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Nitrogen Use E? ciency of Local and National Aromatic Rice Varieties in Indon esia ..... Journal of Tropical Crop Science Vol. 5 No. 3, October 2018 www.j-tropical-crops.com 79 Nitrogen E? ciency Local National Rice Varieties in Indonesia Abstract Nitrogen e? ciency indicates ratio between amount fertilizer removed the ? eld 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 superior rice treated di? erent of fertilizer The was using levels N as main plots, 0, 90, and 180 -1 ; two varieties sub a Aceh "Sigupai" a rice variety "Inpari 23 Bantul". The results showed that the application N kg.ha -1 to signi? cantly increased plant However, caused delay the to in varieties. 23 applied N kg.ha -1 produced highest of Application N kg.ha -1 on variety reduced number of grains. has higher of grains panicle yield sampling than "Inpari 23 Bantul", and dosage N 90 kg.ha -1 increased grain per and per plot signi? cantly. at kg.ha -1 increased N and N primordial of "Sigupai" and N content the 23 variety. at kg.ha -1 in had higher at phase than 23 This showed local variety is for rice low nitrogen input. Keywords: Aceh rice, input, dose, N uptake, Oryza sativa L.

Introduction Nitrogen is important for including rice (Oryza sativa L.) to sustain growth, yield and prime quality (Mauad et al., 2003; Samonte et al., 2006; et ., Faraji, Gu al ., 2015; Singh et al., 2016; Zhu et al ., 2016). In Indonesia, the of as fertilizer an input rice because it easily and the response to fertilization (Choudhury Kennedy, Lestari, Kasno Rostam, At the use N rice 90 130 -1 (BALITTANAH, 2013). Indonesia is the 3 rd country worldwide with the highest fertilizer in Asia 2015).

The high N uses do not only increase production cost, but causes nitri? cation waters et

al ., 1995; Xue et al., 2016). Studies nitrogen e? ciency in have been widely reported, e.g. Tayefe et al. (2011); Haque and (2016); al. but study on rice still Siregar Marzuki (2011) several that 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 for value rice been increasing et 2011). aromatic is estimated to have reached 15 to18% of the rice trade, which into highest in world (Giraud, 2013). According to BALITBANGTAN (2015), there currently ? ve rice in which categorized have characters.

with increasingly aromatic consumption the it Chairunnisak A , Sugiyanta* B , Edi Santosa B A Post Graduate School, Bogor Agricultural University, Bogor 1668 0, Indonesia. B Department of Agronomy and Horticulture, Bogor Agricultural Uni versity, Bogor 16680, Indonesia. *Corresponding authors; email:mr_sugiyanta@yahoo.co.id RESEARCH ARTICLE Chairunnisak, Sugiyanta, Edi Santosa Journal of Tropical Crop Science Vol. 5 No. 3, October 2018 www.j-tropical-crops.com 80 important to understand the nitrogen use e? ciency of these Moreover, rice believe that increasing nitrogen fertilization to their rice crops will rice Therefore, e? orts increase NUE, for aromatic are in to the implementation of rice cultivation.

“Inpari Bantul” one aromatic varieties which has the highest yield of dried unhusked grain 9.2 -1 an of t.ha -1 DUG (BALITBANGTAN, 2017). The national superior varieties have ripening However, rice consistently other varieties “Sigupai”, represents the of Aceh Daya In the grains this has ? u? y and pandanus-like (BPTP, even the is round to t.ha -1 (PPVTPP 2014).

lower of rice is commonly by superiority other traits, as biotic abiotic and speci? c grain (Bakhtiar al., 2011; Sitaresmi et al., 2013). In study, of two rice “Inpari 23 Bantul” and the Aceh local variety “Sigupai” were to the ect N doses growth yield these aromatic rice results this can information a e? cient of sustainable cultivation based the nitrogen use e? ciency.

Materials and Methods Experimental Site The was at Experimental Station Sawah IPB, Bogor (106.736284, and -6.561721) in November 2017 until March with rainfall 207.0, 189.2, and mm 211.8 per month), respectively, and temperature of 26.3ºC, 25.9 ºC, ºC, ºC, ºC, (average 25.9 (BMKG The site about above levels. soil was with content 0.14%, C P 2 O 5 ppm, Ca of -1 , 1.58 cmol.kg -1 , 0.18 cmol.kg -1 , and Na 2.07 of cmol.kg -1 .

Plant Materials The rice used this were “Inpari Bantul” 1 and (Figure 1 Seedlings transplanted they 16-day-old. Prior sowing, seeds ? rstly soaked water separate good rice seeds and grains Seeds were with spacing 25 x cm, seeds per planting hole. Figure 1. Rice “Inpari 23 Bantul” (A) and “Sigupai” (B) The and seedlings then at to weeks planting N was applied three times with equal split dose at seven days after planting (DAP), the tillering phase, and the primordial Due harvesting di? erence between “Sigupai” “Inpari Bantul” second and third N fertilizers were applied at di? erent times.

The ? rst variety, “Sigupai”, had the second and third fertilizer on 35 th 75 th while second “Inpari Bantul”, the same of on 28 th 45 th Phosphorus fertilizer was applied in the form of SP36 at kg.ha -1 at fertilizer at kg.ha -1 applied half planting and rest grain phase. growing around crops removed required. and controls carried manually chemically using pesticides. Irrigation was carried out intermittently. was after of rice had yellow.

water was terminated a week before harvesting. Data Collection The measured the (the of plant, number tillers time ? ower), the yield components (the proportion of empty grains, the of per the yield per and plot N and absorption the at phase include whole ground straw grains. plant plot sampled NUE measurements.

Plant height and the number of tillers were every whereas to (in after DAP) calculated 50% the population the had The component calculated harvesting which conducted 145 after in “Sigupai”, 115 after in 23 Nitrogen Use E? ciency of Local and National Aromatic Rice Varieties in Indon esia ..... Journal of Tropical Crop Science Vol. 5 No. 3, October 2018 www.j-tropical-crops.com 81 Bantul”.

Proportion of empty grains was calculated by separating grains the grains four panicles plant each using following formula : N content in the rice primordial stage, straw and grain was by Kjedahl (Eviati Sulaeman, Additionally, was using following (Siregar Marzuki, 2011): Experimental Design The design in study the randomized plot The plot 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 23 Each consisted a plot of 5 m x 5 m and replicated three times, totaling 30 plots.

The obtained analyzed analysis variance (ANOVA) using SAS version 9.1. Signi? cant di? erent treatments further using Multiple Test at signi? cant level of 5%. Results and Discussion Plant Height and Number of Tillers The of fertilizer plant and number of tillers in both varieties; the results also show interaction the dosages and varieties. application N on “Sigupai” resulted taller than “Inpari Bantul”.

the “Inpari Bantul” signi? cantly more than “Sigupai” (Table 1; Figure 2 A). Plant was by physiological genetic the The application of N fertilizer at high doses promoted plant growth. is important the phase, speci? cally promoting growth rice branches and leaves.

Nitrogen is one of the essential nutrients make amino proteins has roles plant rates 2007). adequate of will optimal absorption protein and facilitating Meanwhile, from was as to vegetative growth, including to increase of plant height and number of tillers. Therefore, N fertilizer enhances the growth plants compared non- fertilized The conducted Zadeh Hashemi also that higher the dose of N fertilizer applied the higher the increase in plant height. “Sigupai” “Inpari Bantul” di? erent height number tillers 1, 2 A B).

the erences plant and number tillers “Sigupai” “Inpari Bantul” varieties the of di? erent traits of the two cultivars (Sitohang, 2014). Figure Rice 32 at days planting rice at days after planting (B) Table 1. The ects N doses plant and of rs rice and 23 Bantul”. Dose N (kg.ha -1) Plant height (cm) “Sigupai”“Sigupai” 0 106.20 d14.47 b 45112.47 d12.20 bc 90112.33 d13.80 bc 135110.60 d17.27 a 180119.93 d17.73 a Note: followed the erent within same show di? erences to test at a 5%. Chairunnisak, Sugiyanta, Edi Santosa Journal of Tropical Crop Science Vol. 5 No.

3, October 2018 www.j-tropical-crops.com 82 Time to Flower and Proportion of Empty Grains Nitrogen fertilizer and rice varieties have a signi? cant e? ect the time the of empty (Table The to of “Sigupai” 35 slower “Inpari Bantul” (Table 2). “Sigupai” fertilized with 135 kg.ha -1 ? owered at the time the In the application of N at 90 kg.ha -1 signi? cantly delayed the to of 23 Apparently “Inpari Bantul” a sensitivity nitrogen than With fertilization 180 -1 ? owered days than whereas “Inpari Bantul” the to was only 6 than Table e? ects N doses time ? ower the n empty of “Sigupai” and “Inpari 23 Bantul”. Dosis N (kg.ha -1) Time to ? ower (DAP) “Sigupai”“Sigupai” 0 75.33 e 40.15 a 4575.66 e 39.20 ab 9076.67 d 29.41 ab 13581.33 c 27.84 ab 18081.00 c 31.11 ab Note: followed the erent within same show di? erences to test at a 5%. DAP: day after planting. control (Table 2).

The in time to fertilizer application been reported et 2010; et 2016; et 2018). According Makarim Suhartik early maturing (110 has vegetative of 45 days followed by a 35 days of reproductive phase, and with of for days. is in to age old (130 in the phase for days; days the phase 30 for of In study, delay ? owering “Sigupai” “Inpari Bantul” because the vegetative the of other phases of growth was relatively undisturbed.

In control (without application), the of grains “Sigupai” signi? cantly than of 23 increasing of which up 135 -1 , did a? ect number empty in However, at dose 180 -1 the had grain that higher the control. the hand, increasing of in 23 had reduced percentage

of grains. fertilizer at kg.ha -1 increased the proportion of empty grains (Table 3). The level empty ? lled in was by genetic and environmental factors (Yoshida, 1981; Tubur al.,2012; and 2014; Sridevi Chellamuthu, Dulbari al., 2018a; 2018b). Nitrogen important the and physiological of crops, rice (Chaturdevi, Islam al., Wang al.,

The in proportion empty grains “Sigupai” the N at of to kg.ha -1 was related the characters the “Sigupai” had and leaves that shaded each resulting leaf was This caused uneven of light all of leaf. the of might decreased. morphological that the of grains the were posture plants causing to According Wahyuti taller usually weaker stems they easily which result in a damaged xylem and phloem thus inhibits nutrient and photosynthetic transport. “Inpari Bantul” with at 90 135 kg.ha -1 a in proportion empty grains, was related the in yellowing, in longer for photosynthesis, as also reported by Abu et al. (2017).

The rainfall that occurred at 10 th week after planting until the period quite which “Inpari Bantul” to attacked disease, especially plants received at kg.ha -1 . These factors likely in the of empty proportion. et (2018) the disturbances against the plants may occur during extreme weather Nitrogen Use E? ciency of Local and National Aromatic Rice Varieties in Indon esia ..... Journal of Tropical Crop Science Vol. 5 No. 3, October 2018 www.j-tropical-crops.com 83 conditions, the of causing increase empty proportion.

Further is to the ects of environmental including rainfall on the NUE of aromatic rice varieties. Rice Yield The fertilizer 90 -1 increased yield per and sampling (Table “Sigupai” produced 12.75% of grain per panicle and 10.08% of sampling plot yield higher than “Inpari 23 Bantul”. The application N 90 -1 signi? cantly grain yield by 34.55% and 36.69% for yield per clump and per sampling plot, respectively, over the control.

The variety up nitrogen compared “Inpari Bantul” shown the analysis N in (Table The yield related the of plant each variety take to N. is of constituent of An in nitrogen increase chlorophyll so high absorption optimize photosynthesis rate. it increases number grains per grain per and plot. products photosynthesis, addition being for growth, is also stored and used as food reserve in the of for formation, and (Rudy, The food stored, more the of formation in each panicle will be.

Nitrogen availability is one of the main limiting factors in growth; yield rice will below its potential N application (Kasno Rostaman, However, too doses can cause decrease yield. 4 that highest yield clump the plot were at kg.N.ha -1 fertilizer treatment. rate increase crop occurred fertilizer at to 90 -1 , yield to as N reported by Moro (2015).

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

absorption shoot weight at stage, and showed they not ected the of dose treatment varieties. di? erent of fertilizer increased the content and absorption of N. It can stated increasing dose N increased N absorption and content (Table 5). The content absorption general in primordia, and as N dosages (Table The N and absorption was obtained at 180 kg.N.ha -1 fertilizer relative the which no fertilizer.

The erent varieties di? erences N content absorption. highest content the phase obtained “Sigupai”, the content high rice obtained the “Inpari Bantul”. it also that the content absorption the phase was than of and This in with et (2012) reported nitrogen needed numbers the phase. on accumulation dry about of was by plants the ? owering phase.

Table 5 shows that the N content and in generative in case, analyzed the of straw Table E? ect N dosages the of per e, yield clump, dry 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 26.98 c 4530.79 bc 9041.22 a 13534.92 b 18040.00 a Rice varieties “Sigupai”35.83 “Inpari 23 Bantul”33.74 Interactionns Note: followed the erent within same show di? erences to test at a 5%; ns: not signi? cantly di? erent.

 and This be to decrease the vegetative rate, some were still forming during the generative phase, yet the ? nal number tillers plant very i.e. to three tillers per plant). In study, highest content the phase in “Sigupai”, the N content the was by “Inpari Bantul”.

indicates in early of growth, are responsive fertilization. Another possibility is because “Sigupai” was included in deep variety, has longer phase; hence the accumulation of N was also greater. The “Sigupai” N more in “Inpari 23 Bantul” in the primordia phase.

Contrarily, the 23 variety early meaning it a time accumulate Interestingly; N in “Inpari Bantul” variety was than of The grain in 23 was stronger compared to “Sigupai”. This is most likely because the amount grain panicle “Inpari Bantul” 12.75%, which was lower than that of “Sigupai”(Table 4). Nitrogen Use E ? ciency (NUE) NUE calculated on absorbed plants total applied the Our demonstrated NUE in? uenced N doses the variety.

there no signi? cant between dose variety in ecting (Table The without was as for calculation. NUE of was higher “Inpari Bantul” 6). NUE “Sigupai” the phase stage) 59.85% higher “Inpari Bantul”, indicates NUE in? uenced plant factors. ? ndings report Rose al.

that rice is in? uenced the of plant. Table shows NUE a? ected the phase plant NUE the stage was than generative Besides, grain with user higher to straw.

relationship partitions of and use nitrogen rice has been widely studied (Duan et al., 2006). According to Jipelos (1989), the proportion of nitrogen absorbed by plants to application ranges 22 to 65%; and NUE of irrigated rice ? elds was about 45%. that the of of according to Duan et al. (2007), Triadiati et al. (2012), Li al.

are cultivars, availability N in soil, of fertilizer and availability of enzymes for assimilation. In study, NUE decreased 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 in? uenced various including cultivation et 2017).

An ? nding from study that local showed higher NUE values compared to the national superior variety, "Inpari Bantul". indicates the of varieties, some can an alternative to excessive of The productivity "Sigupai" in study Table E? ect N dosage nitrogen and up take rice and 23 Bantul" Dosage N (kg.ha -1) N content (%) Shoots at primordial stage Straw Shoot at primordial stage Straw 0 0.87 a 1.14 b0.31 a 450.80 a0.40 bc0.35 c 901.05 a 1.21 b0.46 a 1350.99 a 1.38 a0.43 a 1800.99 a 1.39 a0.41 a Rice variety "Sigupai"0.93 a 1.22 b0.39 a "Inpari 23 Bantul"0.95 a0.38b0.44 a Interactionnsnsns Note: followed the erent within same show di? erences to test at a 5%; ns: not signi? cantly di? erent.

reached 10.08% higher than that of "Inpari 23 Bantul". From economic the dose N "Sigupai" 90 -1 . when compared "Inpari Bantul" required at 135 -1 requires kg nitrogen. The yield in yield N at kg.ha -1 is viable.

The of production Indonesia been increasing 2016; The of study demonstrated there opportunities to N and the of production in Indonesia by growing local rice varieties. Conclusion Nitrogen e? ciency aromatic is by nitrogen doses and rice varieties. "Sigupai" variety has higher compared the variety, the "Inpari 23 Bantul", at the same nitrogen dose. The local variety can grown a N input 90 -1 .

study that e? orts to reduce excessive use of N fertilizer could be achieved by growing selected local varieties. Acknowledgement The thanked Republic Indonesia, for scholarship research for this study. References Abu, Basri, and U. Response growth yield rice Oryza sativa L.) plants on the need for Nitrogen using leaf color chart. Agroland 24 ,119 ? 127. Bakhtiar., E., T., Rahmawati, (2011).

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"Hasil Struktur Usaha Tanaman 2017(SOUT2017-SPD)". pp. Badan Pusat Statistik. Jakarta. Table 6. The e? ciency of nitrogen use (NUE) in di? erent growth stages of rice "Sigupai" and "Inpari 23 Bantul" treated with di? erent dosages of nitrogen fertilizer. Dosage N (kg.ha -1) NUE (%) Vegetative phase Primordia Grain 0 - 4514.59 a 908.92 ab 1355.69 b 1803.38 b Rice variety "Sigupai"8.41 a "Inpari 23 Bantul"7.88 a Interactionns Note: followed the erent within same show di? erences to test at a 5%; ns: not signi? cantly di? erent.

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