STUDY ON THE EFFECTS OF OLIGOCHITOSAN AND BIOLIQUIFERT ON TWO RICE MUTANTS, NMR 151 AND NMR 15

KAJIAN KESAN OLIGOKITOSAN DAN BIOLIQUIFERT KE ATAS DUA MUTAN PADI, NMR 151 DAN NMR 152

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Abstract

Nuclear Malaysia has successfully developed two new rice mutants namely NMR 151 and NMR 152. In addition, Nuclear Malaysia has also successfully developed Oligochitosan and liquid biofertilizer (Bioliquifert). Oligochitosan acts as elicitor that has been proven to be very effective in controlling disease infections and improving yield productivity. Bioliquifert on the other hand is a mixture of microbes containing major nutrient-providing microorganisms. The objective of this study is to observe the effects of Oligochitosan and Bioliquifert on rice mutants, NMR 151 and NMR 152. The treatment was applied on 14 day old seedlings of MR 219, NMR 151 and NMR 152 sowed in 20 cm pots containing silty clay from the paddy soil of TanjungKarang, Selangor. The seedlings were then placed in the greenhouse at Nuclear Malaysia until it reaches 110 days old. Study was conducted in a Complete Randomized Design (CRD) with 3 replications was used and each replication consisted ofthree plants. All treatments received compound and single dressing fertilizer as recommended by National Rice Production Package except for Treatment 2 and 3, in which Treatment 2 received Oligochitosan and Bioliquifert while Treatment 3 only received Bioliquifert. Results on plant height, number of tiller and plant fresh weight are not significantly different for all cultivar except for seed dry weight of NMR 152 and MR 219.

Keywords/Kata kunci: Mutation Breeding, Rice Cultivars, Oligochitosan and Bioliquifert.

Abstrak

Nuklear Malaysia telah berjaya membangunkan dua mutan baru padi yang diberi nama NMR 151 dan NMR 152. Nuklear Malaysia juga telah membangunkan Oligokitosan dan biobaja cecair (Bioliquifert). Oligokitosan berfungsi sebagai elisitor yang sangat efektif dalam mengawal jangkitan penyakit dan meningkatkan produktiviti hasil. Bioliquifert adalah campuran mikroorganisma yang berfungsi sebagai pembekal nutrient utama. Objektif kajian ini adalah *untuk melihat kesan aplikasi Oligokitosan dan Bioliquifert terhadap pertumbuhan dan hasil padi Nuklear Malaysia, NMR 151 dan NMR 152. Rawatan diberikan kepada anak benih padi MR 219, NMR 151 dan NMR 152 berusia 14 hari yang ditanam secara individu di dalam pasu yang mengandungi tanah dari jenis tanah liat berpasir dari kawasan sawah di Tanjung Karang, Selangor dan diletakkan di dalam rumah hijau di Nuklear Malaysia sehingga berusia 110 hari. Kajian ini menggunakan Rekabentuk Rawak Lengkap (CRD) dengan 3 replikasi dan setiap replikasi mengandungi 3 pokok padi. Semua rawatan diberikan baja sebatian dan baja tunggal berdasarkan syor dari Pakej Pengeluaran Padi Kebangsaan kecuali bagi Rawatan 2 dan 3, dimana Rawatan 2 dirawat dengan Oligokitosan dan Bioliquifert, sementara Rawatan 3, hanya dirawat dengan Bioliquifert. Perbandingan diantara rawatan terhadap tinggi pokok, bilangan anak padi dan berat basah pokok padi menunjukkan kesan yang tidak signifikan bagi semua kultivar kecuali bagi berat kering biji NMR 152 dan MR 219.*

Katakunci: Pembiakbakaan mutasi, kultivar padi, oligokitosan dan biobaja cecair

INTRODUCTION

Rice is regularly consumed by almost half of the world's population and *Oryza sativa* is the most popular variety in Asean. Rice also is a staple food for Malaysian, but the national rice self sufficiency level (SSL) is only at about 70% and there is a need to sustain it through continuous rice research and development (Haron, 2013). Nuclear Malaysia was started the research on mutation breeding of rice since 2008 and has successfully developed two new rice mutants namely NMR 151 and NMR 152. These two mutants are developed from gamma irradiated seeds of MR 219 at dose 300 Gy. NMR 151 and NMR 152 are screened and selected for minimal water condition, but also acceptable for flooded and aerobic condition.

In addition, Nuclear Malaysia has successfully developed Oligochitosan and liquid biofertilizer (Bioliquifert). Oligochitosan acts as elicitor that has been proven to be very effective in controlling disease infections especially by fungal or bacterial attack and improving yield productivity (Tamada et. *al*., 2009). Study by Yacob et *al*. (2013), shown Oligochitosan act as growth promoter during rice seedling period of 1st day to 15th day and from blast lesion index, which mean Oligochitosan treatment has shown an effective elicitor which can protect rice plant from blast disease.

Bioliquifert is a natural, multifunction and multi-application liquid biofertilizer. It contains microorganisms that provide major nutrients through activities of nitrogen fixation, phosphate and potassium solubilisation and plant growth promotion. Bioliquifert is environmentally friendly, economic and easy to handle. This fertilizer is adaptable to various agricultural applications such as fertigation system, flooded and aerobic rice farming and vegetable crop cultivation (Rahim and Hoe, 2015). Since that, it is recommended to use biofertilizers as a replacement of our chemical fertilizers. Major problem is biofertilizer are not as effective as chemical fertilizers and farmers often try to use chemical fertilizers in the agricultural field for crop development. But obviously the chemical fertilizers are not environment friendly (Uma Maheswari and Elakkiya, 2014). In this study, all treatments were received compound and single dressing fertilizer except for Treatment 2 and 3, in which Treatment 2 received

Oligochitosan and Bioliquifert. The objective of this study is to observe the effects of Oligochitosan and Bioliquifert on rice mutants, NMR 151 and NMR 152.

MATERIAL AND METHOD

Seed germination and transplanting

Seeds of NMR 151, NMR 152 and MR 219 were soaked overnight in 5g/L fungicide (Thiram®). Then the soaked seeds were toasted and placed on sterilized wet cotton. After that, the seeds were incubated for two days at 30ºC in 24 hours light to initiate germination. After two days, germinated seeds were placed on top soil in a plastic container. The container were flooded and placed in the greenhouse to encourage growth until 14 days. Then the seedlings of MR 219, NMR 151 and NMR 152 were sowed individually in 20 cm pots containing silty clay from the paddy soil of Tanjung Karang, Selangor. The pots were flooded and placed in the greenhouse at Nuclear Malaysia until 110 days old.

Treatments

Study was conducted in a Complete Randomized Design (CRD) with 3 replications and each replication consisted of three plants. All treatments received compound and single dressing fertilizer as recommended by National Rice Production Package except for Treatment 2 and 3, in which Treatment 2 received Oligochitosan and Bioliquifert while Treatment 3 only received Bioliquifert. Table 1 showed the treatment that has been used in this study.

Fertilizer	Rate	Application time	Treatment 1	Treatment 2	Treatment 3
NPK fertilizer (17.5:15.5:10)	360 kg/ha	7 DAT	Yes	Yes	Yes
Urea (46% N)	100 kg/ha	25 DAT	Yes	Yes	Yes
Compaund fertilizer 12:12:17:2MgO+TE	175 kg/ha	55, 75 DAT	Yes	Yes	Yes
Oligochitosan	2L/ha	5, 23, 53, 73 DAT	No	Yes	No
Bioliquifert	5L/ha	6, 24, 54, 74 DAT	No	Yes	Yes

- DAT – Day after transplanting

Data collection

Data on plant height were measured on the main culm (or the tallest tiller) at or following anthesis from ground level to the tip of the panicle. Number of tiller was counted at the anthesis stage. The plants were harvest after 110 days after sowing (DAT) and all the seeds were removed and collected for weighing. Data on plant fresh weight was measured immediately after harvest. Then the plants were placed in oven at 60^{o}C for at least 3 days and data on plant dry weight were measured after the plant are totally dried. Harvest index was calculated using the following formula:

$$\text{Harvest index} = \frac{\text{Seed dry weight}}{\text{Seed dry weight + plant dry weight}} \times 100\%$$

Statistical analysis

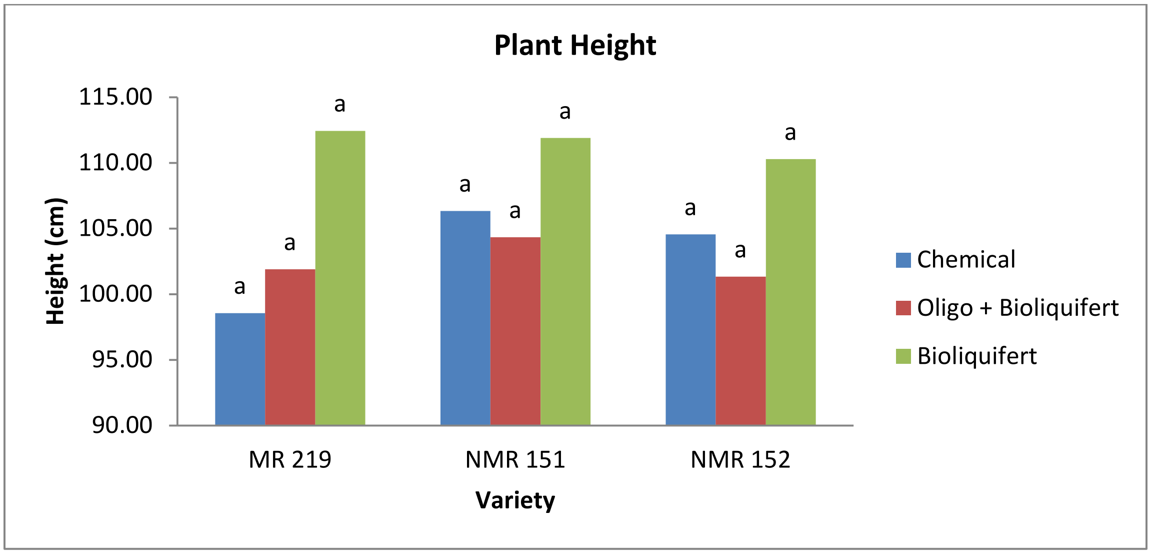
The study was conducted in a Complete Randomized Design (CRD) with 3 replications and each replication consisted ofthree plants. Statistical Analysis System software was used for analysis of variance (ANOVA) and Duncan's Multiple Range Test (DMRT) was used for comparison among treatment means at P<0.05.

RESULT AND DISCUSSION

Effects of Oligochitosan and Bioliquifert on plant height, number of tiller, plant fresh weight

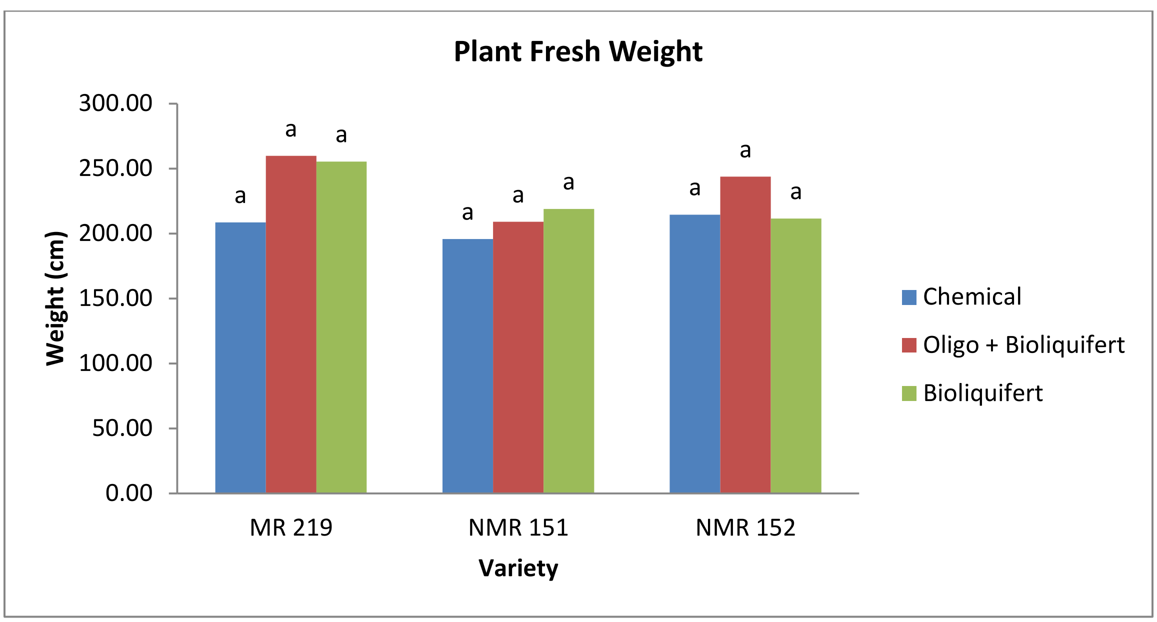
In this study, the effects of oligochitosan and bioliquifert on plant height, number of tiller and plant fresh weight were not significantly different from the chemical. However, Bioliquifert was still able to increase the mean of plant height for all three varieties; MR 219, NMR 151 and NMR152 as shown in Figure 1. Besides, the mean of plant fresh weight are highest in treatment 2 which is added with Oligochitosan and Bioliquifert and in Treatment 3 which is added with Oligochitosan for MR 219 and NMR 151 as compare to chemical alone. For MR 219, the mean of plant fresh weight is 208.62g in treatment with chemical alone, 259.76 in treatment 2 which is added with Oligochitosan and Bioliquifert and 255.40g in treatment 3 which is added with Bioliquifert. The highest mean of plant fresh weight (219.02g) for NMR 151 is found on treatment added with Bioliquifert and followed by 209.00g in treatment added with Oligochitosan and Bioliquifert as compare to 195.76g in treatment with chemical alone. NMR 152 showed a good response to treatment added with Oligochitosan and Bioliquifert as compared to treatment added with Bioliquifert and chemical alone. According to Uma Maheswari and Elakkiya (2014), biofertilizers contains microorganisms which promote the adequate supply of nutrients to the host plants to ensure their proper development of growth and regulation in their physiology.

Figure 1: The mean of plant height after treated with chemical fertilizer, Oligochitosan and Bioliquifert



Means followed by the same letter are not significantly different, according to Duncan's Multiple Range Test (P<0.05)

Figure 2: The mean of plant fresh weight after treated with chemical fertilizer, Oligochitosan and Bioliquifert

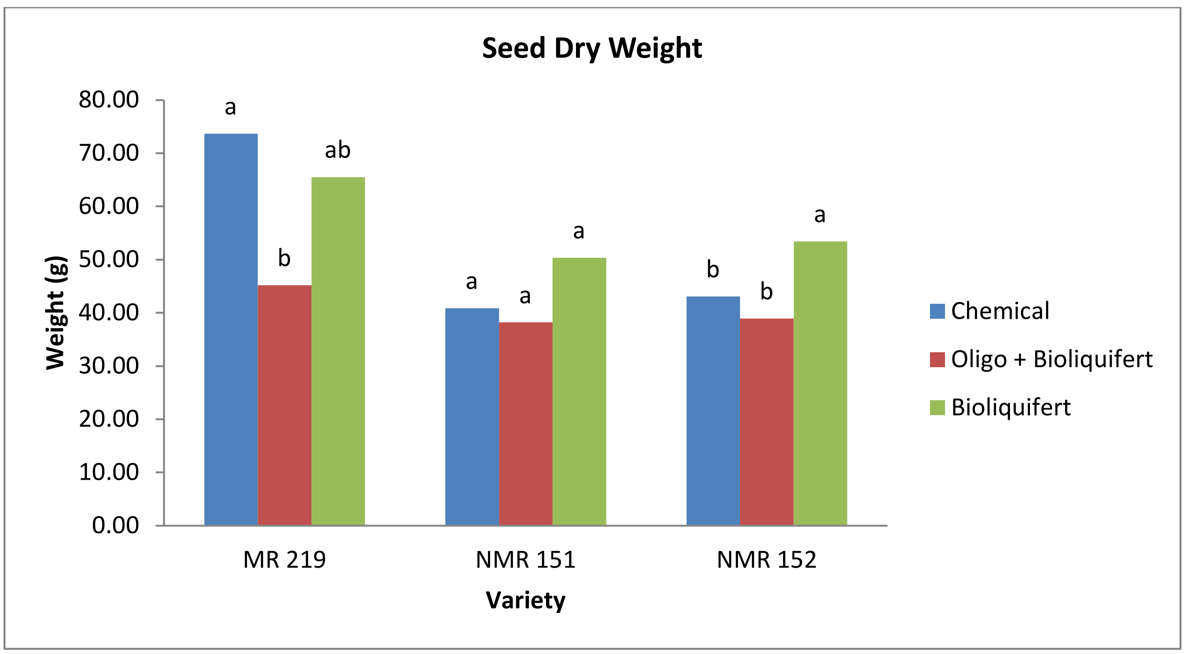


Means followed by the same letter are not significantly different, according to Duncan's Multiple Range Test (P<0.05)

Effects of Oligochitosan and Bioliquifert on seed dry weight and rice harvest index

Fresh weight is not always a reliable measure for higher plants because most of the plant tissues are approximately contained 80 percent of water. Water content is highly variable and fresh weight will fluctuate widely with changes in ambient moisture and the water status of the plant (Öpik and Rolfe, 2005). In this study, dry weight was determined after drying the material to a constant weight, is a measure of the amount of protoplasm or dry matter. Comparison between treatments on seed dry weight for MR 219 and NMR 152 are significantly different and not significantly different for NMR 151 as shown on Figure 3. For NMR 151, the highest mean of seed dry weight (50.37g) is in treatment added with Bioliquifert and for NMR 152, also the highest mean of seed dry weight (53.43g) is found on treatment added with Bioliquifert.

Figure 3: The mean of seed dry weight after treated with chemical fertilizer, Oligochitosan and Bioliquifert

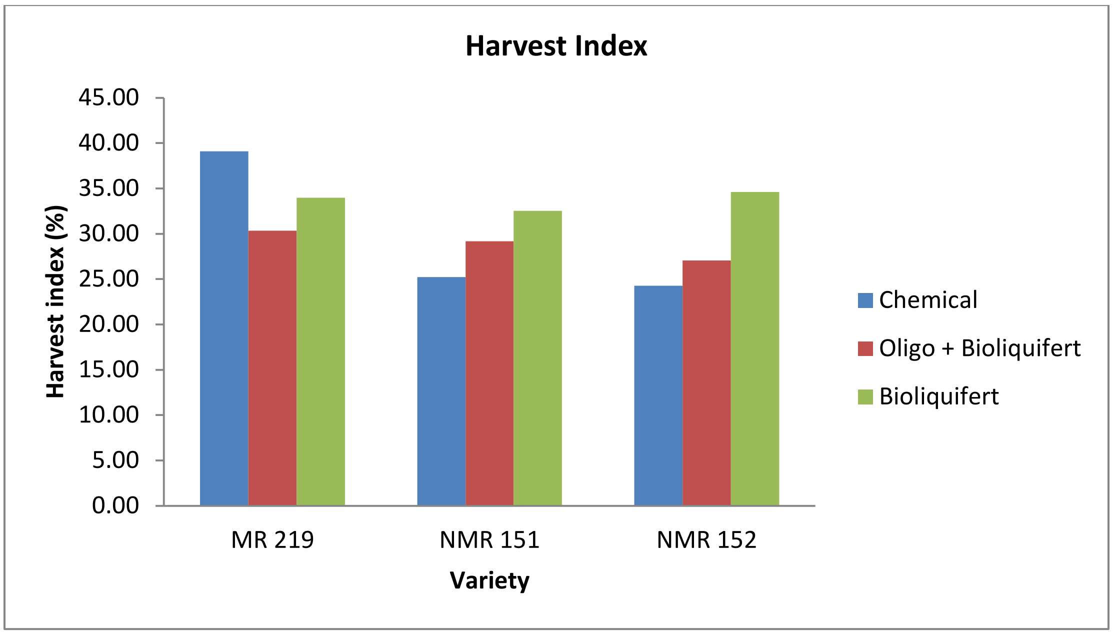


Means followed by the same letter are not significantly different, according to Duncan's Multiple Range Test (P<0.05)

Harvest index is indicated the partitioning of dry matter between grain yield and vegetative part. Grain harvest index is an important parameter in determining distribution of photosynthetic product between shoot and grain and consequently grain yield (Ishii, 1995). Generally, increased harvest indexes have contributing to higher yield in rice, barley and wheat (Fageria et. *al.*, 2006). In this study, the highest harvest index for NMR151 and NMR152 which are 32.52% and

34.62%, respectively are found on treatment added with Bioliquifert, followed by treatment added with Oligochitosan and Bioliquifert which are 29.18% and 27.06%, respectively. This result indicated Bioliquifert potentially can increase the yield of both rice mutants (NMR 151 and NMR 152). For MR 219, treatment with chemical showed the highest percentage (39.09%), followed by treatment added with Bioliquifert (33.98%) and the lowest is treatment added with Oligochitosan and Bioliquifert (33.98%).

Figure 4: The rice harvest index after treated with chemical fertilizer, Oligochitosan and Bioliquifert



CONCLUSION

Oligochitosan and Bioliquifert have their potential to increase the yield of rice mutant. Both products showed a positive on both rice mutants, NMR 151 and NMR 152. However, further study must be done in order to optimize in term of application and the interaction effect between the Oligochitosan and Bioliquifert on rice mutants growth.

ACKNOWLEDGEMENT

Authors would like to thank Mr. Muhammad Ruzaini Abdul Wahab, Ms. Hazlina Abdullah, Mr. Muhammad Fikri Zainodin, Mr. Mohd Khairi Ishak, Mr. Nor Fairul Azam Abdul Wahab and Mr. Razak Roslan for their help in this study.

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