The Effect Of An Alternative KCL Fertilizer From Coconut Husk On Morphology Of *Oryza sativa L*. Cempo Ireng

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***Abstract*—** Black rice (*Oryza sativa L. Cempo Ireng*) is one of the rice varieties that are rich in nutrients viz. anthocyanin, flavonoids, vitamin B1and E, Fe and amino acids. In Indonesia, utilization of nutrients in the black rice is still limited due to low productivities and its cultivation is also not well known. An alternative natural fertilizer that can improve the productivity of black rice is organic KCl fertilizer derived from coconut husk. The current study aimed to analyze the effect of organic KCl fertilizer on the morphological growth of black rice including stem height, number of leaves, number of tillers, and time of panicle out. The research was carried out in a greenhouse using a Completely Randomized Design (CRD) single factor (concentration of organic KCl fertilizer) with five treatments levels: 0 ml (P_0) as control, 20 ml (P_1), 40 ml (P_2), 60 ml (P_3) and 80 ml (P_4). All experiments were performed in five replications. Application of KCl fertilizer on the growth of black rice was given at three different times i.e. at 0 day after sowing (DAS), 7 DAS, 21 DAS and the transition time of vegetative to generative phase. The data obtained were analyzed using Analysis of Variance (ANOVA) and continued by Duncan's Multiple Range Test (DMRT) at a 95% confidence level. The results showed that the application of KCl fertilizer at concentration of 20 ml/L had the significant effect on the plant height, number of tillers, number of leaves, and time of panicle out. The organic KCl fertilizer at concentration of 20 ml/L has increased the growth of 31.8 %, the number of tillers by 19 %, the number of leaves by 100%. Therefore, this study presents an alternative organic fertilizer that would enhance productivity of plant, as a result would contribute to strengthen national food and also minimize environmental pollution.

Keywords- Black rice; Organik fertilizer; coconut husk; morfology.

INTRODUCTION

Black rice is a type of the rice species *Oryza sativa* L. which is rich in nutrients and mainly cultivate in Asia. The common's names of black rice are also known as purple rice, forbidden rice, heaven rice, imperial rice, king's rice and prized rice. This rice is free of gluten and cholesterol, low in sugar, salt and fat. The nutritional composition of black rice is made up of anthocyanin, vitamin B and E, iron, thiamine, magnesium, niacin, and phosphorus. Black rice also contains energy (315 Kkal), protein (8 gram), carbohydrate (76.9 g) and fibers (6.1 g) [1].

Based on morphology characteristic, there are 200 types of black rice varieties in the world [1] and only four varieties groups grow well in Indonesia [2]. One of them is *Oryza sativa* L. Cempo Ireng [3] that is predominantly cultivated in Java Island. The Cempo Ireng is the richness of germplasm of Indonesia that should be preserved because of its nutritive and medicinal value. Scientists reported that black rice was an alternative healthy food for diseases treatments such as atherosclerosis, hypertension, diabetes, asthma, cancer, heart disease, stroke, and even weight gain [1]. However, the large application of black rice was restricted in supply those only China is responsible for 62 % of black rice global production. Indonesia alone occupies the third position after Sri Langka to black rice cultivation and only has 42 germplasm collections [1]. The obstacles (reluctances) to cultivate black rice (*Oryza sativa* L. cempo ireng) in Indonesia are due to long harvesting age and low productivity. Thus, in order to maintain its varieties and great application as antioxidant in healthy field, improving black rice varieties in terms of harvesting age and productivity is crucial [4].

According to researchers, utilization of organic fertilizer such as KCl organic has been able to enhance the growth, number of stomata, plant height and leaf thickness, harvesting age and productivity of a plant. Therefore, this study aimed to cultivate/ preserve *Oryza sativa* L. Cempo Ireng as a source of antioxidant using coconut husk as a natural organic fertilizer.

Materials and Methods

Raw Materials

The main materials were the dried coconut husks that were collected from Desa Alue Ie Puteh, Langsa, Aceh. They were prepared by peeling and separated from coconut shell, and then a smooth outer skin was peeled again until remaining coconut coir. The KCl organic fertilizer was prepare by soaking coconut coir within 14 days and supplemented by brown sugar and EM4.

Plants and Culture Conditions

The experiment was conducted in the green house of Samudra University starting in August – October 2017. Meanwhile, the seeds used in this research are black rice (*Oryza sativa* L) Cempo Ireng which are originated from Sleman Yogyakarta. The seedling of selected seeds was performed by spreading them on trays/ containers containing media seedling for 15 days. It was followed by transferring/ transplanting them into the 15 kg pots (diameter 30) that filled with medium consisting of cocopit, manure, sand, and humus. In order to maintain

humidity all treatments, irrigation of the plants was carried out by flooding the planting media (maximum 5 cm) every day.

Treatments

The experiment was set up using a Completely Randomized Design (CDR) single factor (concentration of organic KCl fertilizer) with five treatments levels: 0 ml (P_0) as control, 20 ml (P_1), 40 ml (P_2), 60 ml (P_3) and 80 ml (P_4). All experiments were conducted in five replications. Application of KCl fertilizer on growth of black rice was given for four times viz. (1) at 0 day after sowing, (2) 7 days after sowing (DAS), (3) 21 days after sowing (DAS), and the transition of vegetative to generative phase respectively. Parameter observed in this study was the vegetative growth of black rice. They are plant height, leaf number, tiller number, and panicle age.

Statistical Analysis

The effects of treatments were evaluated using Analysis of Variance (ANOVA). When the obtained data were different from the reality, it would be continued by Duncan's Multiple Range Test (DMRT) at a 95% confidence level by using the software package SPSS 17.0 for Windows.

Results and Discussion

Plant Height

The statistical analysis result revealed that the organic KCl fertilizer from coconut husk exhibited the significant influence on the height of black rice at 2, 4, 6, 8 weeks after sowing (WAS) (Table 1).

Table1. Provision of organic KCl fertilizer against the plant height (cm)

Average of plant height (cm)	Treatments				
	P_0	P_1	P_2	P_3	P_4
2 WAS*	$37,9^{d}$	$43,3^{a}$	$40,1^{c}$	$41,8^{b}$	$38,9^{cd}$
4 WAS	$85,3^{b}$	$92,4^{a}$	$92,3^{a}$	$91,3^{a}$	$84,5^{b}$
6 WAS	$102,5^{d}$	$127,0^{a}$	$118,7^{b}$	$110,6^{c}$	$103,8^{d}$
8 WAS	$104,5^{c}$	$131,5^{a}$	121.2^{b}	$116,0^{b}$	$104,5^{c}$

* WAS is week after sowing

** Different letters in the same columns and rows indicated a significant difference in organic KCL treatment based on a confidence level of DMRT 95 %.

Table 1 displays that the treatment P_1 (20 ml of organic KCl concentration) has function as the optimal dosage and increased the plant height of 31.8 %. This is due, at the 20 ml/L concentration of organic KCl fertilizer has been provided the nutrients to the soil either macro or micro to support the growth and development of plants. This finding was accordance with Doberman dan Faihust [5]. who reported that for every ton of produced rice, it absorbs about 14.5 Kg K / ha which can be obtained from the soil, irrigation, or added fertilizer.

Potassium (K) is a fundamental third element after N dan P that functions to enhance growth of plants particularly stems branches and leaves. In addition, it raises the process of photosynthesis, efficient use of water, maintaining turgor, forming a stronger rod, as activator of various enzyme systems, strengthen the roots and thus increase the plant height as well as improve the resistant plant against disease [5, 6]. On the other hand, the increasing dosage of organic KCl fertilizer revealed the insignificant effect on the growth of black rice. This fact indicated that higher dosage of the KCl fertilizer might inhibit the plant growth. This result was strongly supported by researchers who state the excessive concentration of K and Cl elements might lead to poison plant. This can be observed from the curl and thicken leaves in rice plants, as a consequent decreasing height and productivity of plant [7, 8].

Tiller Number

The number of productive tiller was performed by calculating all the numbers of seedlings which produce panicles. The obtained data revealed that organic KCl fertilizer contribute the positive effect toward number of tillers. In contrast, the strong effect was displayed by the KCl organic fertilizer at concentration of 20 ml/L (Table 2).

Table 2. Provision of organic KCl fertilizer against the tiller number

Average of tiller number	Treatments				
	P_0	P_1	P_2	P_3	P_4
2 WAS*	1^{d}	3^{c}	4^{ab}	5^{ab}	6^{a}
4 WAS	2^{d}	10^{a}	7^{b}	8^{bc}	9^{ab}
6 WAS	2^{d}	20^{a}	16^{b}	15^{b}	14^{b}
8 WAS	3^{c}	23^{a}	16^{b}	15^{b}	15^{b}

* WAS is week after sowing

** Different letters in the same columns and rows indicated a significant difference in organic KCL treatment based on a confidence level of DMRT 95 %.

According to researcher, fertilization using KCl organic will activate synthesis enzyme that plays a role in photosynthesis as well as turgor and osmotic regulation [9, 10]. Furthermore, the KCl element is responsible to provide nitrogen dan phosfor elements in soil that plays role in biosynthesis of sitocynin and inhibit strigolacton respectively. Sitocynin is a hormone that promotes the growth of tiller, while suppression of strigolacton activity may increase number of produced tillers [11, 12].

Leaf Number

The produced data illustrated that all treatments give the progressive effect to the number of leaves (Table 3). P_1, P_2, and P_3, treatments encouraged 4, 3, and 1 times increases number of leaves compare to the control (P_0). In contrast, P_4 treatment exhibits the same influence either the control. This finding might be clarified by [13] who discovered that the excessive levels of KCl can lead to toxicity in plant cells.

Table1. Provision of organic KCl fertilizer against the leaf number

Leaf Number	Treatments				
	P_0	P_1	P_2	P_3	P_4
2 WAS*	8^{e}	11^{d}	26^{c}	31^{b}	45^{a}
4 WAS	13^{d}	56^{a}	45^{c}	50^{c}	56^{a}
6 WAS	14^{c}	75^{a}	69^{b}	70^{ab}	67^{b}
8 WAS	14^{c}	81^{a}	71^{b}	71^{b}	69^{b}

*WAS is week after sowing

PPDifferent letters in the same columns and rows indicated a significant difference in organic KCL treatment based on a confidence level of DMRT 95 %.

Panicle Age

The results of variance analysis for time of panicle out described that the concentration of 20 ml/L KCl organic fertilizer was positively correlated to faster panicle out by 57 days (Table 4). It is assumed that application of the organic KCl at concentration of 20 ml/L has been able to provide K requirement for plant. As a consequent, it will promote plant to move on reproductive phase (producing flowers and fruits) by acceleration the assimilation process from source to sink [14]. Excessive doses of the KCl fertilizer on rice plants can slow down the generative phase of plant, as in the use of organic KCl fertilizer at concentration of 60 and 80 ml/L (Table 4.4). This is presumably because of the high concentration KCl elements in plants can trigger the growth of the vegetative phase of the plant thus the plants are longer in flowering. High concentration of KCl can increase the size of the node in the plasmodesmata then it will result of increasing the water absorption process. As a consequence of high water content in plants might stimulates the plant to be only in the vegetative phase. In contrast, when KCl levels are low in plants, there will encourage transitional process from vegetative to generative phase. This is indicated by flowering phase [14].

Table 4. The average age to panicle out of the black rice after treatment

Treatments	Age Panicle out (days)	Results
P_0	74	A
P_1	57	C
P_2	64	B
P_3	69	A
P_4	73	A

Different letters in the same columns and rows indicated a significant difference in organic KCL treatment based on a confidence level of DMRT 95 %.

Conclusion

The study presents utilization of coconut husk as source of an alternative organic KCl fertilizer. The applications of KCl organic fertilizer exhibit the significant influence on the morphological growth parameters including plant height, leaf number, tiller number, and panicle age. However, based on the results of statistical analysis, the treatments of KCl fertilizer at concentration of 20 ml/L on the growth of black rice (*Oriza sativa* L) Cempo Ireng render the crucial effects compare to others treatments. Thus, this research would provide the information for improving the productivity of black rice, contribute to strengthen national food and also minimize environmental pollution by coconut husk waste.

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