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THE EFFECT OF PGPR AND NITROGEN APPLICATION RATES ON THE GROWTH OF RICE (Oryza sativa) MR 219

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THE EFFECT OF PGPR AND NITROGEN APPLICATION RATES ON THE GROWTH OF RICE (*Oryza sativa*) MR 219

By

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CERTIFICATION FORM

This project report entitled The Effect of PGPR and Nitrogen Application Rates on the Growth of Rice (*Oryza Sativa*) MR 219 is prepared by Muhammad Hafiz Bin Maslan Malik and submitted to the Faculty of Agriculture, Universiti Putra Malaysia in fulfillment of the requirement of PRT 4999 (Final Year Project) for the award of Bachelor of Agricultural Science

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TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURE

LIST OF APPENDICES

ABSTRACT

Oryza sativa L. is the common species of rice planted in Asia. It is an important food crop in the world and forms the staple diet in Malaysians. To meet the challenge of feeding the world's growing population more rice must be produced from less land with minimum cost and under environmentally adverse inputs. Overuse of chemical fertilizers will increase production costs and also environmental pollution. Therefore, plant growth promoting rhizobacteria (PGPR) are frequently used to improve rice yield production. It can increase nutrient uptake and can become an alternative source of elemental nitrogen for crop production. An experiment was conducted in laboratory and glasshouse condition with the following objectives: i) to determine the effect of PGPR on the growth of rice, ii) to determine the best rate of nitrogen application on the growth of rice, iii) to determine the interaction of inoculating bacteria and nitrogen fertilizer on the growth of MR219 rice variety. There were 6 treatments [T1 (0% N + UPMB10); T2 (25% N + UPMB10); T3 (50% N + UPMB10); T4 (100% N + UPMB10); T5 (0% N – UPMB10); T6 (100% N – UPMB10). This experiment was arranged in a Randomized Complete Block Design (RCBD). Plants were sampled at 70 days of growth. Parameters that were collected at day 70 during harvesting period were plant height, chlorophyll content, plant dry weight, NPK content in leaves tissue, root length, root surface area and root volume. Result shows that plant that inoculated with UPMB10 gives the highest result better than the plant that were not inoculated with UPMB10. The parameter that show significant difference is nitrogen content in leaves tissue. As a conclusion from the study, plant inoculated with UPMB10 can increase the plant growth.

ABSTRAK

Oryza sativa L. adalah spesies padi yang biasa ditanam di Asia. Ia merupakan tanaman makanan yang penting di dunia dan merupakan makanan ruji rakyat Malaysia. Untuk menyahut cabaran makan penduduk beras lebih berkembang di dunia mesti dihasilkan dari tanah kurang dengan kos yang minimum dan di bawah input alam sekitar yang buruk. Berlebihan baja kimia akan meningkatkan kos pengeluaran dan juga pencemaran alam sekitar. Oleh itu, pertumbuhan tumbuhan menggalakkan rhizobacteria (PGPR) sering digunakan untuk meningkatkan pengeluaran hasil padi. Ia boleh meningkatkan pengambilan nutrien dan boleh menjadi sumber alternatif bagi unsur nitrogen untuk pengeluaran tanaman. Satu eksperimen telah dijalankan di makmal dan keadaan rumah kaca dengan objektif-objektif berikut: i) untuk menentukan kesan PGPR kepada pertumbuhan padi, ii) untuk menentukan kadar terbaik nitrogen terhadap pertumbuhan padi, iii) untuk menentukan interaksi daripada suntikan bakteria dan baja nitrogen kepada pertumbuhan padi (MR219). Terdapat 6 rawatan [T1 (0% N + UPMB10) T2 (25% N + UPMB10); T3 (50% N + UPMB10); T4 (100% N + UPMB10); T5 (0% N - UPMB10); T6 (100% N - UPMB10). Eksperimen ini telah disusun dalam bentuk rekabentuk blok rawak lengkap (RCBD). Tumbuh-tumbuhan telah disampel pada 70 hari pertumbuhan. Parameter yang telah dikumpulkan pada hari 70 dalam tempoh penuaian adalah ketinggian pokok, kandungan klorofil, berat kering tumbuhan, kandungan NPK dalam daun tisu, panjang akar, keluasan akar dan isipadu akar. Keputusan menunjukkan bahawa tumbuhan yang disuntik dengan UPMB10 memberikan hasil yang paling tinggi yang lebih baik daripada tumbuhan yang tidak disuntik dengan UPMB10. Parameter yang menunjukkan perbezaan yang ketara adalah kandungan nitrogen dalam tisu daun. Sebagai kesimpulan daripada kajian, suntikan UPMB10 boleh meningkatkan pertumbuhan tumbuhan.

CHAPTER 1

INTRODUCTION

Rice plant belongs to the family of Graminae. The common species planted in Asia region is *Oryza sativa* L. Based on geographical location and morphological characteristics, Indica is one of the subspecies that can be commonly found in southeast region. The entire growing period of rice generally varies between 90-150 days depending on variety, temperature and sensitivity to day length. Rice (*Oryza sativa* L.) is an important food crop in the world and forms the staple diet in Malaysians. Malaysia current self sufficiency level for rice is at 73% (MARDI, 2008). It is about 2.3 million tonnes of Malaysia's rice production for year 2007 (Rice Statistics, USDA, 2008). Rice yield of Malaysia for year 2008 is 3.46 tonnes per hectare (Rice Statistic, USDA, 2008).

To meet the challenge of feeding the world's growing population, more rice must be produced from less land with minimum cost and under environmentally adverse inputs. Urea is the most common nitrogen fertilizer applied in rice fields (Piao et al., 2005). Nitrogen is the most important input required for rice production. Rice requires 1 kg of nitrogen to produce 15-20 kg of grain. Yields per hectare are critically dependent on the nature, amount and timing of N supply (George et al., 1992). According to DOA (2011), paddy cultivation area in 2011 for our country is 683,677 hectare, but we are still importing 960,000 metric tonnes of the rice from neighbouring countries to meet the total needs for our nation's rice. Rice crops remove around 16-17 kg N for the production of each ton of rough rice including straw (De Datta 1981; Ponnamperuma and Deturck, 1993).

Overuse of chemical fertilizers, can increase the production costs and also environmental pollution. Use of biofertilizer can increase nutrient uptake and can become an alternative source of elemental nitrogen for crop production. According to Manna and Singh in 1991, nitrogen plays a key role in increasing productivity of high yielding rice varieties. Developing countries are facing greater problems to supply nitrogen for rice culture since the production of N fertilizers is becoming more expensive due to the crisis associated with the supply of raw materials.

Plant Growth-Promoting Rhizobacteria (PGPR) may improve the uptake of nutrients by plants and/or produce plant growth promoting compounds. They also protect plant root surfaces from colonization by pathogenic microbes through direct competitive effects and production of antimicrobial agents. These plant growth-promoting bacteria can enter into a symbiotic relationship with plants (i.e. Rhizobium-legume and Frankia-actinorhizal plant symbiosis), but also non-symbiotic free living soil bacteria can promote plant growth (Glick 1995; Klopper et al., 1989).

These PGPR can indirectly or directly affect plant growth. There are several ways in which different plant growth-promoting rhizobacteria have been reported to directly facilitate the proliferation of their plant hosts. PGPR may fix atmospheric nitrogen and supply it to plants; they may synthesize siderosphores which can solubilize and sequester iron from the soil and provide it to plant cell; they may synthesize several different phytohormones, including auxins and cytokinins, which can act to enhance various stages of plant growth (Patten and Glick, 1996, Tien et al., 1979), gibberellins (Guatierrez-Manero et al. 2001) and ethylene (Lynch, 1990). Production of indole-3-ethanol or indole-3-acetic acid (IAA), compounds

belonging to auxins, has been reported for several bacterial genera, such as Frankia Enterobacter (Haahtela et al., 1988), Pseudomonas (Yrjonen et al., 2001) and Bacillus (Gutierrez Manero et al., 1996). Indirect plant growth promotion includes the prevention of the deleterious effects of phytopathogenic organisms. This can be achieved by the production of siderophores, i.e. small non-binding molecules. Siderophore production enables bacteria to compete with pathogens by removing iron from the environment (O'Gara, 1994).

Different abiotic and biotic factors influencing bacterial colonization and viability were reviewed in Benizri et al. (2001). Most importantly, for rhizobaceria to act beneficially, they must be able to efficiently colonize and multiply in the plant rhizosphere.

1.1 Objectives

The main objective of this study is as follows:

1) To determine the effect of PGPR on the growth of rice.

2) To determine the best rate of nitrogen application on the growth of rice.

3) To determine the interaction of inoculating bacteria and nitrogen fertilizer on the growth of MR219 rice variety.

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