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THE CONTRIBUTION OF BIO FERTILIZERS AND SOIL CONDITIONERS TO INCREASE GROWTH AND YIELD OF PADDY RICE

Betty Natalie Fitriatin[1], Emma Trinurani Sofyan[1], Anny Yuniarti[1] and Tien Turmuktini[2]
[1]Soil Science Department, Agriculture Faculty of UniversitasPadjadjaran, Indonesia
[2]Agriculture Faculty of Winayamukti University, Indonesia

ABSTRACT

The excessive application of in soil conditioner on paddy rice not only increase the production but also give a significant effect on land degradation, environmental problems and the increasing of rice yield losses. The experiments had been conducted to investigate the effect of biofertilizer (consortia of phosphate-solubilising mircrobes and nitrogen-fixing bacteria) and soil conditioners (straw compost and charcoal husk) to increase growth and yield of paddyrice. The experiment was arranged as randomized block design (RBD) with three replications. The combination treatments consisted of biofertilizers(phosphate-solubilizing microbes (Pseudomonas mallei. P.cepacea, Penicilliumsp. and Aspergillussp, and nitrogen-fixing bacteria (Azotobactersp. and Azosprilillumsp.), which were ; without bio fertilizer; 5 L ha-1 of liquid bio fertilizer; and 50 kg ha-1 of solid biofertilizer. While the soil conditioners ,which were : without soil conditioner; straw compost; charcoal husk; and cow manure. The results of experiment revealed thatbiofertilizer and soil conditioners increased growth and yield of paddy rice.

Keywords: biofertilizers, paddy rice and soil conditioner

1. INTRODUCTION

Potential biofertilizer to be applied to integrated and sustainable agricultural systems include: nitrogen fixing-bacteria, phosphate-solubilizing microbes, plant growth promoting rhizobacteria, microbes of decomposers and a biological agent (Singh and Purohit 2011). Biological fertilizers are very instrumental to improve the marginal soil such as by nitrogen fixing-bacteria and phosphate-solubilizing microbes.

Some free-living microbes in the soil has the ability to dissolve P soil is bound to be available, so that the plants are able to absorb P (Lambers, et al., 2006). Phosphate solubilizing microbes are a group of soil microbes that have the ability to extract P from bonding with Al, Fe, Ca, and Mg, so as to dissolve P which are not available to the plants become to available to plants. This happens because these microbes secrete organic acids that can form stable complexes with cations binder P in the soil (Withelaw, 2000).

Phosphate solubilizing microbes (PSM) play an important rolein influencing thegrowthof plants, in addition toa fixedPreleasecan also producethe enzymephosphatase (Saparatka, 2003; Yadav

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and Tarafdar, 2003) and can produce phytohormones (Fitriatin et al. 2014). Phosphatase enzyme released by these microbes can make mineralization of organic P into P inorganic. (George, et al, 2002; Saparatka 2003).

Some free living bacteria (non-symbiotic) or symbiotic with plants can convert atmospheric nitrogen into ammonia. Non-symbiotic nitrogen-fixing bacteria include *Clostridium*, *Azotobacter*, *Azomonas*, *Azospirillum*, *Klebsiella*. Futhermore, the symbiotic nitrogen-fixing bacteria were known of the bacteria nodule roots or *Rhizobium*. The fixation capacity of *Azotobacter* about 15-50 kg N / ha while the fixation capacity of *Rhizobium* about 200 kg N / ha (Hindersah, et al. 2006), so this bacterium is very important in the availability of N for the plant. The application of these N-fixing microbes as biofertilizers is essential in providing nitrogen so as to reduce the need for chemical fertilizers.

The soil conditioners as a source of soil organic matter is an important factor in providing energy sources for microbes, the availability of soil conditioners derived from agricultural waste (crop residues: straw, husk, etc.), livestock waste, urban organic waste and agricultural industrial waste.

The screening of soil conditioners is best to be a source of nutrients for microbes in biological fertilizers as well as to improve the physical, chemical and biological properties of sub-optimal soil. Therefore, the development of fertilizer formula in the form of consortia between phosphate solubilizing microbes and nitrogen-fixing bacteria and PGPR needed to obtain the best and best formula and to be applied to rice plants in marginal soil.

The objectives of the research are to study the contribution ofbiofertilizer (consortia of phosphate-solubilizing mircrobes and nitrogen-fixing bacteria) and soil conditioners (straw compost and charcoal husk) to increase growth and paddy rice.

2.MATERIALS AND METHODS

The experiments include and testing and optimizing the formula for a consortia of phosphate solubilizing microbes and nitrogen fixing bacteria. Solid biofertilizers usedmixing of peat and compost as carrier. Liquid biofertilizers use molasses (2%) + NH_4Cl 0.01 %. Soil conditioner used straw compost, charcoal husk and cow manure.

The experiments were conducted to study the application of biofertilizer and soil conditioner to improve growth of rice on marginal soils. The experiment was arranged randomized block design (RBD) with three replications. The combination treatment consisted of biofertilizer(Phosphate-solubilizing microbes (*Pseudomonas mallei*. *P.cepacea*, *Penicillium*sp. and *Aspergillus*sp, and nitrogen-fixing bacteria (*Azotobacter*sp.And *Azosprilillum*sp.). Each treatment were A = control; B = solid biofertilizer; C = liquid bioferlitizer; D = solid biofertilizer+straw compost; E = solid biofertilizer+charcoal husk; F = solid biofertilizer+cow manure; G = liquid biofertilizer+straw compost; H = liquid biofertilizer+charcoal husk; I = charcoal husk+cow manure; J = straw compost; K = charcoal husk and L = cow manure.

The variables observed were number of tillers and plant height every week until four weeks after planting.

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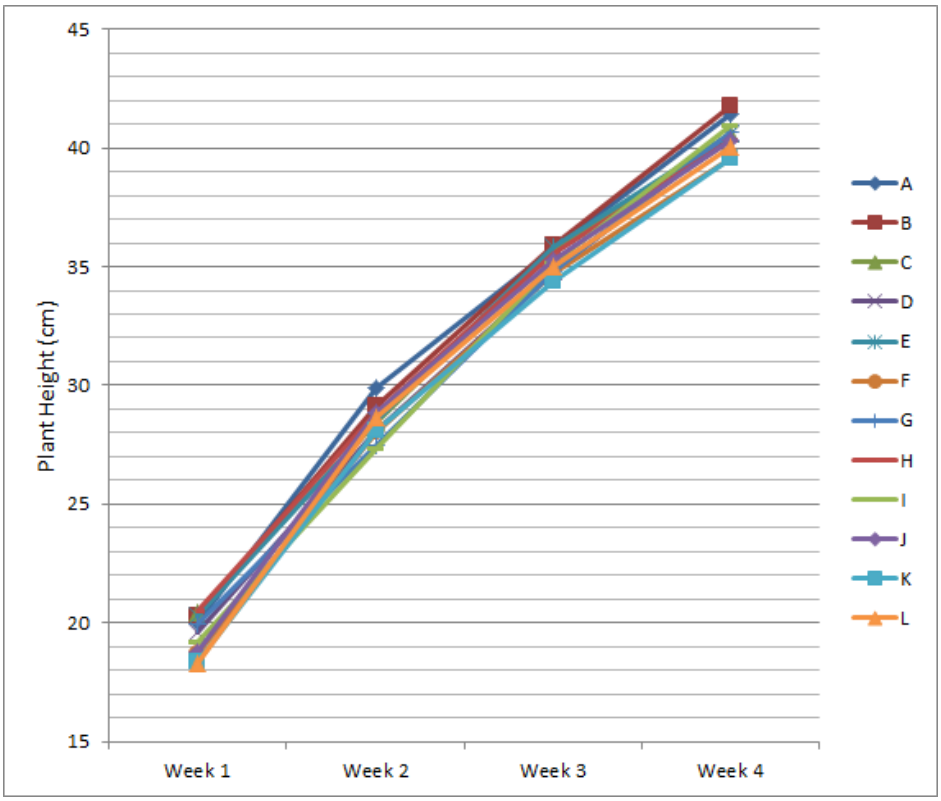
3. RESULTS AND DISCUSSION

Growth of plants

The result of experiment showed that application of biofertilizer and soil conditioners increased growth of rice plants (Figure 1). Base on measurement of weekly observation, the higest growth of rice was showed to solid biofertilizer treatment and the most tillers was showed to solid biofertilizer and straw compsost. This is due tothe role of inoculant carrier was mixture of peatandcompostsupportedthe growth of microbes. Formulation of biofertilizer influenced on ability of activity P-solubilizing microbes. Fitriatin et al. (2014) reported that mixture of peat and compost as carrier gave best effect on population of P-solubilizing microbe.



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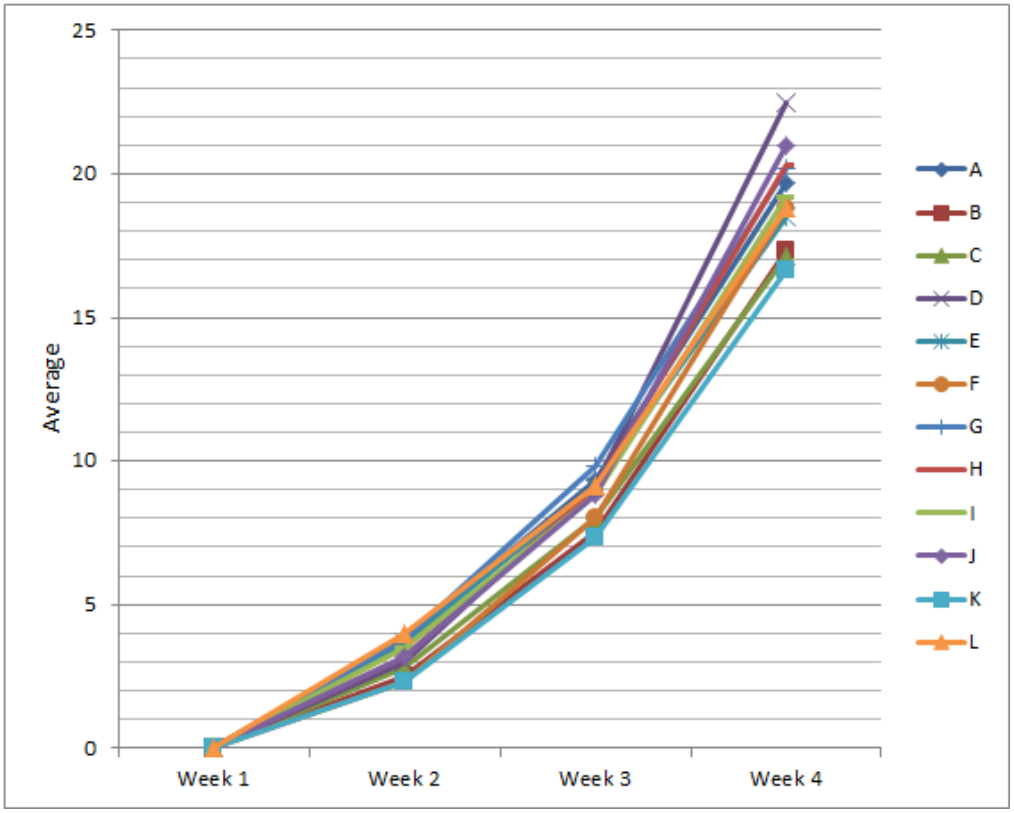

Figure 1. Plant height (left) and number of tillers (right) at 1-4 weeks after planting

Paddy rice yield

Based on the results of the analysis, the application of biofertilizers improve grain weight of paddy rice (Table 1). The treatment of liquid biofertilizers and solid bio-fertilizers with straw compost resulted in a weight grain per pot which was significantly different compared to the control treatment, respectively 38.41g, 38.62 and 38.33g. The weight of 1000 grains was not affected by the treatment of biofertilizers and soil conditioner. However, the results of this experiment showed an increase in weight of 1000 grains.

The result showed that application of biofertilizers and soil conditioner increased yield of paddy rice (grain weight). This is in line with Pratiwi's research, (2016) which states that the addition of organic fertilizers increases the yield of paddy rice by 52% more than the treatment without organic fertilizer. The addition of straw compost increases the weight of grain compared to controls. Composting can reduce the use of N fertilizer by 50% with recommended amounts (Barus, 2011). Salamone, et. al. (2012) reported that addition of *Azospirillum* and *Pseudomonas* inoculants increased paddy rice yield by 11% more compared to controls.

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Table 1.The effect of biofertilizers and soil conditioner on paddy rice yield.

Treatments	Grain weight per pot (g)	Weight of 1000 grains (g)
Control	31,33 a	28,90 a
Control	36,45 ab	31,90 a
Solid bio-fertilizers	38,41 b	30,90 a
Liquid bio-fertilizer	38,62 b	30,87 a
Solid bio-fertilizer + straw compost	35,88 ab	30,67 a
Solid bio-fertilizer + husk charcoal	37,05 ab	30,77 a
Solid bio-fertilizer + cow manure	38,33 b	31,57 a
Liquid bio fertilizer + straw compost	34,60 ab	31,03 a
Liquid bio- fertilizer + husk charcoal	33,66 ab	31,47 a
Liquid bio-fertilizer + cow manure	34,34 ab	31,57 a
Straw compost	35,59 ab	30,30 a
Cow manure	34,92 ab	31,33 a

Remarks: The average score followed by the same letter is not significantly different according to the Tukey HSD Advanced Test at the 5% level.

Giving of straw compost is highly recommended to improve soil fertility. Itcontains essential nutrients needed by paddy rice. One ton of straw contains 6.16kg N, 0.83kg P, and 22.5kg K. The use of rice straw reduces the use of inorganic fertilizers and reduces the cost of production (Senaratne, et. al. 2006). The addition of organic material to the soil improves soil sustainability as soil ameliorants. This increases fertility, soil nutrients, reduces pests and diseases in plants. According to Gao, et. al. (2013) the addition of forage fertilizer for 28 years can increase paddy rice yield by 18-27%.

The weight of 1000 grains according to the description of Ciherang variety is about 28g. In this study, the weight 1000 of grains increased by giving 3g of biological fertilizer and organic ameliorants. According to Setiawati, et al., (2016) the application of NPK fertilizer and bio-fertilizers did produce a real effect on the weight of 1000 grains. This could be caused by the number of rice tillers that didn't produce productive panicles which as a result, affected the weight of 1000 rice grains. Supported by Aryanto's research, et al., (2015) the addition of bio-fertilizers didn't produce results on the weight of 1000 grains IR 64 varieties because of low soil fertility. The weight of 1000 grains is a decisive component, the weight of paddy rice can be influenced by various factors including environmental factors. This is allegedly due to non-optimal irradiation during planting which can disrupt photosynthesis and starch formation.

4. CONCLUSIONS

The results of experiment revealed thatbiofertilizer and soil conditioners gave interaction effect significantly on growth and yield of paddy rice. Application of biofertilizer and soil conditioners increased growth and yield of paddy rice.Solid formula of biofertilizer and straw compost gave better effect on growth and yield of paddy rice.

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