ISSN 2356-0169

Journal of Tropical Crop Science

Volume 5, Number 3, October 2018

DEPARTMENT OF AGRONOMY AND HORTICULTURE
FACULTY OF AGRICULTURE
BOGOR AGRICULTURAL UNIVERSITY

www.j-tropical-crops.com

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JOURNAL OF TROPICAL CROP SCIENCE
Printed ISSN : 2356-0169
Electronic ISSN : 2356-0177
J-TROPICAL-CROP.COM | Peer-review | Open Access

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Journal of Tropical Crop Science Vol. 5 No. 3, October 2018
www.j-tropical-crops.com

RESEARCH ARTICLE

Nitrogen Use Efficiency of Local and National Aromatic Rice Varieties in Indonesia

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Abstract

Nitrogen use efficiency (NUE) indicates the ratio between the amount of fertilizer N removed from the field by the crop and the amount of fertilizer N applied. NUE is an important indicator of agro-environment for a sustainable farming, including in rice. The objective of the current study was to evaluate NUE of local and national Indonesian superior aromatic rice varieties treated with different levels of nitrogen fertilizer (N). The experiment was arranged using five levels of N as the main plot, plots, i.e. 0, 45, 90, 135 and and 180 kg.ha^{-1}; and two rice varieties as sub plots, a local Aceh variety "Sigupai" and a national rice variety "Inpari 23 Bantul". The results showed that the application of N 180 kg.ha^{-1} to "Sigupai" significantly increased the plant height. However, it caused a delay in the time to flower in both varieties. "Inpari 23 Bantul" applied with N 180 kg.ha^{-1} produced the highest number of tillers. Application of N 90 kg.ha^{-1} on "Sigupai" variety significantly reduced the number of empty grains. "Sigupai" has a higher proportion of grains per panicle and yield per sampling plot than "Inpari 23 Bantul", and dosage N 90 kg.ha^{-1} increased grain yield per clump and yield per sampling plot significantly. Nitrogen at 180 kg.ha^{-1} increased the N content and absorption N in primordial phase of "Sigupai" variety, and increased N grain content of the "Inpari 23 Bantul" variety. Nitrogen at 90 kg.ha^{-1} in "Sigupai" had a higher NUE at primordia phase than "Inpari 23 Bantul". This study showed that local variety "Sigupai" is suitable for growing rice with low nitrogen input.

Keywords: Aceh aromatic rice, low input, nitrogen dose, N uptake, *Oryza sativa* L.

Introduction

Nitrogen (N) is an important element for crops, including rice (*Oryza sativa* L.) to sustain growth, yield and prime quality (Mauad et al., 2003; Samonte et al., 2006; Manzoor et al., 2006; Faraji, 2013; Gu et al., 2015; Singh et al., 2016; Zhu et al., 2016). In Indonesia, the use of N as a fertilizer is an important input for rice cultivation because of it is easily leached, and the crop response positively to nitrogen fertilization (Choudhury and Kennedy, 2005; Lestari, 2016; Kasno and Rostam, 2017). At present, the average use of N for rice is 90 to 130 kg.ha^{-1} (BALITTANAH, 2013). Indonesia is the 3rd country worldwide with the highest N fertilizer consumption in Asia (FAO, 2015). The high N uses do not only increase production cost, but also causes high nitrification of waters (Singh et al., 1995; Xue et al., 2016).

Studies of nitrogen use efficiency (NUE) in rice have been widely reported, e.g. Tayefe et al. (2011); Haque and Haque (2016); Koffi et al. (2016), but the study on aromatic rice is still limited. Siregar and Marzuki (2011) identified several factors that determine the level of NUE of rice plants, including varieties and the improvement of cultivation techniques. The cultivation techniques include plant density, proper irrigation and proper application of N fertilizer, including the dosage, method and time of fertilizer application.

The demand for high value aromatic rice has been increasing (Golam et al., 2011). The aromatic rice is estimated to have reached 15 to18% of the rice trade, which turns into the highest price in the world market (Giraud, 2013). According to BALITBANGTAN (2015), there are currently around five aromatic rice varieties in Indonesia which are categorized to have superior characters. Along with the increasingly popular aromatic rice consumption within the community, it is important to understand the nitrogen use efficiency of these varieties. Moreover, most rice growers believe that increasing nitrogen fertilization to their rice crops will increase rice yields. Therefore, the efforts to increase the NUE, especially for the aromatic rice, are important in order to support the eco-friendly implementation of rice cultivation.

"Inpari 23 Bantul" is one of national aromatic rice varieties which has the highest yield of dried unhusked grain (DUG), 9.2 t.ha^{-1} with an average of 6.9 t.ha^{-1} DUG (BALITBANGTAN, 2017). The national superior varieties normally have early ripening process. However, some rice growers consistently cultivate other local varieties like "Sigupai", which represents the identity of Aceh Barat Daya Regency. In addition, the rice grains of this variety has a fluffy texture and pandanus-like scent (BPTP, 2016), even though the productivity is only round 3 to 4 t.ha^{-1} (PPVTPP 2014). The lower productivity of local rice varieties is commonly compensated by the superiority of other traits, such as better biotic and abiotic adaptation, and having specific rice grain quality (Bakhtiar et al., 2011; Sitaresmi et al., 2013).

In this study, NUE of the two aromatic rice varieties, "Inpari 23 Bantul" and the Aceh local variety "Sigupai" were studied to evaluate the effect of N fertilizer doses on growth and yield of these two aromatic rice varieties. The results of this study can provide information of a more efficient development of sustainable rice cultivation systems based on the nitrogen use efficiency.

Materials and Methods

Experimental Site

The experiment was conducted at the Experimental Station Babakan Sawah Baru IPB, Dramaga, Bogor (106.736284, and -6.561721) in November 2017 until March 2018 with monthly rainfall of 207.0, 181.2, 189.2, 358.9, and 122.7 mm (average 211.8 mm per month), respectively, and temperature of 26.3ºC, 25.9 ºC, 25.7 ºC, 25.4 ºC, 26.0 ºC, respectively (average 25.9 ºC) (BMKG 2018). The study site is about 250 above sea levels. The soil type was latosol with N content of 0.14%, organic C 0.91%, P_2O_5 9.5 ppm, Ca 5.27 of cmol.kg^{-1}, Mg 1.58 of cmol.kg^{-1}, K 0.18 of cmol.kg^{-1}, and Na 2.07 of cmol.kg^{-1}.

Plant Materials

The two rice varieties used in this experiment were "Inpari 23 Bantul" (Figure 1 A) and "Sigupai" (Figure 1 B). Seedlings were transplanted when they were 16-day-old. Prior to sowing, the seeds were firstly soaked in water to separate the good quality rice seeds (drowning) and empty grains (floating). Seeds were planted with a spacing of 25 cm x 25 cm, two seeds per planting hole.

Figure 1. Rice "Inpari 23 Bantul" (A) and "Sigupai" (B)

The rotten and dwarf seedlings were then replaced at one to two weeks after planting (WAP). N fertilizer was applied three times with equal split dose at seven days after planting (DAP), the tillering phase, and the primordial phase. Due to harvesting age difference between the "Sigupai" and "Inpari 23 Bantul" the second and third N fertilizers were applied at different times. The first variety, "Sigupai", had the second and third N fertilizer application on the 35th and 75th DAP, while the second variety, "Inpari 23 Bantul", had the same amount of fertilizer on the 28th and 45th DAP. Phosphorus fertilizer was applied in the form of SP36 at 100 kg.ha^{-1} at planting. Potassium fertilizer (KCl) at 100 kg.ha^{-1} was applied twice, half at planting and the rest at grain filling phase. Weeds growing around the crops were removed as required. Pest and disease controls were carried out manually and chemically using pesticides. Irrigation was carried out intermittently. Harvesting was done after 90-95% of rice grains had turned yellow. The water supply was terminated a week before harvesting.

Data Collection

The variables measured were the growth (the height of the plant, the number of tillers and time to flower), the yield components (the proportion of empty grains, the number of grains per panicle, the grain yield per plant, and sampling plot yield), N content and absorption of the plants at primordial phase which include the whole above ground shoots, straw and grains. One plant per plot was sampled for NUE measurements. Plant height and the number of tillers were measured every week, whereas time to flower (in days after planting, DAP) was calculated when 50% of the plant population in the plot had flowered. The yield component was calculated after harvesting which was conducted at 145 days after planting in "Sigupai", and 115 days after planting in "Inpari 23

Bantul". Proportion of empty grains was calculated by separating filled grains from the empty grains of four panicles per plant from each plot using the following formula :

$$\text{Percentage of empty grains} = \frac{\text{Total number of empty}}{\text{grains/Number of grains}} \text{ x } 100\ \%$$

N content in the rice primordial stage, straw and grain was measured by the Kjedahl method (Eviati and Sulaeman, 2009). Additionally, NUE was calculated using the following formula (Siregar and Marzuki, 2011):

$$\text{NUE\%} = \frac{\text{N removed / N applied}}{\text{N fertilizer (Kg N/ha)}} \text{ x } 100$$

Experimental Design

The experimental design used in this study was the randomized split plot design. The main plot was the dose of nitrogen fertilizer (N) of 0, 45, 90, 135, and 180 kg.ha^{-1} and the subplot is the rice varieties, "Sigupai", and "Inpari 23 Bantul". Each replication consisted of a plot of 5 m x 5 m and replicated three times, totaling 30 plots.

The data obtained were analyzed using analysis of variance (ANOVA) using SAS version 9.1. Significant different between treatments were further analyzed using Duncan Multiple Range Test (DMRT) at a significant level of 5%.

Results and Discussion

Plant Height and Number of Tillers

The application of N fertilizer increased plant height and number of tillers in both varieties; the results also show an interaction between the fertilizer dosages and rice varieties. The application of N fertilizer on "Sigupai" significantly resulted in taller plants than in "Inpari 23 Bantul". On the contrary, "Inpari 23 Bantul" significantly produced more tillers than the "Sigupai" (Table 1; Figure 2 A).

Plant growth was influenced by environmental, physiological and genetic of the plants. The application of N fertilizer at high doses promoted plant growth. N is very important in the vegetative phase, specifically in promoting the growth of rice stems, branches and leaves. Nitrogen is one of the essential nutrients that make up amino acids, proteins which has important roles in plant growth rates (Lakitan, 2007). The adequate availability of N will ensure optimal N absorption for protein formation and facilitating photosynthesis. Meanwhile, assimilates from photosynthesis was used as energy to support vegetative growth, including to increase of plant height and number of tillers. Therefore, N fertilizer enhances the vegetative growth of plants as compared to non-fertilized plants. The study conducted by Zadeh and Hashemi (2014) also demonstrated that the higher the dose of N fertilizer applied the higher the increase in plant height.

"Sigupai" and "Inpari 23 Bantul" have different plant height and number of tillers (Table 1, Figure 2 A and B). Presumably, the differences in plant height and number of tillers in "Sigupai" and "Inpari 23 Bantul" varieties are the results of the different genetic traits of the two cultivars (Sitohang, 2014).

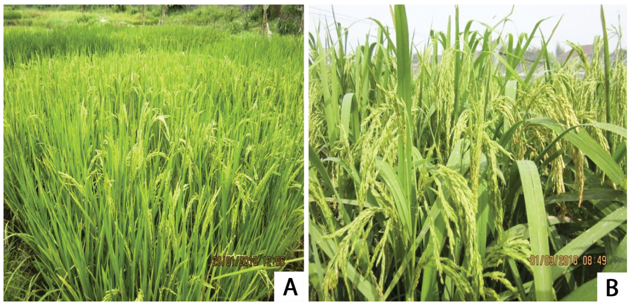

Figure 2. Rice "Inpari 32 Bantul" at 80 days after planting (A); rice "Sigupai" at 100 days after planting (B)

Table 1. The effects of N fertilizer doses on plant height and number of tillers of rice "Sigupai" and "Inpari 23 Bantul".

Dose N (kg.ha^{-1})	Plant height (cm)		Number of tillers	
	"Sigupai"	"Inpari 23 Bantul"	"Sigupai"	"Inpari 23 Bantul"
0	118.87 d	106.20 d	11.60 c	14.47 b
45	138.27 c	112.47 d	12.20 bc	12.20 bc
90	154.73 b	112.33 d	12.10 bc	13.80 bc
135	158.07 b	110.60 d	11.80 bc	17.27 a
180	175.47 a	119.93 d	13.40 bc	17.73 a

Note: Values followed by the different letters within the same column show significant differences according to DMRT test at α 5%.

Time to Flower and Proportion of Empty Grains

Nitrogen fertilizer and rice varieties have a significant effect on the flowering time and the proportion of empty grains (Table 2). The time to flower of the “Sigupai” was 35 day slower than “Inpari 23 Bantul” (Table 2). “Sigupai” fertilized with 135 kg.ha^{-1} flowered at about the same time with the control. In contrast the application of N at 90 kg.ha^{-1} significantly delayed the time to flower of “Inpari 23 Bantul”. Apparently “Inpari 23 Bantul” showed a higher sensitivity to nitrogen fertilization than “Sigupai”. With nitrogen fertilization at 180 kg.ha^{-1} “Sigupai” flowered nine days later than control, whereas in “Inpari 23 Bantul” the time to flower was delayed only by 6 days than control (Table 2).

The delayed in flowering time due to N fertilizer application has been widely reported (Mahajan et al., 2010; Wani et al., 2016; Wang et al., 2018). According to Makarim and Suhartik (2009) early maturing rice (110 days) has a vegetative period of 45 days followed by a 35 days of reproductive phase, and ended with maturation of seeds for 30 days. It is in contrast to the age of old rice (130 days), in which the vegetative phase lasts for 65 days; 35 days for the reproductive phase and 30 days for maturation of seeds. In this study, the delay of flowering in “Sigupai” and “Inpari 23 Bantul” occurred because of the prolonged vegetative phase; the duration of the other phases of growth was relatively undisturbed.

In the control treatment (without N application), the proportion of empty grains in “Sigupai” was significantly lower than that of “Inpari 23 Bantul”. The increasing dose of N, which was up to 135 kg.ha^{-1}, did not affect the number of empty grain in “Sigupai”. However, N at the dose of 180 kg.ha^{-1} the plants had empty grain proportion that was higher than the control. On the other hand, the increasing dose of N in “Inpari 23 Bantul” had a reduced the percentage of empty grains. N fertilizer application at 180 kg.ha^{-1} increased the proportion of empty grains (Table 3). The level of empty and filled grains in rice was influenced by genetic and environmental factors (Yoshida, 1981; Tubur et al.,2012; Nokkoul and Wichitparp, 2014; Sridevi and Chellamuthu, 2015; Dulbari et al., 2017; 2018a; 2018b).

Table 2. The effects of N fertilizer doses on time to flower and the proportion of empty grains of rice “Sigupai” and “Inpari 23 Bantul”.

Dosis N (kg.ha^{-1})	Time to flower (DAP)		Percentage of empty grains (%)	
	“Sigupai”	“Inpari 23 Bantul”	“Sigupai”	“Inpari 23 Bantul”
0	110.00 b	75.33 e	24.54 b	40.15 a
45	110.00 b	75.66 e	18.80 b	39.20 ab
90	110.00 b	76.67 d	18.40 b	29.41 ab
135	110.00 b	81.33 c	22.50 b	27.84 ab
180	119.00 a	81.00 c	32.60 b	31.11 ab

Note: Values followed by the different letters within the same column show significant differences according to DMRT test at α 5%. DAP: day after planting.

Nitrogen has important influence the growth and physiological variables of the crops, including rice (Chaturdevi, 2005; Islam et al., 2009; Wang et al., 2017). The increase in the proportion of empty grains in “Sigupai” with the application N fertilizer at doses of 135 to 180 kg.ha^{-1} was likely related to the morphological characters of the plant; “Sigupai” had broader and longer leaves so that they shaded each other resulting the leaf canopy was drooping. This condition caused an uneven distribution of light to all parts of the leaf. Consequently, the rate of photosynthesis might have decreased. Other morphological characters that influence the level of empty grains in the “Sigupai” were taller posture plants which causing plant to lodge. According to Wahyuti (2012), taller plants usually have weaker stems so they can easily collapse, which may result in a damaged xylem and phloem thus inhibits nutrient and photosynthetic transport.

“Inpari 23 Bantul” fertilized with N at of 90 to 135 kg.ha^{-1} had a reduction in the proportion of empty grains, which was presumably related to the delay in leaf yellowing, resulting in a longer duration for photosynthesis, as also reported by Abu et al. (2017). The rainfall that occurred at 10th week after planting until the harvesting period was quite heavy which caused “Inpari 23 Bantul” plants to be attacked by disease, especially in plants that received N at 180 kg.ha^{-1}. These environmental factors were likely resulted in the increase of the empty grain proportion. Dulbari et al. (2018) reported the physiological disturbances against the plants may occur during extreme weather conditions, including the translocation of nutrients causing the increase of empty grain proportion. Further research is required to determine the effects of extreme environmental conditions including heavy rainfall on the NUE of aromatic rice varieties.

Rice Yield

The N fertilizer at 90 kg.ha^{-1} increased grain yield per clump and per sampling plot (Table 4). "Sigupai" produced 12.75% of grain per panicle and 10.08% of sampling plot yield higher than "Inpari 23 Bantul". The application of N at 90 kg.ha^{-1} significantly increased grain yield by 34.55% and 36.69% for yield per clump and per sampling plot, respectively, over the control.

The "Sigupai" variety took up more nitrogen compared to "Inpari 23 Bantul" as shown by the analysis of N content in tissues (Table 5). The grain yield was related to the ability of the plant in each variety to take and to use N. Nitrogen is one of the constituent elements of chlorophyll. An increase in nitrogen will increase the chlorophyll content, so the high N absorption will optimize the photosynthesis rate. Hence, it also increases the number of grains per panicle, grain yield per clump and per plot. The products of photosynthesis, in addition to being used for growth, is also stored and used as food reserve in the form of carbohydrates for flower formation, fruit and seeds (Rudy, 2017). The more food reserves stored, the more likely the occurrence of grain formation in each panicle will be.

Nitrogen availability is one of the main limiting factors in rice growth; the yield of rice plants will be below its genetic potential without N fertilizer application (Kasno and Rostaman, 2017). However, at too high doses N can also cause a decrease in yield. Table 4 shows that the highest grain yield per clump and the highest plot yield were obtained at 90 kg.N.ha^{-1} fertilizer dosage treatment. The rate of increase in crop yields occurred in fertilizer treatments at 45 to 90 kg.N.ha^{-1}, then yield started to decrease as the N dosage increases. These results are similar to those reported by Moro (2015).

Nitrogen Levels in Rice Shoots at Primordial Stage, Straw and Grains

The N content and absorption of shoot dry weight at primordial stage, straw and grain showed that they were not affected by the interaction of N dose treatment and varieties. The different rates of N fertilizer increased the content and absorption of N. It can be stated that increasing the dose of N fertilizer increased N absorption and content (Table 5).

The N content and absorption in general increased in the primordia, straws and grain as the N fertilizer dosages increased (Table 5). The highest N content and absorption was obtained at 180 kg.N.ha^{-1} fertilizer relative to the control which received no N fertilizer. The different rice varieties showed differences in N content and absorption. The highest N content in the primordia phase was obtained in "Sigupai", while the N content in high grain rice was obtained in the "Inpari 23 Bantul". However, it was also seen that the N content and absorption in the primordial phase was higher than that of straws and grains. This is in line with Triadiati et al. (2012) who reported that nitrogen is needed in numbers during the vegetative phase. Based on the accumulation of dry matter, about 80% of N was absorbed by the plants before the flowering phase. Table 5 shows that the N content and absorption in the generative phase,which in this case, were analyzed for the decrease of the straw

Table 4. Effect of N fertilizer dosages on the number of grains per panicle, grain yield per clump, and dry tile yield of rice "Sigupai" and "Inpari 23 Bantul"

Dosage N (kg.ha^{-1})	Number of grains per panicle	Grain yield per clump (g)	Sampling plot yield (kg per 6.25m^2)
0	231.07 a	26.98 c	1.95 d
45	271.87 a	30.79 bc	2.30 c
90	286.89 a	41.22 a	3.08 a
135	259.60 a	34.92 b	2.55 b
180	288.32 a	40.00 a	2.36 bc
Rice varieties			
"Sigupai"	281.92 a	35.83	2.58 a
"Inpari 23 Bantul"	245.97 b	33.74	2.32 b
Interaction	ns	ns	ns

Note: Values followed by the different letters within the same column show significant differences according to DMRT test at α 5%; ns: not significantly different.

Table 5. Effect of N fertilizer dosage on nitrogen content and nitrogen uptake of rice “Sigupai” and “Inpari 23 Bantul”

Dosage N (kg.ha^{-1})	N content (%)			Absorbtion of N (g per plant)		
	Shoots at primordial stage	Straw	Grain	Shoot at primordial stage	Straw	Grain
0	1.30 b	0.87 a	1.14 b	0.25 c	0.31 a	0.30 c
45	1.62 b	0.80 a	1.15 b	0.40 bc	0.34 a	0.35 c
90	1.71 b	1.05 a	1.21 b	0.38 bc	0.46 a	0.47 b
135	2.29 a	0.99 a	1.38 a	0.61 ab	0.43 a	0.51 ab
180	2.49 a	0.99 a	1.39 a	0.88 a	0.41 a	0.57 a
Rice variety						
“Sigupai”	2.01 a	0.93 a	1.22 b	0.62a	0.39 a	0.44 a
“Inpari 23 Bantul”	1.75 b	0.95 a	1.29 a	0.38b	0.39 a	0.44 a
Interaction	ns	ns	ns	ns	ns	ns

Note: Values followed by the different letters within the same column show significant differences according to DMRT test at α 5%; ns: not significantly different.

and grain. This may be due to a decrease in the vegetative growth rate, although some tillers were still forming during the generative phase, yet the final number of tillers per plant was very small, i.e. two to three tillers per plant).

In this study, the highest N content in the primordia phase was in the “Sigupai”, while the highest N content in the grain was produced by the “Inpari 23 Bantul”. This indicates that in the early stages of growth, varieties are more responsive to fertilization. Another possibility is because “Sigupai” was included in a deep age variety, which has a longer vegetative phase; hence the accumulation of N was also greater. The variety “Sigupai” absorbed N 38.71% more than in “Inpari 23 Bantul” in the primordia phase. Contrarily, the “Inpari 23 Bantul” variety was early maturing, meaning that it had a shorter time to accumulate N. Interestingly; the N content in the “Inpari 23 Bantul” variety (grain) was higher than that of “Sigupai”. The grain seen in “Inpari 23 Bantul” was a stronger sink compared to “Sigupai”. This is most likely because the amount of grain per panicle of “Inpari 23 Bantul” was 12.75%, which was lower than that of “Sigupai”(Table 4).

Nitrogen Use Efficiency (NUE)

NUE was calculated based on N absorbed by plants with total N applied to the crop. Our results demonstrated that NUE was influenced by N doses and the rice variety. However, there were no significant interactions between N dose and variety in affecting NUE (Table 6). The treatment without N was used as reference for relative calculation. The NUE value of “Sigupai” was significantly higher than “Inpari 23 Bantul” (Table 6). The NUE in “Sigupai” in the vegetative phase (primordial stage) was 59.85% higher than “Inpari 23 Bantul”, which indicates that NUE was influenced by plant genetic factors. These findings confirmed report by Rose et al. (2017) that rice NUE is highly influenced by the genetics of the plant.

Table 6 shows that NUE was affected by the growth phase and plant parts. NUE at the primordial stage was higher than the generative phase. Besides, the grain combined with N user was higher compared to the straw. The relationship between partitions of plants and the use of nitrogen in rice plants has been widely studied (Duan et al., 2006). According to Jipelos (1989), the proportion of nitrogen absorbed by plants compared to the application level ranges from 22 to 65%; and NUE of irrigated rice fields was about 45%. Factors that influence the value of NUE of rice according to Duan et al. (2007), Triadiati et al. (2012), Li et al. (2017) are rice cultivars, the availability of N in the soil, application of N fertilizer dosage, and the availability of enzymes for assimilation.

In this study, the NUE value decreased with the increasing doses of N fertilizer. However, it cannot be concluded that this trend is an exclusive phenomenon in aromatic rice. In general, the value of NUE is more influenced by various factors including technical cultivation (Yadaf et al., 2017). An interesting finding from this study is that the local “Sigupai” showed higher NUE values compared to the national superior variety, the “Inpari 23 Bantul”. This indicates that the use of local varieties, in some ways, can be an alternative way to reduce excessive use of N. The productivity of “Sigupai” variety in this study only

Table 6. The efficiency of nitrogen use (NUE) in different growth stages of rice "Sigupai" and "Inpari 23 Bantul" treated with different dosages of nitrogen fertilizer.

Dosage N ($kg.ha^{-1}$)	NUE (%)		
	Vegetative phase	Generative phase	
	Primordia	Straw	Grain
0	-	-	-
45	32.01 a	14.59 a	10.62 a
90	15.20 a	8.92 ab	18.81 a
135	27.01 a	5.69 b	11.43 a
180	36.01 a	3.38 b	14.52 a
Rice variety			
"Sigupai"	39.65 a	8.41 a	14.82 a
"Inpari 23 Bantul"	15.92 b	7.88 a	14.64 a
Interaction	ns	ns	ns

Note: Values followed by the different letters within the same column show significant differences according to DMRT test at α 5%; ns: not significantly different.

reached 10.08% higher than that of "Inpari 23 Bantul". From the economic perspective, the recommended dose of N in "Sigupai" is 90 $kg.ha^{-1}$. Therefore when compared to "Inpari 23 Bantul" which required N at 135 $kg.ha^{-1}$ "Sigupai" requires 45 kg less nitrogen. The 10.08% yield increase in "Sigupai" yield with N fertilization at 90 $kg.ha^{-1}$ is economically viable. The cost of rice production in Indonesia has been increasing (BPS, 2016; 2017). The results of this study has demonstrated that there are opportunities to reduce N fertilizer and reduce the cost of rice production in Indonesia by growing local rice varieties.

Conclusion

Nitrogen use efficiency in aromatic rice is influenced by nitrogen doses and rice varieties. "Sigupai" variety has a higher NUE compared to the national variety, the "Inpari 23 Bantul", at the same nitrogen dose. The local rice variety "Sigupai" can be grown with a low N fertilizer input of 90 $kg.ha^{-1}$. The study implies that efforts to reduce excessive use of N fertilizer could be achieved by growing selected local varieties.

Acknowledgement

The authors thanked LPDP, Republic of Indonesia, for providing scholarship and research supports for this study.

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