Results And Quality Of Various Rice Varieties That Applied Of Fixator Bacteria As A Source Of Nitrogen

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Abstract: This study aimed to determine the effect of various varieties and packages of fertilization (inorganic and biological) either singly or interactions of the results and the carbohydrate and protein content of grain. The study was conducted from March to October 2012, at the screen house, Faculty of Agriculture, University of Hasanuddin. The design used was a randomized block design group (RAK) two-factor factorial. The first factor is the rice variety, consisted of four types, namely: Pandan Putri varieties, Invari Sidenuk, Ciliwung, and Ciherang. The second factor is five packets fertilization, namely: 5.0 L Azospirillum sp., ½ dose recommendation of urea + 2.5 L Azotobacter sp.,1/2 dose of recommendation of urea + 5.0 L Azotobacter sp., 5.0 L Azotobacter sp. And ½ dose recommendation of urea + 2.5 L Azospirillum sp. + 2.5 L Azotobacter sp .. The results showed that the varieties of Invari Sidenuk gave the highest grain yield per panicle is 71.64 g, followed by Ciherang, 65.31 g, Ciliwung varieties, 65.25 g, and the last varieties of Pandan Putri amount of 60.99 g. Ciherang varities that given 1/2 dose of recommendation of urea + 5.0 L Azotobacter sp. resulted in the highest of carbohydrate content of 72.59 and the highest grain protein content was obtained from the treatment of Pandan Putri varieties inoculated with 5.0 L Azospirillum sp . It was concluded that the combination of a half dose of recommendation of urea and biological fertilizer Azotobacter sp. increased rice yield and grain carbohydrates and grain protein is given a 5.0 L Azospirillum sp. at the study site.

Index Terms: Quality of grain, rice varieties, Fixator bacteria.

1 INTRODUCTION

Rice is the main food crop for nearly seven and a half billion people in the world, more than 90% is consumed in Asia (Mohanty, 2013) [1]. Rice which is a product of the rice plants, plays an important role in the national economy in developing countries. Looking ahead, demand for rice is not only related to the aspect of quantity, but also quality, nutritional value, socio-cultural aspects in each region, and the development of agro-industry technology (Badan Litbang Pertanian, 2005) [2]. All this can be achieved by increasing the production of rice in the quantity and quality to fulfil the needs of the population and national food security. Production and protein content of rice can be enhanced through increased application of fertilizer nitrogen for rice cultivation (BPTPI, 2010) [3]. Furthermore, stated that that the higher dose applications of urea, protein content of rice produced higher. This is shown by the results of the study by Setyono et al., (2007) [4], the increasing of the dose of urea fertilizer application of 100 kg / ha of the usual dose can increase the protein content of rice respectively 0.74%, 0.65% and 0, 68% for Ciherang varities, Cibogo and Beras Merah (Red Rice).

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While an increase in the dose of urea fertilizer to 600 kg / ha, the total protein content of rice is 9.96% for Ciherang Varieties, 9.24% for Cibogo varities and 9.50% for Red Rice. There has been much research on the use of urea fertilizer to paddy fields and proven to improve the yield and quality of grain. But on the other hand the use of inorganic fertilizers to improve the productivity of paddy fields in addition to costs and relatively high energy also have negative impacts on the environment such as increased nutrient (eutrophication) in water as well as a decrease in soil organic material. (Badan Litbang Pertanian, 2008)[5] reported that, land in South Sulawesi, especially in rice production centres in the Eastern and Western sectors have organic-C is very low (<2%). Conditions such land has poor soil structure with low micro-nutrient content and biological life is also low. Therefore, it needed an alternative technology that can reduce the use of chemical fertilizers, especially nitrogen for rice cultivation, including the use of biological fertilizers derived from microbes and is expected to still be able to increase the yield and quality of grain especially contain of carbohydrates and protein. Some non-pathogenic microbes effectively tie up nitrogen from the air such as Azotobacter sp. and Azospirillum sp.that can live in a variety of ecosystems in nature. Fixator Bacteria are able to decrease the use of urea, maintain soil organic material and reduce pollution. Azotobacter sp. inoculation of rice plants, either with or without the addition of urea fertilizer obtained results of plant height, number of tillers and seeds grain weight more than rice plants that only given urea alone (Syam'un et al., 2006) [6]. Sattar et al. (2008) [7]., stated that inoculation of Azotobacter sp. shown to increase the yield between 15-100% and reduce the use of artificial fertilizers by up to 30% on dry land ecosystems. Furthermore, Katupitiya and Vlassak (1990) [8]. stated that Azospirillum sp. able to stimulate an increase important agricultural output 30 to 50% in the different soil and climatic conditions in a period of 20 years. In addition to the fertilizer, increasing rice production is also influenced by varieties. High yielding varieties is one of the technological innovations sizable contribution in increasing national rice production. Until now, many new varieties of rice that has been assembled and released by Agricultural

Research and Development Agency, but the use and development of farmers is still limited (Badan Litbang Pertanian, 2007)[9]. Therefore, necessary testing effort of various varieties of new varieties of specific locations that adapted well and have a high yield potential to support increased production and farmers' income. Application of fertilization packets Azotobacter sp. and Azospirillum sp. in the form of bio-fertilizer with half dosage of inorganic N recommendations and the selection of appropriate varieties needs to be studied. It is expected that the combination can improve the yield and quality of rice especially carbohydrate and protein content of grain and can reduce the use of inorganic N and still be able to maintain the sustainability of land productivity and environmental health.

2. MATERIALS AND METHODS

This study was a pot experiment carried out at the experimental garden, Faculty of Agriculture, University of Hasanuddin from March to October 2012. The study was designed in a Randomized Block Design (RBD) with factorial pattern that consisted of two factors. The first factor was the rice variety (V), wass composed of four types, namely: Putri Pandan varieties (v1), Invari Sidenuk (v2), Ciliwung (v3), and Ciherang (v4). The second factor was five packets of fertilization (P) as follows: 5.0 L Azospirillum sp. (p1), ½ dose of recommendation urea + 2.5 L Azotobacter sp. (p2), ½ dose of recommendation urea + 5.0 L Azotobacter sp. (p3), 5.0 L Azotobacter sp. (p4), and ½ dose of recommendation urea + 2.5 L Azospirillum sp. + 2.5 L Azotobacter sp. (p5). From these two factors there were 20 (4 x 5) a combination of treatments. Each treatment combination was repeated three times consisting of three experimental units (pots) so that overall there are 60 units of the pot. Materials and tools used were rice seed varieties of Pandan Putri, Invari Sidenuk, Ciliwung and Ciherang, formula of biological fertilizer, compost, urea fertilizer , TSP, KCl, paddy soil derived from Maros Regency, laboratory equipment, shovel, sieve, hoe, meter, scales, plastic pots, and other supporting facilities. Rice land that was wind dried for seven days and put in plastic pots and then saturated with water for two days. Preparation of seed was done by sowed the seeds with appropriate varieties separated, after the 20-day-old seedlings after sowing, the seedlings transferred to plastic pots. Application of fertilization packet carried out according to a predetermined treatment of urea by sowing into the planting medium and biological fertilizers are given by drip formula that has been diluted with water to planting medium close with planting root. Plant maintenance was done according to the guidelines rice cultivation, the plants were allowed to grow until the next harvest age. Observation was conducted for grain weight per panicle, grain carbohydrate content, and protein content of grain,. Data were analyzed using analysis of variance (ANOVA). The results of the analysis indicated a significant treatment effect or a very real effect then conducted further tests to distinguish among the average of treatment using Duncan's Multiple Range Test (JBD).

3. RESULTS AND DISCUSSION

Results of analysis of variance showed that the treatment of varieties and various fertilizer package was very significant effect on grain weight per panicle, while the interaction between varieties and package fertilization effect was not real. The average weight of grain per panicle were presented in Table 1.

Table 1. The average weight of grain per panicle (g) in the treatment of varieties and fertilizer package

Fertilization package	Varieties				Average	NP JBDα=0,01
	Pandan Putri (v1)	Invari Sidenuk (v2)	Ciliwung (v3)	Ciherang (v4)		
5,0 L *Azospirillum* sp. (p1)	55,10	65,03	59,44	57,21	59,19^{q}	5,008
½ dose of urea + 2,5 L *Azotobacter* sp. (p2)	67,60	75,56	71,88	71,09	71,53^{p}	5,230
½ dose of urea + 5,0 L *Azotobacter* sp. (p3)	64,69	75,13	66,81	68,78	68,85^{p}	5,371
5,0 L *Azotobacter* sp. (p4)	53,82	63,45	56,76	61,01	58,76^{q}	5,460
½ dose of urea + 2,5 L *Azospirillum* sp. + 2,5 L *Azotobacter* sp. (p5)	63,75	79,04	71,38	68,46	70,65^{p}	
Average	60,99^{b}	71,64^{a}	65,25^{b}	65,31^{b}		
NP JBDα= 0,01	4,479	4,678	4,804			

Description: The numbers followed the same letter on the line (a, b, c, d) and column (p, q, r, s) means were not significantly different on JBDα test = 0.01

Statistical test results in Table 1 showed the variability of the four varieties of grain yield. It was thought to be caused by the genetic nature of each varieties. Each varieties had genetic potential could be different from one another, therefore each variety had the ability to grow and thrive, gave different results. The highest yield was obtained from varieties Invari Sidenuk (v2) produced an average weight of grain per panicle 71.64 g and significantly different to the other varieties. The high grain weight per panicle due Invari Sidenuk varities were more response to environmental conditions caused by fertilization package treatment given compared to other varieties. Ghosh et al. (2003) [10] stated that any rice variety had its own adaptation to the biophysical environment. Sidenuk Invari varieties with the genetic trait had a better adaptability than the other varieties in the environmental site so it more capable in converting of basic resources: soil, water, air and sunlight into the dry ingredients products (seed / grain). Table 1 showed also that the application of ½ dose of urea recommendation + 2.5 L Azotobacter sp. (p2) result in grain weight per panicle of rice plants was 71.53 g and highly significantly different with fertilization package without urea namely: 5.0 L Azospirillum sp. (p1) and 5.0 L Azotobacter sp. (p4), but not significantly different from ½ package of urea fertilizer recommendation + 5.0 L Azotobacter sp. (p3) and 1/2 dose of urea recommendation + 2.5 L Azospirillum sp. + 2.5 L Azotobacter sp. (p5). The addition of microbes (Azotobacter sp. and Azospirillum sp.) in the form of a biological fertilizer at ½ dose of urea recommendation could affect the increasing of rice crop yield due to absorption of nutrients by plants were higher. Bacteria Azotobacter sp. and Azospirillum sp. N2 could fixate N2 free of air (Anas, 1989) [11] thus increasing the N content in the soil which and increase the intake of N plant. But its presence without the addition of urea did not give better results. It could be seen from the results of the study that giving of ½ dose of urea fertilizer recommendation along with good biological Azospirillum sp. and Azotobacter sp. or both of them produced grain weights heavier than the biological fertilizer application only. This showed that the paddy crop N needs not fulfilled if only expected belay N of bacteria alone. Therefore, the use of biological fertilizers needed to be combined with the addition of urea according to the amount needed. Urea was a source of N that could be immediately available to the plant at the beginning of the growth, according to the level of need. Budiyanto and Krisno (2004) [12] claimed that inorganic nitrogen compounds (urea) in a small amount of nitrogen was needed to address the needs at the beginning of growth before plants could rely on nitrogen requirement of N2 fixation by bacteria. Against the grain carbohydrate content, the results of the analysis of variance showed that treatment of varieties, fertilization package, as well as their interaction was highly significant. Average grain carbohydrate content (%) are presented in Table 2.

Table 2. Average Of Grain Carbohydrate Content (%) In The Treatment Of Varieties And Fertilization Package

Fertilization Package	Varieties				NP JBDα=0,01
	Pandan Putri (v1)	Invari idenuk (v2)	Ciliwung (v3)	Ciherang (v4)	
5,0 L *Azospirillum* sp. (p1)	$53,02^{d}_{t}$	$57,86^{c}_{s}$	$62,69^{b}_{r}$	$67,66^{a}_{s}$	0,169
½ urea + 2,5 L *Azotobacter* sp. (p2)	$58,63^{d}_{s}$	$59,29^{c}_{s}$	$63,69^{b}_{q}$	$72,44^{a}_{p}$	0,176
½ urea + 5,0 L *Azotobacter* sp. (p3)	$58,86^{d}_{r}$	$60,01^{c}_{r}$	$63,69^{b}_{q}$	$72,59^{a}_{p}$	0,181
5,0 L *Azotobacter* sp. (p4)	$59,52^{d}_{q}$	$60,26^{c}_{q}$	$65,56^{b}_{p}$	$69,82^{a}_{r}$	0,184
½ urea + 2,5 L *Azospirillum* sp. + 2,5 L *Azotobacter* sp. (p5)	$60,14^{d}_{p}$	$60,61^{c}_{p}$	$65,61^{b}_{p}$	$71,37^{a}_{q}$	
NP JBDα=0,01	0,151	0,158	0,162		

Description: The numbers followed the same letter on the line (a, b, c, d) and column (p, q, r, s) means were not significantly different on JBDα test = 0.01

JBD test in Table 2 showed that Ciherang given ½ dose of urea recommendation + 5.0 L Azotobacter sp. (v4p3) resulted in the highest carbohydrate content (72.59%) and significantly different to the other varieties, while Variety Ciherang given ½ dose of urea recommendation + 5.0 L Azotobacter sp. (v4p3) differ significantly with other fertilizer package unless Ciherang varieties given ½ dose of urea recommendation + 2.5 L Azotobacter sp. (v4p2). This suggested that Ciherang varieties grown on environmental conditions that had been treated ½ dose of urea recommendation and bacteria Azotobacter sp. (Both 5.0 L Azotobacter sp and 2,5 L Azotobacter sp.) was quite appropriate to support the growth and development of better for the next to produce grain carbohydrate content higher than the other varieties. Carbohydrate content was lowest for the Pandan Putri varieties inoculated with 5.0 Azospirillum sp. (V1P1) of 53.02% and highly significant with other varieties, while the Pandan Putri varieties given 5.0 Azospirillum sp. (V1P1) significantly different with other fertilization package. The presence of bacteria Azotobacter. sp. that in addition to increase the availability of N for plants also produce growth hormone (PGPR), such as auxin, gibberellins and cytokinins as well as a variety of vitamins that can improve plant growth (Simarmata, 2005) [13].. In addition to producing hormones, bacterial inoculation of Azotobacter sp. also increases the absorption of N, P, K, and Fe in rice plants. With the increasing uptake of these elements increased the photosynthetic activity and resulted to increase the synthesis of carbohydrates. Against the grain protein content, the results of the analysis of variance showed that treatment of varieties, fertilizer package and interaction both of them were highly significant. Average of grain protein content (%) were presented in Table 3.

Table 3. Average Grain Protein Content (%) In The Treatment Of Varieties And Fertilization Package

Fertilization package	Varieties				NP JBDα=0,01
	Pandan Putri (v1)	Invari Sidenuk (v2)	Ciliwung (v3)	Ciherang (v4)	
5,0 L *Azospirillum* sp. (p1)	$5,74^{a}_{p}$	$5,39^{c}_{rs}$	$5,47^{b}_{q}$	$5,45^{bc}_{q}$	0,083
½ urea + 2,5 L *Azotobacter* sp. (p2)	$5,19^{d}_{s}$	$5,32^{c}_{s}$	$5,43^{b}_{q}$	$5,62^{a}_{p}$	0,086
½ urea + 5,0 L *Azotobacter* sp. (p3)	$5,35^{c}_{r}$	$5,56^{a}_{p}$	$5,45^{b}_{q}$	$5,39^{bc}_{qr}$	0,089
5,0 L *Azotobacter* sp. (p4)	$5,57^{a}_{q}$	$5,44^{b}_{qr}$	$5,11^{d}_{r}$	$5,29^{c}_{s}$	0,090
½ urea + 2,5 L *Azospirillum* sp. + 2,5 L *Azotobacter* sp. (p5)	$5,23^{d}_{s}$	$5,50^{b}_{pq}$	$5,66^{a}_{p}$	$5,35^{c}_{rs}$	
NP JBDα=0,01	0,074	0,077	0,079		

Description: The numbers followed the same letter on the line (a, b, c, d) and column (p, q, r, s) means were not significantly different on JBDα test = 0.01

JBD test in Table 3 showed that the Pandan Putri varieties were inoculated 5.0 L of Azospirillum sp.(V1P1) produced the highest grain protein content of 5.74% and significantly different to the other varieties. While Pandan Putri Variety were inoculated with 5.0 L Azospirillum sp. (V1P1) differ significantly with other fertilization package. This suggested that the varieties of Pandan Putri were treated 5.0 L of Azospirillum sp. enough to grow and produce grain with a higher protein content than the other varieties. Anas (1989) [13] stated that the bacterium of Azospirillum sp. able to tie up nitrogen (N2) from the air in microaerophilic conditions and turn it into NH4 + that could be absorbed by plants. High N uptake by plants leads to formation of more proteins in the fruit (grain). Nitrogen is a building block of amino acids, proteins and nucleoprotein and enzymes (Gardner et al., 1995) [14]. Grain protein content was lowest for the Ciliwung varieties were inoculated with 5.0 L of Azotobacter sp. (V3P4) of 5.11% and significantly different to the other varieties. While the Ciliwung varieties were inoculated with 5.0 L of Azotobacter sp. (V3P4) differ significantly with other fertilization package. Pandan Putri varieties were treated with 5.0 L of biofertilizer Azospirillum sp. obtained the highest grain protein content, but contrary to the carbohydrate content of grain. This was presumably due to the presence of the protein synthesis dependence on the availability of carbohydrates in plants. The process of photosynthesis that occurs in plants produced carbohydrates through a variety of metabolic processes, carbohydrate formed the basis of protein synthesis. Thus the nitrogen assimilation affected the use of carbohydrates. The formation of amino acids from nitrogen using intermediates of the tricarboxylic acid cycle derived from the metabolism of carbohydrates and their derivatives (Prawiranata et al., 1988) [15]. Furthermore, it was stated that to reduce nitrate, nitrite ions and ammonia nitrogen assimilation required energy reduction, the process led to the amount of carbohydrates that have been or will be formed into a carbohydrate reduced.

4. CONCLUSIONS AND RECOMMENDATIONS

Varieties of Invari Sidenuk provided the highest grain yield per of 71.64 g, followed Ciherang, 65.31 g, Ciliwung varieties, 65.25 g, and the last Pandan Putri varities of 60.99 g. Ciherang given ½ dose of urea recommendation + 5.0 L Azotobacter sp. resulted in the highest carbohydrate content of 72.59 while the highest grain protein content was obtained from the treatment of Pandan Putri varieties were inoculated with 5.0 L of Azospirillum sp. It was concluded that the combination of half dose of urea fertilizer from recommendation doze and biological fertilizer of Azotobacter sp. and Azospirillum sp. increased rice yields. Interaction between Ciherang varities and fertilization package of ½ doze of urea fertilizer recommendation + 2.5 L of Azotobacter sp. gave the highest grain carbohydrate content whereas the highest grain protein obtained from treatment of Pandan v Putri varieties which given 5.0 L of Azospirillum sp. at the study site.

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