the soil was classified as acidic. Organic matter given in the form of biocompost fertilizer for all treatments had little effect on increasing the pH of the soil. Biocompost fertilizer produces OH- which can neutralize H^+ activity. Organic acids derived from biocompost fertilizers bind Al_3^+ and Fe_2^+ in the soil as a source of H+ which can form complex compounds (chelates), so that Al_3^+ and Fe2+ are not hydrolyzed and ultimately do not produce H+ in the soil solution (Siregar *et al*., 2017) .

Table 1. Effect of fertilizer treatment and upland rice varieties on pH (KCl 1: 2.5 w/v)

Fertilizer Treatment	Upland rice varieties	
	V_1	V_2
P_0	4.72 b	4.69 b
	A	A
P_1	4.69 b	5.06 a
	B	A
P_2	4.93 a	4.58 b
	A	B

Note : Numbers followed by the same capital letters in the same row and the same lowercase letters in the same column mean that they are not significantly different in DMRT 5%. P0 = No fertilizer; P1 = compound micro fertilizer; P2 = Macro fertilizer recommended for upland rice. V1 = Red upland rice; V2 = White upland rice

Effect of fertilizer treatment on soil properties, soil microorganisms, and plants

Table 2. Effect of fertilizer treatment on Dissolved Salt Content (KGT), Uptake P, soil microorganisms, and root colonization

Fertilizer Treatment	KGT (mg L^{-1})	P absorption (mg $plant^{-1}$)	s.m.o (x 106 CFU g^{-1})	Root Colonization (%)
P_0	31.37 b	150.94 c	342.53	77.50 b
P_1	35.11 ab	285.59 a	327.11	88.75 a
P_2	39.30 a	241.72 b	298.08	78.75 b

Note: The numbers followed by the same letter in the same column mean that they are not significantly different at the 5% DMRT level, KGT = Dissolved Salt Level, mot = Soil Microorganisms. P0 = No fertilizer; P1 = compound micro fertilizer; P2 = Macro fertilizer recommended for upland rice

Dissolved Salt Level (mgL^{-1})

The treatment of compound macro and micro fertilizers produced salt levels that were not significantly different and higher than the control (P_0). The reason is that the dissolved salt content is the amount of nutrients (cations and/or anions) dissolved in the soil solution from macro and micro fertilizers. Examples are the elements Na, K, Ca, Mg, S, Cl, B, and C. Na salt is an important element in the cation exchange process in the soil along with Ca, Mg and P (Handoyo *et al*., 2018).

P uptake (mg plant^{-1})

The salt content in all fertilizer treatments was low (Balittanah, 2009) so that it did not inhibit the absorption of soil nutrients by upland rice plants. Micro fertilizers resulted in plant P uptake of 285.59 mg plant^{-1} (the highest), because the added microfertilizers played a very important role in increasing P uptake by plants. In accordance with the research results of Arifiyatun *et al*. (2016) who reported that the addition of Zn micronutrients was able to increase the absorption of P nutrients by rice plants fertilized with inorganic NPK fertilizers.

Soil Microorganisms (x 106 CFU g^{-1})

The total microorganism population was not significantly different in all fertilizer treatments. This is because the basic fertilizer of biocompost and

The effect of upland rice varieties on soil properties, soil microorganisms, and upland rice plants

Table 4. Effect of variety on soil salt content, P uptake, soil microorganisms and root colonization

Varieties	KGT (mg L^{-1})	P absorption (mg $plant^{-1}$)	s.m.o (x 106 CFU g^{-1})	Root Colonization (%)
V_1	32.38 b	218.68 b	310.58 a	82.50 a
V_2	38.14 a	233.48 a	334.57 a	80.83 a

Note: Numbers followed by the same letter in the same column mean that they are not significantly different in DMRT 5%, KGT = Dissolved Salt Concentration, mot = Soil microorganisms. V_1 = Red upland rice; V_2 = White upland rice

Dissolved Salt Level and P . Uptake

Dissolved Salt Levels (KGT) and P uptake were significantly different in the treatment of upland rice varieties. KGT in upland rice varieties (V_2) was 38.14 mg L^{-1} and P uptake 233.48 mg $plant^{-1}$ was higher than KGT in red upland rice varieties, V_1 (32.38 mg L^{-1}) and P uptake 218.68 mg $plant^{-1}$.This happened because the number of tillers of white upland rice (V_2) was different from that of red upland rice (V_1).

Soil Microorganisms

The population of soil microorganisms was not significantly different from the treatment of upland rice varieties (red and white varieties).This happens because the coastal land is very poor in organic matter which is a source of energy for microorganisms in the soil.

Root Colonization

Root colonization of upland rice was not significantly different between treatments of red and white upland rice varieties.This happens because the development of microorganisms in coastal areas is very limited due to the low level of organic matter as a source of energy needed.

Plant Height, Flowering Age and Harvest Age

The treatment of upland rice varieties was not significantly different to plant height, flowering age and harvest age. The red variety had a plant height (129.31 cm), the fastest flowering age (101.50 DAP) and the fastest harvest age (175.83 DAP) which were relatively high compared to the white variety. This is due to the different genotype composition of upland rice plants so that they display a variety of different morphologies and physiologies.

Number of productive tillers

The treatment of upland rice varieties significantly affected the number of productive tillers (JAP). The white upland rice variety produced higher JAP (15.15 tillers) than the red variety (12.77 tillers). This is because the type of variety greatly influences the growth of upland rice plants, because each variety has a different genotype composition, thus displaying a variety of different morphologies and physiologies (Rahayu & Harjoso, 2011).

1000 Grain Weight, Grain Weight per Plant and Yield per Plot

The white variety has genetics that are able to adapt so that it shows good generative growth compared to the red variety. This shows that the white variety has a good adaptability to the growing environment so that there are varied responses. Plant growth is not only due to the influence of fertilizers, but varieties are also very influential, because each variety has different genetic, morphological, and physiological properties (Rahayu & Harjoso, 2011). Differences in varieties affect differences in the diversity of plant appearances. Due to differences in plant properties (genetic) or environmental influences. In addition, differences in genetic composition are one of the factors causing the diversity of plant appearances.

Table 5. Effect of upland rice varieties on plant height, flowering age, harvest age, and number of productive tillers

Varieties	ST (cm)	UB (dap)	UP (dap)	JAP ($clump^{-1}$)	B 1000 G ($g\ plot^{-1}$)	BGT ($g\ plant^{-1}$)	HPP ($g\ plot^{-1}$)
V_1	129.31 a	101.50 a	175.83 a	12.77 b	18.53 a	33.39 b	1673.75 b
V_2	124.93 a	97.42 a	174.83 a	15.15 a	20.69 a	35.17 a	1800.95 a

Note: The numbers followed by the same letter in the same column mean that they are not significantly different in DMRT 5%, hst = Days after planting, TT = Plant Height, UB = Flowering Age, UP = Harvest age, B1000G = 1000 weight grain. BGT = Grain Weight per Plant, HPP = Crop Yield per Plot, JAP = Number of Productive Tillers. V_1 = Red upland rice; V_2 = White upland rice

CONCLUSION

There was a significant interaction between fertilizer treatment and upland rice varieties on pH (KCl 1:2.5 w/v) of the soil, whereas microfertilizer application for white varieties resulted in the highest pH (KCl 1:2.5 w/v), i.e. 5.06.

The best fertilizer treatment was micro fertilizer which produced the highest pH (KCl 1:2.5 w/v) (5.11), highest P uptake (285.59 mg $plant^{-1}$), highest root colonization (88.75 %) , the highest number of productive tillers (16.18 tillers $clump^{-1}$), the highest grain weight per plant (35.46 g $plant^{-1}$), and the highest yield per plot (1810.66 g $plot^{-1}$).

The best upland rice variety was Putih which produced the highest P uptake (233.48 mg $plant^{-1}$), the highest number of productive tillers (15.15 tillers $clump^{-1}$), the heaviest grain weight per plant (35.17 g $plant^{-1}$), and the highest yield of upland rice. per tile heaviest (1800.95 g $plot^{-1}$).

From the results of this study it is suggested that further research needs to be carried out using different doses of micro fertilizers, in order to obtain the optimum dose of micro fertilizers in order to increase the yield of upland rice in coastal areas.

References

Alavan, A., Hayati, R. & Hayati, E. (2015). The Effect of fertilization on the growth of several upland rice varieties (*Oryza sativa* L.). *Journal of Floratek*, 10, 61 – 68.

Arifiyatun, L., Maas, A. & Utami, S.N.H. (2016). The Effect of NPK + Zn compound fertilizer doses on growth, production, and Zn uptake in rice fields in Inceptisol, Kebumen. *Tropical Planta Journal of Agro Science*, 4(2), 101-106.

Badan Pusat Statistik. (2019). Bengkulu in Numbers. Central Bureau of Statistics. Bengkulu Province.

Soil Research Institute. (2009). Chemical Analysis of Soil, Plants, Water and Fertilizers. Technical Guide 2nd edition. Center for Research and Development of Agricultural Land Resources. Agricultural Research and Development Center, Bogor.

Agricultural Technology Research Center. (2011). Technical Instructions for Integrated Crop and Resource Management (PTT) for Upland Rice. Center for the Study of Agricultural Technology (BPTP) West Java. West Java.

Bertham, Y. H, Aini, N., Murcitro, B.G. & Nusantara, A.D. (2018). Trial of four soybean varieties in coastal areas based on biocompost. *Journal of Biogenesis*, 6(1), 36-42.

Bertham, Y.H. (2002). Response of Soybean [*Glycine max* (L.) Merill] to phosphorus and straw compost fertilization in Ultisol soil. *Indonesian Journal of Agricultural Sciences*, 4 (2), 78 – 83.

Bertham, Y.H., Nusantara, A.D. & Sukisno. (2016). Socialization and assistance for biological technology packages for chili cultivation in Bengkulu coastal areas. *Journal of Dharma Raflesia UNIB*, 14(2), 156-165.

Bertham, Y.H., Nusantara, A.D., Murcitro, B.G. & Arifin, Z. (2020) . Changes in soil characteristics and appearance of several upland rice varieties in coastal areas with the addition of biological fertilizer and biocompost. *Indonesian Journal of Agricultural Sciences*, 22(2), 79-84.

Hairmansis, A., Yullianida, Supartopo, & Suwarno. (2016). Breeding adaptive upland rice on dry land. *Journal of Food Crops Science and Technology*, 11(1), 95-106.

Handoyo, B., Herlinawati & Soelaksini, L. (2018). Application of Salt (Nacl) to Increase Production of Rice (*Oryza sativa* L.) Situ Bagendit Varieties in Litosol Banyuwangi. *Journal of Agritop*, 16(2), 197-204.

Kaya, E. (2013). Effect of straw compost and NPK fertilizer on N-available soil, N-uptake, growth, and yield of paddy rice (*Oryza sativa* L). *Journal of Agrology*, 2(1), 43-50.

Mayun, I.A (2007). Effects of rice straw mulch and cow manure on onion growth and yield in coastal areas. *Journal of Agritrop*, 26(1), 33–40.

Meliala, J.H S., Basuki, N. & Seogianto, A. (2016) . Effect of Gamma Ray irradiation on phenotypic changes in upland rice (*Oryza sativa* L.). *Journal of Plant Production*. 4(7), 585-594.

Norkhalimah, S., Idwar & Yoseva, S. (2015). Responses of several upland rice varieties (*Oryza sativa* L.) from Bengkalis Regency to several N, P and K fertilization doses. *Faperta*, (2), 1-14.

Nuraziza, A., Hairmansis, A. & Damanhuri. (2019) . Yield test and estimation of genetic parameters of agronomic characteristics of upland rice genotypes (*Oryza sativa* L.). *Journal of Crop Production*, 7(12), 2223–2229.

Praba H.W., Harjoko, D. & Yunus, A. (2018). Application of micro and complete nutrients through leaves in several chinese hybrid rice varieties. *Journal of Agroscience*, 20(1), 7-12.

Son, Sunjaya. (2012) . The Effect of single, compound, and leaf fertilizers on increasing upland rice production in Situ Patenggang varieties. *Agrotop Journal*. 2 (1), 55- 61.

Rahayu, A.Y. & Harjoso, T. (2011). Application of husk ash on upland rice (*Oryza sativa* L.) on silicate and proline content of leaves and amylose and protein of seeds. *Journal of Biota*, 16(1), 48−55.

Riyani, R. & Purnamawati, H. (2019) . Effect of potassium fertilization method on growth and productivity of upland rice (*Oryza sativa* L.). *Agrohorti Bulletin*. 7(3), 363-374.

Rizka, F., Yuni, S.R. & Yuliani. (2013). Identification of vesicular arbuscular mycorrhizal fungi (MVA) spores on oil-contaminated soil in Bojonegoro. *LanternBio*, 2(1), 7-11.

Siregar, P., Fauzi & Supriadi. (2017). The Effect of giving several sources of organic matter and incubation period on several chemical aspects of soil fertility Ultisols. *Journal of Agroecotechnology USU FP* , 5(2), 246-264 .

Smith, S.E. & Read, D.J. (2008). Mycorrhizal Symbiosis. Third edition: Academic Press. Elsevier Ltd. New York, London, Burlington, San Diego.

Suardi, D. (2014). Potential of brown rice for food quality improvement. *Journal of Agricultural Research and Development*, 24(3), 93-100.

Sukiman, H., Adiwirman & Syamsiyah, S. (2010) . Upland rice (*Oryza sativa* L.) response to water Stress and mycorrhizal inoculation. *Biologt News*, 10(2), 249-257.

Supriyanto, B. (2013). Effect of drought stress on growth and yield of local upland rice cultivars of guava (*Orysa sativa* Linn). *Journal of Agrifor*, 12(1), 77-82.

Ulma, R.F. & Adiredjo, A.L. (2018) . Test the success of crosses between upland rice varieties and rice fields (*Oryza sativa* L.) to produce F1. *Journal of Crop Production*, 6(12), 3032 – 3038.

Utami, SNH. & Handayani, S. (2003). Chemical properties of Entisols in organic farming systems. *Journal of Agricultural Sciences*, 10(2), 63-69.

inoculation of biofertilizers can improve plant rhizosphere conditions to become optimum for the development of soil microorganisms. Therefore, the fertilizer treatment did not give a real response to the development of total soil microorganisms.

Root Colonization (%)

Root colonization in the micro-compound fertilizer treatment was significantly different compared to the macro and control treatments. This is because micro-fertilizers are more capable of increasing soil pH compared to control and macro-fertilizers, so that the performance of AMF microorganisms is more optimum. According to Bertham *et al*. (2020) which states that the performance of AMF microorganisms is influenced by soil pH. Soil conditions with optimum pH caused the growth of AMF microorganisms to be optimum, so that root colonization increased.

103.25 days after planting (days), at P1, which was 101.50 days after planting and in treatment P2, which was 93.63 days after planting. This is presumably because it is influenced by carbohydrate metabolism and a high N ratio so that it can stimulate the rapid formation of flowering.

Harvest Age

Fertilizer treatment had no significant effect on the harvest age of upland rice plants. The fastest harvesting age was at P2, which was 175.00 DAP, then at P0 at 175.38 and at P2, at 175.63 DAP. This is presumably because in the P2 treatment the nutrients available from P2 fertilizer can be absorbed by plants well.

Table 3. Effect of fertilizer treatment on plant height, flowering age, harvest age, number of productive tillers, 1000 grain weight, grain weight per plant and number of productive tillers

Fertilizer Treatment	ST (cm)	UB (hst)	UP (hst)	B1000G (g plot-1)	BGT (g plant-1)	HPP (g plot-1)	JAP (clump-1)
P_0	122.04 b	103.25 a	175.38 a	20.88 a	32.81 b	1640.34 b	11.88 b
P_1	125.20 b	101.50 a	175.63 a	19.80 a	35.46 a	1810.66 a	16.18 a
P_2	134.11 a	93.63 a	175.00 a	18.16 a	34.57 ab	1761.05 ab	13.83 b

Note : The numbers followed by the same letter in the same column mean that they are not significantly different in DMRT 5%, TT : Plant Height, UB : Flowering Age, UP : Harvest age, B1000G : 1000 Grain Weight. BGT : Grain Weight per Plant, HPP : Crop Yield per Plot and JAP : Number of Productive Tillers per Clump. P0 = No fertilizer; P1 = compound micro fertilizer; P2 = Macro fertilizer recommended for upland rice

Plant height

Plant height in the treatment of macro fertilizer (P_2) was significantly different from the treatment of micro fertilizer (P_1) and control (P_0). This is due to the intake of Nitrogen (N) from Urea fertilizer from P_2 which is higher than P_1 and P_0. The higher the N content, the higher the plant height growth, because N is needed for upland rice plants for vegetative growth of upland rice plants (Putra, 2012).

Flowering Age

Fertilizer treatment did not significantly affect the flowering age of upland rice plants. Late flowering age was found in treatment P0, which was

1000 Grain Weight

Fertilizer treatment had no significant effect on the 1000 grain weight of upland rice plants. The highest 1000 grain weight was found at P0 which was 20.88 g plot^{-1},then at P_1 which was 19.80 gplot^{-1} and at P_2 which was 18.16 g plot^{-1}. This is because the response of upland rice plants to fertilizers given both basic fertilizer and fertilizer as a treatment has the same effect on the 1000 grain weight of upland rice plants.

Grain Weight per Plant and Yield per Plot

Fertilizer treatment had a significant effect on grain weight per plant and crop yield per plot. This is because the levels of micro and macro nutrients in P_1 and P_2 can increase the weight of grain per plant and grain yield of rice plants.

Number of productive tillers

Fertilizer treatment had a significantly different effect on the number of productive tillers (JAP), with P_1 treatment showing the highest JAP. Upland rice plants produce high JAP if the nutrients provided are optimal as happened in the P_1 treatment (sufficient levels of micro and macro nutrients are available).

CONCLUSION

References