The Effect of Different Rate of Biofertilizer on the Growth Performance and Yield of Rice

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Abstract. Rice (Oryza sativa L.) is an important cereal in the world and can be grown in different habitats such as lowland, irrigated and upland rice. In order to study the effects of biofertilizer on the growth performance and yield of rice, the experiment was carried out using Complete Randomized Design (CRD) based on 5 treatments with 5 replications. The control treatment (T0) was 100% of NPK fertilizer, treatment 1 (T1) was 30% biofertilizer and 70% NPK fertilizer, treatment 2 (T2) was 50% biofertilizer and 50% NPK fertilizer, treatment 3 (T3) was 70% biofertilizer and 30% NPK and treatment 4 (T4) was 100% biofertilizer. The rice variety used was MR 220 and different doses of biofertilizer were applied 4 times. Each of the application was mixed with inorganic fertilizer NPK at a recommended rate. The parameters used in this study were number of leaves, number of tillers, number of panicles, height of rice, 1000-grain weight and fresh weight. In this experiment, treatment 2 (50% biofertilizer and 50% NPK) showed positive result for all parameters and has significant difference between the treatments. Treatment 3 (70% biofertilizer and 30% NPK) showed the lowest means for most of the parameters. Thus, from this study, the combination of 50% biofertilizer with 50% chemical fertilizer is proved to boost a better growth and yield of rice.

Keywords: Cereal; NPK; CRD; Control Treatment; Boost

1. Introduction

Rice (Oryza sativa L.) is a staple food for about 50 percent of the world’s population especially those who reside in Asia, where 90 per cent of the world’s rice is grown and consumed [1]. In Malaysia, rice is mainly grown at Peninsular and Borneo Island, about 300,500 hectares in Malaysian Peninsular and 190,000 hectares in Borneo Island. Today, Malaysia’s self-sufficiency level (SSL) of rice production is 72% and this is not enough, thus urges us to import from other countries such as Vietnam, Philippines and Thailand [2]. The average consumption of rice for Malaysian citizen is about 82.3 kilograms per year. The Ministry of Agriculture and Agro-based Industry (MOA) has actualized National Agriculture Policy (NAP) to guarantee adequate supply of sustenance and to change the agro-based industry in order to become a more focused and manageable industry which allows increment in salary of entrepreneurs in this industry. The National Agrofood Policy of Malaysia, 2011-2012 had featured that local rice creation must be enhanced to guarantee the nation’s demand in future.

Fertilizer application is the most important aspect increase of rice yield. The type of fertilizer and fertilizer application are important in measuring the growth of rice. Fertilizer comes in two types, organic and inorganic fertilizer. Compound fertilizer such as NPK is the common fertilizer applied to plants. However, the rice cultivation depends too much on the use of NPK fertilizer to meet the demand of rice [3]. The overuse of chemical fertilizers lead to groundwater pollution, adverse change in...
properties of the soil such as increase in acidity of the soil. There is a need to develop a suitable agricultural system which receives lower fertilizer input with higher use efficiency. Biofertilizer could be an alternative for nutrient management in growing rice.

Biofertilizer is defined as a substance which contains living micro-organisms to help in the development of root system and better seed germination [4]. A healthy plant usually contains many beneficial microbes in their rhizosphere. Biofertilizers containing beneficial microbes help to improve soil chemical and biological characteristics, phosphate solutions and agricultural production [5]. In addition, microbial inoculants can be used as an economic input to increase crop productivity where fertilizer doses can be lowered and more nutrients can be harvested from the soil. Microbiological fertilizers are important for the sustainable agricultural practices and it is environment friendly [6].

Biofertilizers are assumed as an extremely notable part in enhancing soil fertility. Beneficial microbes in biofertilizer help in regulating the dynamics of organic matter decomposition and increase the availability of plant nutrients such as nitrogen, phosphorus and sulfur [7], therefore improving the exchange capacity of nutrients, increasing soil water retention, promoting soil aggregates and buffering the soil against acidity, alkalinity, salinity, pesticides and toxic heavy metals [8]. Thus, the objective of this study was to determine the effects of different rates of biofertilizer on the growth and yield performance in rice.

2. Materials and Methods

The rice (Oryza sativa) variety MR220 was used in this research. The seeds were planted in the trays for 14 days, then seedlings were transplanted to trial pots. Different doses of biofertilizer were applied on each post. The NRICH Bio Organic fertilizer from Felcra which contained mycorrhiza and trichoderma were applied four times at 30, 45, 60 and 75 days after transplanting. Recommended inorganic fertilizer NPK (15:15:15) in granule form were applied at vegetative and reproductive phase, then NPK 12: 12: 17: 2 was applied at reproductive phase for control treatment (T0). The application of NPK were at 15, 35, 55 and 75 days after transplanting. Field analysis was done to measure the number of leaves, number of tillers, number of panicles, 1000-grain weight, and fresh weight every week to observe the growth and yield performance of paddy.

2.1 Treatment and experimental design

The experiment was arranged in a Complete Randomized Design (CRD) with 5 treatments and 5 replications. The control treatment (T0) apply with 100% of NPK fertilizer, treatment 1 (T1) apply with 30% biofertilizer and 70% NPK fertilizer, treatment 2 (T2) apply with 50% biofertilizer and 50% NPK fertilizer, treatment 3 (T3) apply with 70% biofertilizer and 30% NPK while treatment 4 (T4) apply with 100% biofertilizer. Data were assessed by Analysis of Variance (ANOVA) with a probability P<0.05 using the Minitab program (version 18.0).

3. Results and Discussion

In this study, different rate of biofertilizer showed significant effects on the growth as well as productivity of the paddy. During the growth stages of the crop, there were significant difference between treatments (P < 0.05) in the number of leaves, number of tillers, number of panicles and fresh weight due to the controlled amount of biofertilizer level in the containers.

Leaves are important organ which play an active role in photosynthesis. There was a significant difference between the treatments (P<0.05) as shown in Figure 1. The highest mean number of leaves was treatment 2 (50% biofertilizer + 50% NPK) as compared to other treatments. According to Oladele and Awodum [9], symbiotic microorganisms in biofertilizer helped in improving nutrition and growth of rice. The treatment with biofertilizer had improved the quality of crop growth by subsequently increasing photosynthesis, producing bioactive substances such as hormones and enzymes which caused the increase in leaf number due to sufficient nutrition that has possibly increased nutrient absorption capacity of the plant.
Tillering is a significant attribute for grain production. A significant difference between the treatments (P<0.05) was found where the highest mean of tiller was observed in treatment 2 (50% biofertilizer + 50% NPK) as compared to other treatments (Figure 2). This might be due to biofertilizer enhancing the colonization of mycorrhizae, thus improving phosphorus supply that influenced the number of tillering in plant [10].

It was also found that the highest mean for number of panicles was in treatment 2 (50% biofertilizer + 50% NPK) as compared to other treatments (Figure 3). That may be attributed by the biofertilizer which enhances soil biological activity thus improving nutrient mobilization from organic and chemical sources for the use in panicle development [11].

The highest mean of fresh weight was also found in treatment 2 (50% biofertilizer + 50% NPK) as compared to other treatments (Figure 4). There is a significant difference between the treatments (P<0.05). Two types of bacteria commonly found in biofertilizer, Azospirillum and Azotobacter could increase crop biomass and crop productivity through nitrogen fixation at crop rhizosphere as well as phytohormone [12].

The productivity of paddy was measured at 105 days after planting. The highest mean of 1000-grains dry weight was also observed in treatment 2 (50% biofertilizer + 50% NPK) as compared to other treatments (Fig. 5) where there was a significant difference between treatments (P<0.05). Dekhane et al. [13] stated that the increasing amount of bacteria in biofertilizer helped to fix the nitrogen and increased the nitrogen plant uptake. It can significantly increase yield parameters such as the number of panicles per plant and the weight of 1000 grains.
Based on this experiment, the treatment with 50% biofertilizer and 50% NPK application gave significant improvement thus facilitating in the uptake of nutrients in the plants. This led to the enhancement of chlorophyll content and carbohydrate synthesis by helping the root growth and uptake of other nutrients to a greater extent. As a result, the enlargement in cell size and cell division increased the number of leaves, number of tillers, number of panicles, fresh weight and grains dry weight in paddy.
Conclusion
Among all the treatments, treatment 2 (50% biofertilizer with 50% NPK) showed the most positive performance as compared to other treatments. Application of biofertilizer with chemical fertilizer had improved the growth and yield performance in paddy. From the financial perspective, farmers can utilize the mix of biofertilizer and thus lessen the use of inorganic fertilizer.

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