[AJCS] Submission Acknowledgement

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Tanggal: Selasa, 15 Oktober 2019 13.59 GMT+7

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#2524 Review

Submission

Authors	Gribaldi Manan
Title	Strategy of Nitrogen Fertilizer Application to Increase Rice Growth and Production at Tidal Lowland Area
Section	Articles
Editor	Tony Elders

Peer Review

Round 1

Review Version	2524-5861-1-RV.DOCX 2019-10-15
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AJCS-Gribaldi-PNE2524 [Major revisions required]

Dari: Tony Elders (tony.elders@gmail.com)

Kepada: gribaldi64@yahoo.co.id

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Dear Mr. Gribaldi Gribaldi

Experts in the field have carefully reviewed your manuscript, submitted to Australian Journal of Crop Science.

Reference No: AJCS-Gribaldi-PNE2524 [Major revisions required]

Title: Strategy of Nitrogen Fertilizer Application to Increase Rice Growth and Production at Tidal Lowland Area

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Strategy of Nnitrogen Ffertilizer Aapplication to Iincrease Rrice Ggrowth and Pproduction at Ttidal Llowland Aarea

Gribaldi*, Nurlaili, F. Sakalena, N.Dewi and A. Asroh

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Abstract.

This research objective was to determine the effect of several rice varieties and N fertilizing application setting on the growth and yield of rice crop (*Oryza sativa* L.) at tidal lowland area. It was conducted at Experimental Site of Agricultural Agency of Banyuasin District by using Split Plot Design with three replications. The main plot is nitrogen fertilizer application (N) consisting of N1, N3(fertilizingof ½ dose at planting + ½ dose at primordial phase), N2, N4(1/3 dose at planting + 1/3 dose at primordial phase + 1/3 dose at harvest) at each dose of 90, 135 kg Nha^{-1}. The subplot is rice varieties (V) consisting of V1= Inpari 30, V2= Inpara 3, V3= Inpari 33, V4= Inpari 43 andV5 = Hipa 5 Ceva.The results showed that nitrogen fertilizing strategy could increased rice growth and yield at tidal lowland area. Hybrid rice variety of Hipa 5 Cevaby using several nitrogen fertilizing strategies was capable to increase rice tiller numbers and rice yield respectively in the range of 9 to 21 percent and 20 to 32 percent compared to inbred varieties. Hybrid rice variety of Hipa 5 Ceva added with fertilizer at dose of 135 kg N/ha and using fertilizing strategy of ½ dose at planting and the rest was given at primordial phase was the best treatment having the highest unhull rice yield of 4.9 ton of milling dry unhull rice/ha.

Keywords: Nitrogen fertilizing ,rice variety, tidal lowland.

Introduction

Tidal lowland is suboptimal land that had potential to be developed for rice cultivation site. Area of tidal lowland in Indonesia is estimated of

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Comment [A3]: The main problem of study is the experimental design when authors have not used any control treatment. Where is control treatment for fertilization strategy and also the control variety that all comparisons should be made with?

Comment [A4]: The definition and environmental condition of tidal lowland area should be given in MM section.

Comment [A5]: Do not use capital letters in the middle of sentences.

Comment [A6]: Ths does not definitely make sense! What is N1 and What is N2, N3, N4,.... Why authors have not clearly indicated what are N1, N2, N3 etc..?

Comment [A7]: On top of the above mentioned, these doses (90, 135) do not make sense at all! where is the position of these in you split-plot design?
I must be mentioned line the one in MM section.

Comment [A8]: The sentence is wrong! How rice variety is capable of rising yield etc. but the fertilizing is capable of this increase.

Comment [A9]: How much yield it was produced? Indicate it.

Comment [A10]: It looks that Introduction has not done an in-depth literature review.

about 20.1 million hectares and about 9.53 million hectares is potential to be developed for agricultural land (Haryono, 2013).

Rice production at tidal lowland area up to now is still low and it is estimated of about 600-700 thousand tonsof milling dry unhull rice per year or about 1.5 percent from national rice production of 62.56 million tons of milling dry unhull rice at productivity level of 3.0-5.0 $tonha^{-1}$. This low level of rice productivity among others caused by land biophysical condition and environment as well as cultivation system (BBSDLP, 2011).Therefore, one of efforts to increase rice productivity at tidal lowland is through improvement of cultivation system by using proper variety and fertilizing.

The selection of proper variety is one of efforts to increase rice crop yield. According to Gribaldi andNurlaili (2019), the use of proper variety which is suitable to specific environment will have effect on rice growth and yield at tidal lowland area. Planting of hybrid rice is one of efforts to utilize technology in increasing rice production. According to ZuanitaandSuryanto (2018), hybrid rice has potential 20–30 percent higher than that of inbred rice variety. In addition, Susilawati et al. (2012) had stated that hybrid rice had better growth than inbred rice variety and had produced higher harvest dry unhull rice per hectare with magnitude of about 39 percent. Moreover, study conducted by GribaldiandNurlaili (2019) showed that the use of hybrid rice variety of Hipa 5 Cevawas capable to increase rice production with magnitude of about 16 to 36 percent than that of inbred rice variety. Innovation of Nitrogen fertilizer application is also needed in addition to proper rice variety usage.

Nitrogen (N) is essential nutrient and plant requires higher N nutrient than other nutrients, besides it is a limiting factor for plant productivity

(Duanet al., 2007). Therefore, N fertilizer application is highly needed to increase rice growth and rice yield. According to Fifi (2016), application nitrogen fertilizer at dose of 138 kg/ha which is equivalent tourea fertilizer at dose of 300 kg/ha had produced the highest growth and yield of ratoon rice, although the recommended dose of nitrogen fertilizer for rice crop is 92 kg/ha or equivalent tourea fertilizer at dose of 200 kg/ha (Ambarita, 2018). According to Sakakibara et al. (2006), nitrogen gives significant effect on rice tillers development. In addition, Alfandi (2006) had stated that application of half dose N fertilizer at planting time will affect vegetative phase growth of crop, especially plant height and tillers development. The study results conducted by Gribaldiet al.(2013) showed that application of half dose urea fertilizerat planting time + Si and Zn nutrients, whereas the rest was applied 42 days after planting, gave the highest yield of unhulled rice for all tested varieties for immersion7-14 days after planting.

Based on the above discussion, the researcher had conducted study related to improvement of growth and yield of several rice varieties through N fertilizer application setting at tidal lowland area. The objective of this research was to determine the effect of several rice varieties and N fertilizer application setting on the growth and yield of rice (*Oryza sativa* L.)at tidal lowland area.

Comment [A11]: The aims and novelty of work must be clearly emphasized here....

Results and discussion

Comment [A12]: Discussion of each sub-heading is too short and weak. Authors SHOULD write a separate sub-headings to discuss the results using at least 10-14 new relevant references.

Results of analysis of variance in Table 1 showed that for each parameter amongstvariety had significant effect except for plant height parameter at 42 days after planting, whereas for each parameter amongst treatment had no significant effect, except for parameters of 100 grains weight, numbers

Comment [A13]: ??

of grains per panicle, and percentage of filled grains which had significant effect. Interaction between varieties and fertilizing treatments had no significant effect, except for parameters of numbers of grains per panicle, grain weight per panicle and percentage of filled grains per panicle.

The Chemical Property of Soil Prior to Treatment.

Comment [A14]: Do not use uppercase letters in the middle of sentences.

Analysis results of soil chemical properties prior to treatment at experimental land plot showed very low soil fertility, acid soil pH (pH = 4.63) with very low Al-dd content (Table 2). Base content such as Ca, Mg and K-dd was in the range of very low to low which indicate low nutrients availability at experimental land plot. Ameliorant in form of manure fertilizer at dose of 10 ton ha^{-1} and Nitrogen fertilizer were added in order to improve soil fertility so that lacking of nutrients availability could be overcome and could increase rice plant production.

Plant ~~H~~height~~.~~

The effect of fertilizing strategy for rice varieties at tidal lowland area on plant height of 42 days after planting can be seen in Figure 1. The plant height was diverse amongst varieties, but there was a trend that plant height of Hipa 5 Ceva variety was higher than other varieties at 42 days after planting amongst fertilizing treatments. This is due to the fact that hybrid variety of Hipa 5 Ceva had different characteristics than other varieties (inbred varieties) so that plant performance which is expressed by plant height was also different. This was in accordance ~~to~~ with opinion of Sitompul andGuritno (1995) which stated that genetic composition difference results in different plant performance. Moreover, GribaldiandNurlaili (2019) had stated that rice hybrid such as Hipa 5

Ceva is first generation(F1) that has characteristics which is highly determined by its both parents, whereas inbred varieties such as Inpari 30, Inpari 33, Inpari 43 and Inpara 3 are produced from strains crosses which produce pure strains so that these differences between hybrid and inbred varieties also results in different plants perfomance.

Number of Tillers.

Strategy of N fertilizing application for several rice varieties at age of 42 days after planting in relation to number of tillers at tidal lowland area can be seen in Table 3. The results showed that number of tillers for Hipa 5 Ceva variety was not significantly different than Inpari 43 variety, but it was significantly different than other varieties.

Hipa 5 Ceva variety is hybrid variety that has more tillers than that of inbred varieties (Inpari 30, Inpara 3, Inpari 33 and Inpari43), in which these varieties produce tiller numbers in the range of 79 to 91 tillers or 9 to 21 percent lower than that of Hipa 5 Ceva variety (Figure 2). High tiller numbers on hybrid variety (Hipa 5 Ceva) because this variety is more adaptive to environmental condition having low soil pH (pH 4.6) so that it has faster vegetative growth than inbred varieties. This was in accordance to opinion of Virmaniand Kumar (2004) which stated that hybrid rice had high adaptation capability in low pH environment. According to HusanaandSuryanto (2010), tiller numbers of rice plant would be maximum if it has suitable genetic characteristics and suitable environmental condition for its growth and development. In addition, Satoto et al. (2009) had stated that hybrid rice has higher vigority than inbred rice and genetical property of hybrid rice is superior compared to

its parents. Therefore, hybrid rice has better vegetative growth (Susilawati et al., 2011).

Plant Dry Matter Weight.

Results of this study showed that plants dry matter weight at age of 42 days after planting was significantly different amongst varieties, in which hybrid variety of Hipa 5 Ceva had the highest dry matter weight with magnitude of 20.1 g clump^{-1} (Table 4). This is due to the fact that this variety showed fast growth response as indicated by high tiller numbers than other varieties so that plants dry matter weight for this variety was also high. According to Mungara (2013), the increase of plants dry matter weight is an indicator of the increase of plants growth and development. Plant dry matter weight is an accumulation of organic compounds that has been successfully been synthesized by plant from inorganic compounds, especially water and carbohydrate (Suryaningrum et al., 2016).

Yield and Yield Components.

The effect of varieties and fertilizing treatments at tidal lowland area on unhull rice yield (ton ha^{-1}) can be seen in Table 5. The varieties treatment had significant effect on unhull rice yield in which hybrid variety of Hipa 5 Ceva was significantly different than other inbred varieties. Hybrid variety of Hipa 5 Ceva that was given ½ dose fertilizer at planting time and the rest dose was given at primordial phase with dose of 135 kg N ha^{-1} had the highest unhull rice yield with magnitude 4.9 ton of milling dry unhull rice per ha. Inbred varieties (Inpari 30, Inpara 3, Inpari 33 and

Inpari 43) had produced unhull rice of about 68–80 percent or 20-32 percent lower than that of hybrid variety of Hipa 5 Ceva (Figure 2B). This was in accordance to opinion of ZuanitaandSuryanto (2018) which stated that hybrid variety rice had yield potential 20-30 percent higher than that of inbred variety rice. In addition, high yield of unhull rice on hybrid variety of Hipa 5 Ceva was due to higher values of numbers of grains per panicle, grains weight per panicle and percentage of filled grain than that of other inbred varieties in this study (Tabel 6). High values of yield components results in high yield of unhull rice. According to Khairullah (2006), yield potential is determined from prediction of all yield components per clump multiplied by population per hectare and percentage of living plants. In addition, unhull rice yield was also determined by plants dry matter weight where in this study was indicated by strong relationship between unhull rice yield and plants dry matter weight (r = 0.899*).

Materials and Method

Comment [A15]: This section should be divided with sub-headings such as Plant materials, treatments, experimental design and number of replications, conduction of experiment, traits measured, statistical analysis, etc.

This study was conducted from April to July 2019 at Experimental Site of Agricultural Agency of Banyuasin District, Telang Sari Village, Tanjung Lago Subdistrict, Banyuasin District, South Sumatra, Indonesia by using Split Plot Design with three replications. The main plot is nitrogen fertilizer application (N) consisting of N1 = fertilizingof ½ dose at planting + ½ dose at primordial phase, N2 = 1/3 dose at planting + 1/3 dose at primordial phase + 1/3 dose at harvest) at dose of 90 kg N/ha as well as N3 = ½ dose at planting + ½ dose at primordial phase and N4 = 1/3 dose at planting + 1/3 dose at primordial phase + 1/3 dose at harvest)

at dose of 135 kg N/ha. The subplot is rice varieties (V) consisting of V1= Inpari 30, V2= Inpara 3, V3= Inpari 33, V4= Inpari 43 andV5 = Hipa 5 Ceva.

Land is cleared from grasses and crop residues by spraying them with Paraquat herbicide and subsequently were cut using grass mower machine followed by soil tillage using moldboard plow and tractor, and finally is development of land plots with size of 3x2 m using raffia rope.

Rice seeds of Benih padi varietas Inpari 30, Inpara 3, Inpari 33, Inpari 43, dan Hipa Ceva 5 varieties were incubated for 3 days and after germinating was seeded on raised beds having size of 1.2x8 m. Seedsthat had already 21 days old were transferred into each exprimental plot (unit) having size of 3x2m which was previously added with manure at dose of 10 ton.ha^{-1}, and subsequently seedswere planted at vertical position with planting distance of 25 x25cm and using 2 seedsper planting hole with depth of 2 cm according to method of Gribaldiet al. (2016). N fertilizing was given according to the treatments, whereas P and K fertilizers were given on all treatments at planting time with dose of 60 kg.ha^{-1} respectively (Setiawan et al., 2012). The main trunk of plant was cut during harvest with height of 15-20 cm from soil surface according to method of Nakano et al.(2009).

The agronomic characteristics were consisted of plant height (cm),number of Tillers per plant (steam), plant dry matter weight per clump (g), numbers of grains per panicle (grains), percentage of filled grains per panicle (%), 100 grainsweight (g) and unhull rice yield per hectare (ton).

Agronomic characteristics data was analyzed statistically by using *Analysis of Variance* (ANOVA) followed by Least Significant Different (LSD) test at significant level (α) of 5%. All data calculation was done by

using SPSS 22.0 program and data was presented in form of tables and figures.

Conclusion

Nitrogen fertilizing strategy applied on several rice varieties was capable to increase the growth and rice yield at tidal lowland area. Hybrid variety of Hipa 5 Cevausing several nitrogen fertilizing strategies could increase rice tiller numbers and rice yield with respective magnitude in the range of 9-21 percentand 20–32 percent compared to inbred varieties. Hybrid variety of Hipa 5 Ceva fertilized with fertilizing strategy consisting of ½ dose fertilizer given at planting time and the rest dose was given at primordial phase was the best treatment having the highest unhull rice yield with magnitude 4.9 ton of milling dry unhull rice per ha.

Acknowledgement

The acknowledgement is delivered to Ministry of Research, Technology and Higher Education that had already provided funding for this research through Applied Grant of 2019 with contract number:T/140/E3/RA.00/2019.

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Ambarita Y, Hariyono D,Aini N (2018)Application of NPK and ~~U~~urea fertilizers on rice (*Oryza sativa* L.) using ratoonsystem. Journal of Crop Production. 5:1228-1234.

BBSDLP (2011) State of the art and grand design for swamp land development. Center of Agricultural Land Resource, Bogor. pp. 44 (in Indonesian)

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DuanYH, ZhangYL, Ye LY, Fan XR, XuGH, Shen QR (2007) Responses of rice cultivars with different nitrogen use efficiency to partial nitrate nutrition. Ann. Bot. 1153-1160.

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Table 1. Analysis of variance results in term of nitrogen fertilizing effect on the observed parameter of rice varieties.

No	The observed parameters	Variety (V)	Fertilizing (N)	Interaction (I)
1	Plant height	3.21 ns	3.06 ns	0.78 ns
2	Number of Tillers per plant	3.37*	1.92 ns	1.92 ns
3	Plant dry matter weight per clump	4.67*	1.82 ns	0.37 ns
4	100 grains weight	5.01 *	14.71 *	1.50 ns
5	Numbers of grains per panicle	55.72*	9.39 *	5.79 *
6	Grain weight per panicle	5.37 *	1.41 ns	2.33 *
7	Percentage of filled grains per panicle	13.76 *	6.03 *	8.97 *
8	Unhulled rice yield per hectare	6.96 *	0.54 ns	1.44 ns

* = significantly different
ns = not significantly different

Comment [A17]: I was wondering how how N fertilization does not show any effect on plant height.

Table 2. Analysis results of several soil characteristics prior to treatment.

Type of analysis	Value	Status
pH H_2O	4.63	Acid
C-Organic (%)	3.29	High
N-total (%)	0.25	Medium
P-Bray 1 (ppm)	27	High
K-dd (cmol(+)/kg)	0.13	Low
Na (cmol(+)/kg)	0.33	Low
Ca (cmol(+)/kg)	0.70	Low
Mg (cmol(+)/kg)	0.22	Very Low
KTK (cmol(+)/kg)	15.23	Low
Al-dd (cmol(+)/kg)	2.10	Very Low
Texture		
Sand (%)	41.94	
Loam (%)	24.08	
Clay (%)	33.98	

Source: Soil Science Laboratory, Agricultural Faculty, Sriwijaya University, South Sumatera, Indonesia, 2019.

Comment [A18]: Kg per what?

Comment [A19]: ??

Table 3. Number of tillers (steam) at age of 42 days after planting (*dap*) on several rice varieties and fertilizing treatments at tidal lowland area.

Treatment Fertilizing (N)	Varieties (V)					N average ($LSD_{.05}$: 2.79)
	Inpari 30	Inpara 3	Inpari 33	Inpari 43	Hipa5 Ceva	
N1	12.1	11.6	12.6	14.8	14.9	13.1
N2	10.0	11.5	11.3	12.3	14.1	11.8
N3	10.2	12,0	11.1	11.4	12.7	11.5
N4	11.8	10.9	13.1	12.1	13.8	12.3
V average ($LSD_{.05}$:1.40)	11.0 a	11.5a	12.0a	12.6ab	13.9b	

Numbers followed by the same letter at the same row are not significantly different based on LSD test at α level of 5%.

Table 4. Plant dry matter weight (g $clump^{-1}$) at age of 42 days after planting (*dap*) on several rice varieties and fertilizing treatments at tidal lowland area.

Treatment Fertilizing (N)	Varieties (V)					N average ($LSD_{.05}$: 4.73)
	Inpari 30	Inpara 3	Inpari 33	Inpari 43	Hipa 5 Ceva	
N1	18.4	15.5	16.8	15.1	22.3	17.7
N2	15.2	13.1	15.4	9.2	16.6	13.9
N3	19.7	15.5	19.5	17.0	21.8	18.6
N4	17.4	17.0	14.7	13.0	19.5	16.3
V average ($LSD_{.05}$: 3.24)	17.7ab	15.3 a	16.6 a	13.6 a	20.1 b	

Numbers followed by the same letter at the same row are not significantly different based on LSD test at α level of 5%.

Table 5. Unhulled rice yield (ton ha^{-1}) of several rice varieties and fertilizing treatments at tidal lowland area.

Treatment Fertilizing (N)	Varieties (V)					N average ($LSD_{.05}$: 0.88)
	Inpari 30	Inpara 3	Inpari 33	Inpari 43	Hipa 5 Ceva	
N1	3.8	3.5	4.0	2.1	4.1	3.5
N2	2.8	2.5	3.0	3.7	4.3	3.3
N3	3.8	2.7	3.9	3.0	4.9	3.7

Comment [A20]: Authors should have used a Tukey's test for all tables and then put the significance of differences on top of each value with a, b c etc.

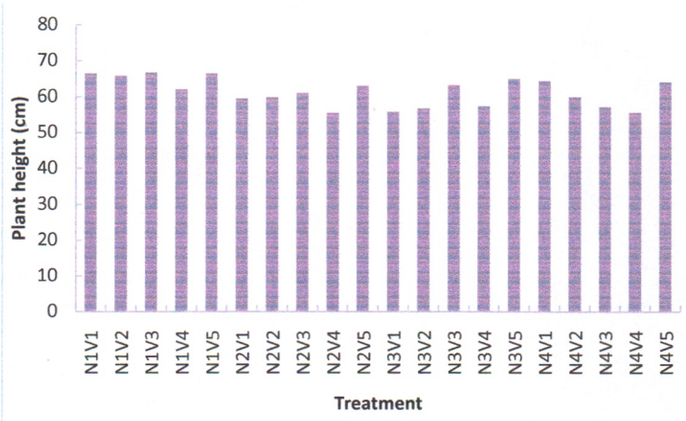
N4	2.6	3.2	3.0	3.1	4.5	3.3
V average	3.3 a	3.0 a	3.5 a	3.0 a	4.4 b	
($LSD_{.05}$: 0.67)						

Numbers followed by the same letter at the same row are not significantly different based on LSD test at α level of 5%.

Table 6. The effect of fertilizing and rice variety on several rice yield components at tidal lowland area.

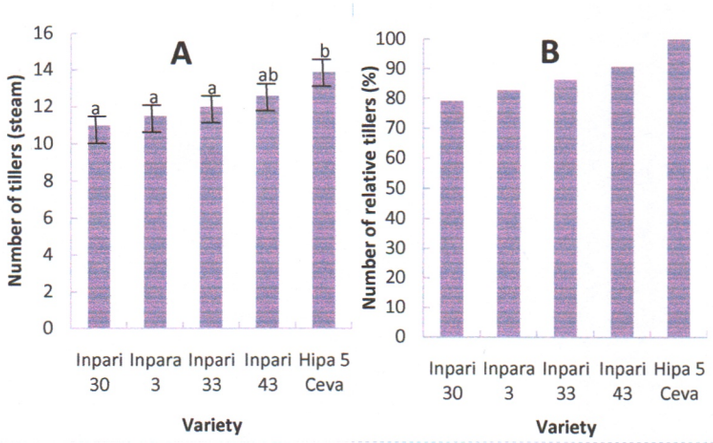
Treatment	Yield component			
	1	2	3	4
N1V1	93ab	1.8 a	89 bcd	2.8
N1V2	91ab	1.9 b	90 bcde	2.6
N1V3	85 a	1.9 b	90 bcde	2.6
N1V4	63 a	1.2 a	95 de	2.3
N1V5	116 b	2.0 b	92 cde	2.5
N2V1	80 a	1.5 a	93 cde	2.4
N2V2	92 ab	1.5 a	92 cde	2.3
N2V3	60 a	1.8 a	88 bc	2.0
N2V4	64 a	1.8 a	85 b	1.9
N2V5	99 ab	2.3 b	94 cde	2.3
N3V1	103 b	2.0 b	94 cde	2.5
N3V2	105 b	1.5 a	94 cde	2.8
N3V3	103 b	1.9 b	91 bcde	2.5
N3V4	62 a	1.7 a	76 a	2.6
N3V5	125 b	2.0 b	92 cde	2.5
N4V1	105 b	1.7 a	94 cde	2.9
N4V2	98 ab	1.5 a	93 cde	2.5
N4V3	73 a	1.4 a	94 cde	2.4
N4V4	85 a	1.7 a	92 cde	2.3
N4V5	107 b	1.9 b	96 e	2.3

1. Number of grains per panicle. $LSD_{.05}$=39.69, 2. grain weight per panicle (g). $LSD_{.05}$=0.69, 3. Percentage of filled grains (%). $LSD_{.05}$= 6.13 and 4. 100 grains weight (g). Numbers followed by the same letter at the same column are not significantly different based on LSD test at α level of 5%.



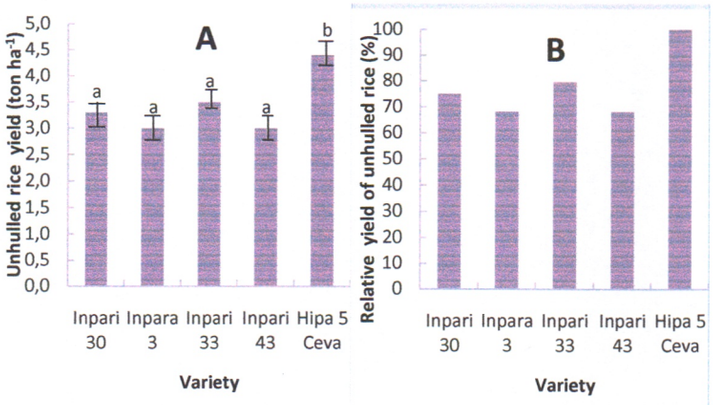
Comment [A21]: If there is no significance as ANOVA Table, then the Fig should be deleted.

Figure 1. Plant height (cm) of several rice varieties using N fertilizing treatments at age of 42 Day After Planting (DAP). V1: Inpari 30, V2: Inpara 3, V3: Inpari 33,V4: Inpari 43, V5: Hipa 5 Ceva. (N1 = fertilizing of ½ dose at planting + ½ dose at primordial phase; N2 = 1/3 dose at planting + 1/3 dose at primordial phase + 1/3 dose at harvest) at dose of 90 kg N ha^{-1} and (N3 = ½ dose at planting + ½ dose at primordial phase; N4 = 1/3 dose at planting + 1/3 dose at primordial phase + 1/3 dose at harvest) at dose of 135 kg N ha^{-1}.



Comment [A22]: SE bars must be added.

Figure2. Number of tillers (A) and number of relative tillers (B) of several rice varieties related to N fertilizing at tidal lowland area. $LSD_{0.05}$ = 1.40.



Comment [A23]: All Figs should be prepared as solid image with JPEG or TIF.

Comment [A24]: The SE bars should be added.

Figure 3. Unhulled rice yield (A) and relative yield of unhulled rice (B) of several rice varieties related to N fertilizing at tidal lowland area. $LSD_{0.05}$ = 0,67.

Re: AJCS-Gribaldi-PNE2524 [Major revisions required]

Dari: Gribaldi Ir (gribaldi64@yahoo.co.id)

Kepada: tony.elders@gmail.com

Tanggal: Sabtu, 8 Februari 2020 04.29 GMT+7

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Pada Kamis, 9 Januari 2020 07.41.20 WIB, Tony Elders <tony.elders@gmail.com> menulis:

Dear Mr. Gribaldi Gribaldi

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Reference No: AJCS-Gribaldi-PNE2524 [Major revisions required]

Title: Strategy of Nitrogen Fertilizer Application to Increase Rice Growth and Production at Tidal Lowland Area

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Dari: Tony Elders (tony.elders@gmail.com)

Kepada: gribaldi64@yahoo.co.id

Tanggal: Sabtu, 8 Februari 2020 07.32 GMT+7

Dear Dr. Gribaldi Gribaldi

I am pleased to inform you that your manuscript entitled,"Strategy of nitrogen fertilizer application to increase growth and yield of rice in ratoon system at tidal swampland", has been accepted for publication in AJCS.

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Re: AJCS-Gribaldi-PNE2524 [Major revisions required]

Dari: Gribaldi Ir (gribaldi64@yahoo.co.id)

Kepada: tony.elders@gmail.com

Tanggal: Sabtu, 8 Februari 2020 12.15 GMT+7

Dear Editor,

Here is the payment receipt for publication fees and English editing services.

I look forward to hearing from you.

Best regard,

Dr.Gribaldi

Pada Sabtu, 8 Februari 2020 07.32.39 WIB, Tony Elders <tony.elders@gmail.com> menulis:

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Gribaldi.

Dear Editor,

Herewith we submitted a manuscript entitled: "**Strategy of Nitrogen Fertilizer Application to Increase Rice Growth and Production at Tidal Lowland Area**" for consideration for publication in Australian Journal of Crop Sciences. This manuscript involved the result of research for increasing rice production in tidal land. Rice production in tidal land is still very low, this is due to low soil fertility and improper use of varieties by farmers. In addition, tidal land has unique characteristics, where the water demand is strongly influenced by tides. The application of fertilizer, especially improper N fertilizer, both in dosage and time of administration will affect the availability of nutrients for plants. Therefore, in this study a strategy was applied to administer N fertilizer by administering N fertilizer to various rice varieties. The results of this study indicate, Nitrogen fertilization strategies in several varieties can increase the growth and yield of rice in tidal fields. The Hipa 5 Cepa hybrid variety with various N fertilization strategies can increase the number of tillers and rice yield ranging from 9-21 percent and 20 - 32 percent compared to inbred varieties. The Hipa 5 Cepa hybrid variety, which is fertilized with 135 kg N / ha with a ½ dose fertilization strategy, is given at planting and the rest is given when primordia is the best treatment with the highest grain yield, which is 4.9 tons GKG / ha.

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We would like to confirm that the manuscript is curently not under consideration for publication elsewhere. All authors have read and approved the manuscript and take full responsibility for its content. The authors are also fully aware and agree with the editorial policy.

Thank you very much for your attention and help. We are looking forward to hearing from you.

Best regards,

Gribaldi

Strategy of Nitrogen Fertilizer Application to Increase Rice Growth and Production at Tidal Lowland Area

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Abstract.
This research objective was to determine the effect of several rice varieties and N fertilizing application setting on the growth and yield of rice crop (*Oryza sativa* L.) at tidal lowland area. It was conducted at Experimental Site of Agricultural Agency of Banyuasin District by using Split Plot Design with three replications. The main plot is nitrogen fertilizer application (N) consisting of N1, N3 (fertilizing of ½ dose at planting + ½ dose at primordial phase), N2, N4 (1/3 dose at planting + 1/3 dose at primordial phase + 1/3 dose at harvest) at each dose of 90, 135 kg N ha^{-1}. The subplot is rice varieties (V) consisting of V1= Inpari 30, V2= Inpara 3, V3= Inpari 33, V4= Inpari 43 and V5 = Hipa 5 Ceva. The results showed that nitrogen fertilizing strategy could increased rice growth and yield at tidal lowland area. Hybrid rice variety of Hipa 5 Ceva by using several nitrogen fertilizing strategies was capable to increase rice tiller numbers and rice yield respectively in the range of 9 to 21 percent and 20 to 32 percent compared to inbred varieties. Hybrid rice variety of Hipa 5 Ceva added with fertilizer at dose of 135 kg N/ha and using fertilizing strategy of ½ dose at planting and the rest was given at primordial phase was the best treatment having the highest unhull rice yield of 4.9 ton of milling dry unhull rice/ha.

Key words: Nitrogen fertilizing , rice variety, tidal lowland

Introduction

Tidal lowland is suboptimal land that had potential to be developed for rice cultivation site. Area of tidal lowland in Indonesia is estimated of

about 20.1 million hectares and about 9.53 million hectares is potential to be developed for agricultural land (Haryono, 2013).

Rice production at tidal lowland area up to now is still low and it is estimated of about 600-700 thousand tons of milling dry unhull rice per year or about 1.5 percent from national rice production of 62.56 million tons of milling dry unhull rice at productivity level of 3.0-5.0 ton ha^{-1}. This low level of rice productivity among others caused by land biophysical condition and environment as well as cultivation system (BBSDLP, 2011). Therefore, one of efforts to increase rice productivity at tidal lowland is through improvement of cultivation system by using proper variety and fertilizing.

The selection of proper variety is one of efforts to increase rice crop yield. According to Gribaldi and Nurlaili (2019), the use of proper variety which is suitable to specific environment will have effect on rice growth and yield at tidal lowland area. Planting of hybrid rice is one of efforts to utilize technology in increasing rice production. According to Zuanita and Suryanto (2018), hybrid rice has potential 20–30 percent higher than that of inbred rice variety. In addition, Susilawati et al. (2012) had stated that hybrid rice had better growth than inbred rice variety and had produced higher harvest dry unhull rice per hectare with magnitude of about 39 percent. Moreover, study conducted by Gribaldi and Nurlaili (2019) showed that the use of hybrid rice variety of Hipa 5 Ceva was capable to increase rice production with magnitude of about 16 to 36 percent than that of inbred rice variety. Innovation of Nitrogen fertilizer application is also needed in addition to proper rice variety usage.

Nitrogen (N) is essential nutrient and plant requires higher N nutrient than other nutrients, besides it is a limiting factor for plant productivity (Duan

et al., 2007). Therefore, N fertilizer application is highly needed to increase rice growth and rice yield. According to Fifi (2016), application nitrogen fertilizer at dose of 138 kg/ha which is equivalent to urea fertilizer at dose of 300 kg/ha had produced the highest growth and yield of ratoon rice, although the recommended dose of nitrogen fertilizer for rice crop is 92 kg/ha or equivalent to urea fertilizer at dose of 200 kg/ha (Ambarita, 2018). According to Sakakibara et al. (2006), nitrogen gives significant effect on rice tillers development. In addition, Alfandi (2006) had stated that application of half dose N fertilizer at planting time will affect vegetative phase growth of crop, especially plant height and tillers development. The study results conducted by Gribaldi et al.(2013) showed that application of half dose urea fertilizerat planting time + Si and Zn nutrients, whereas the rest was applied 42 days after planting, gave the highest yield of unhulled rice for all tested varieties for immersion 7-14 days after planting.

Based on the above discussion, the researcher had conducted study related to improvement of growth and yield of several rice varieties through N fertilizer application setting at tidal lowland area. The objective of this research was to determine the effect of several rice varieties and N fertilizer application setting on the growth and yield of rice (*Oryza sativa* L.) at tidal lowland area.

Results and discussion

Results of analysis of variance in Table 1 showed that for each parameter amongstvariety had significant effect except for plant height parameter at 42 days after planting, whereas for each parameter amongst treatment had no significant effect, except for parameters of 100 grains weight, numbers

of grains per panicle, and percentage of filled grains which had significant effect. Interaction between varieties and fertilizing treatments had no significant effect, except for parameters of numbers of grains per panicle, grain weight per panicle and percentage of filled grains per panicle.

The Chemical Property of Soil Prior to Treatment.

Analysis results of soil chemical properties prior to treatment at experimental land plot showed very low soil fertility, acid soil pH (pH = 4.63) with very low Al-dd content (Table 2). Base content such as Ca, Mg and K-dd was in the range of very low to low which indicate low nutrients availability at experimental land plot. Ameliorant in form of manure fertilizer at dose of 10 ton ha^{-1} and Nitrogen fertilizer were added in order to improve soil fertility so that lacking of nutrients availability could be overcome and could increase rice plant production.

Plant Height.

The effect of fertilizing strategy for rice varieties at tidal lowland area on plant height of 42 days after planting can be seen in Figure 1. The plant height was diverse amongst varieties, but there was a trend that plant height of Hipa 5 Ceva variety was higher than other varieties at 42 days after planting amongst fertilizing treatments. This is due to the fact that hybrid variety of Hipa 5 Ceva had different characteristics than other varieties (inbred varieties) so that plant performance which is expressed by plant height was also different. This was in accordance to opinion of Sitompul and Guritno (1995) which stated that genetic composition difference results in different plant performance. Moreover, Gribaldi and Nurlaili (2019) had stated that rice hybrid such as Hipa 5 Ceva is first

generation(F1) that has characteristics which is highly determined by its both parents, whereas inbred varieties such as Inpari 30, Inpari 33, Inpari 43 and Inpara 3 are produced from strains crosses which produce pure strains so that these differences between hybrid and inbred varieties also results in different plants perfomance.

Number of Tillers.

Strategy of N fertilizing application for several rice varieties at age of 42 days after planting in relation to number of tillers at tidal lowland area can be seen in Table 3. The results showed that number of tillers for Hipa 5 Ceva variety was not significantly different than Inpari 43 variety, but it was significantly different than other varieties.

Hipa 5 Ceva variety is hybrid variety that has more tillers than that of inbred varieties (Inpari 30, Inpara 3, Inpari 33 and Inpari43), in which these varieties produce tiller numbers in the range of 79 to 91 tillers or 9 to 21 percent lower than that of Hipa 5 Ceva variety (Figure 2). High tiller numbers on hybrid variety (Hipa 5 Ceva) because this variety is more adaptive to environmental condition having low soil pH (pH 4.6) so that it has faster vegetative growth than inbred varieties. This was in accordance to opinion of Virmani and Kumar (2004) which stated that hybrid rice had high adaptation capability in low pH environment. According to Husana and Suryanto (2010), tiller numbers of rice plant would be maximum if it has suitable genetic characteristics and suitable environmental condition for its growth and development. In addition, Satoto et al. (2009) had stated that hybrid rice has higher vigority than inbred rice and genetical property of hybrid rice is superior compared to

its parents. Therefore, hybrid rice has better vegetative growth (Susilawati et al., 2011).

Plant Dry Matter Weight.

Results of this study showed that plants dry matter weight at age of 42 days after planting was significantly different amongst varieties, in which hybrid variety of Hipa 5 Ceva had the highest dry matter weight with magnitude of 20.1 g clump^{-1} (Table 4). This is due to the fact that this variety showed fast growth response as indicated by high tiller numbers than other varieties so that plants dry matter weight for this variety was also high. According to Mungara (2013), the increase of plants dry matter weight is an indicator of the increase of plants growth and development. Plant dry matter weight is an accumulation of organic compounds that has been successfully been synthesized by plant from inorganic compounds, especially water and carbohydrate (Suryaningrum et al., 2016).

Yield and Yield Components.

The effect of varieties and fertilizing treatments at tidal lowland area on unhull rice yield (ton ha^{-1}) can be seen in Table 5. The varieties treatment had significant effect on unhull rice yield in which hybrid variety of Hipa 5 Ceva was significantly different than other inbred varieties. Hybrid variety of Hipa 5 Ceva that was given ½ dose fertilizer at planting time and the rest dose was given at primordial phase with dose of 135 kg N ha^{-1} had the highest unhull rice yield with magnitude 4.9 ton of milling dry unhull rice per ha. Inbred varieties (Inpari 30, Inpara 3, Inpari 33 and

Inpari 43) had produced unhull rice of about 68–80 percent or 20-32 percent lower than that of hybrid variety of Hipa 5 Ceva (Figure 2B). This was in accordance to opinion of Zuanita and Suryanto (2018) which stated that hybrid variety rice had yield potential 20-30 percent higher than that of inbred variety rice. In addition, high yield of unhull rice on hybrid variety of Hipa 5 Ceva was due to higher values of numbers of grains per panicle, grains weight per panicle and percentage of filled grain than that of other inbred varieties in this study (Tabel 6). High values of yield components results in high yield of unhull rice. According to Khairullah (2006), yield potential is determined from prediction of all yield components per clump multiplied by population per hectare and percentage of living plants. In addition, unhull rice yield was also determined by plants dry matter weight where in this study was indicated by strong relationship between unhull rice yield and plants dry matter weight ($r = 0.899^*$).

Materials and Method

This study was conducted from April to July 2019 at Experimental Site of Agricultural Agency of Banyuasin District, Telang Sari Village, Tanjung Lago Subdistrict, Banyuasin District, South Sumatra, Indonesia by using Split Plot Design with three replications. The main plot is nitrogen fertilizer application (N) consisting of N1 = fertilizing of ½ dose at planting + ½ dose at primordial phase, N2 = 1/3 dose at planting + 1/3 dose at primordial phase + 1/3 dose at harvest) at dose of 90 kg N/ha as well as N3 = ½ dose at planting + ½ dose at primordial phase and N4 = 1/3 dose at planting + 1/3 dose at primordial phase + 1/3 dose at harvest)

at dose of 135 kg N/ha. The subplot is rice varieties (V) consisting of V1= Inpari 30, V2= Inpara 3, V3= Inpari 33, V4= Inpari 43 and V5 = Hipa 5 Ceva.

Land is cleared from grasses and crop residues by spraying them with Paraquat herbicide and subsequently were cut using grass mower machine followed by soil tillage using moldboard plow and tractor, and finally is development of land plots with size of 3x2 m using raffia rope.

Rice seeds of Benih padi varietas Inpari 30, Inpara 3, Inpari 33, Inpari 43, dan Hipa Ceva 5 varieties were incubated for 3 days and after germinating was seeded on raised beds having size of 1.2x8 m. Seedsthat had already 21 days old were transferred into each exprimental plot (unit) having size of 3x2 m which was previously added with manure at dose of 10 ton.ha^{-1}, and subsequently seedswere planted at vertical position with planting distance of 25 x25 cm and using 2 seeds per planting hole with depth of 2 cm according to method of Gribaldi et al. (2016). N fertilizing was given according to the treatments, whereas P and K fertilizers were given on all treatments at planting time with dose of 60 kg.ha^{-1} respectively (Setiawan et al., 2012). The main trunk of plant was cut during harvest with height of 15-20 cm from soil surface according to method of Nakano et al.(2009).

The agronomic characteristics were consisted of plant height (cm), number of Tillers per plant (steam), plant dry matter weight per clump (g), numbers of grains per panicle (grains), percentage of filled grains per panicle (%), 100 grains weight (g) and unhull rice yield per hectare (ton).

Agronomic characteristics data was analyzed statistically by using *Analysis of Variance* (ANOVA) followed by Least Significant Different (LSD) test at significant level (α) of 5%. All data calculation was done by

using SPSS 22.0 program and data was presented in form of tables and figures.

Conclusion

Nitrogen fertilizing strategy applied on several rice varieties was capable to increase the growth and rice yield at tidal lowland area. Hybrid variety of Hipa 5 Ceva using several nitrogen fertilizing strategies could increase rice tiller numbers and rice yield with respective magnitude in the range of 9-21 percent and 20–32 percent compared to inbred varieties. Hybrid variety of Hipa 5 Ceva fertilized with fertilizing strategy consisting of ½ dose fertilizer given at planting time and the rest dose was given at primordial phase was the best treatment having the highest unhull rice yield with magnitude 4.9 ton of milling dry unhull rice per ha.

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Table 1. Analysis of variance results in term of nitrogen fertilizing effect on the observed parameter of rice varieties.

No	The observed parameters	Variety (V)	Fertilizing (N)	Interaction (I)
1	Plant height	3.21 ns	3.06 ns	0.78 ns
2	Number of Tillers per plant	3.37*	1.92 ns	1.92 ns
3	Plant dry matter weight per clump	4.67*	1.82 ns	0.37 ns
4	100 grains weight	5.01 *	14.71 *	1.50 ns
5	Numbers of grains per panicle	55.72*	9.39 *	5.79 *
6	Grain weight per panicle	5.37 *	1.41 ns	2.33 *
7	Percentage of filled grains per panicle	13.76 *	6.03 *	8.97 *
8	Unhulled rice yield per hectare	6.96 *	0.54 ns	1.44 ns

* = significantly different
ns = not significantly different

Table 2. Analysis results of several soil characteristics prior to treatment.

Type of analysis	Value	Status
pH H_2O	4.63	Acid
C-Organic (%)	3.29	High
N-total (%)	0.25	Medium
P-Bray 1 (ppm)	27	High
K-dd (cmol(+)/kg)	0.13	Low
Na (cmol(+)/kg)	0.33	Low
Ca (cmol(+)/kg)	0.70	Low
Mg (cmol(+)/kg)	0.22	Very Low
KTK (cmol(+)/kg)	15.23	Low
Al-dd (cmol(+)/kg)	2.10	Very Low
Texture		
Sand (%)	41.94	
Loam (%)	24.08	
Clay (%)	33.98	

Source: Soil Science Laboratory, Agricultural Faculty, Sriwijaya University, South Sumatera, Indonesia, 2019.

Table 3. Number of tillers (steam) at age of 42 days after planting (*dap*) on several rice varieties and fertilizing treatments at tidal lowland area.

Treatment Fertilizing (N)	Varieties (V)					N average ($LSD_{.05}$: 2.79)
	Inpari 30	Inpara 3	Inpari 33	Inpari 43	Hipa 5 Ceva	
N1	12.1	11.6	12.6	14.8	14.9	13.1
N2	10.0	11.5	11.3	12.3	14.1	11.8
N3	10.2	12,0	11.1	11.4	12.7	11.5
N4	11.8	10.9	13.1	12.1	13.8	12.3
V average ($LSD_{.05}$:1.40)	11.0 a	11.5a	12.0a	12.6ab	13.9b	

Numbers followed by the same letter at the same row are not significantly different based on LSD test at α level of 5%.

Table 4. Plant dry matter weight (g clump^{-1}) at age of 42 days after planting (*dap*) on several rice varieties and fertilizing treatments at tidal lowland area.

Treatment Fertilizing (N)	Varieties (V)					N average ($LSD_{.05}$: 4.73)
	Inpari 30	Inpara 3	Inpari 33	Inpari 43	Hipa 5 Ceva	
N1	18.4	15.5	16.8	15.1	22.3	17.7
N2	15.2	13.1	15.4	9.2	16.6	13.9
N3	19.7	15.5	19.5	17.0	21.8	18.6
N4	17.4	17.0	14.7	13.0	19.5	16.3
V average ($LSD_{.05}$: 3.24)	17.7ab	15.3 a	16.6 a	13.6 a	20.1 b	

Numbers followed by the same letter at the same row are not significantly different based on LSD test at α level of 5%.

Table 5. Unhulled rice yield (ton ha^{-1}) of several rice varieties and fertilizing treatments at tidal lowland area.

Treatment Fertilizing (N)	Varieties (V)					N average ($LSD_{.05}$: 0.88)
	Inpari 30	Inpara 3	Inpari 33	Inpari 43	Hipa 5 Ceva	
N1	3.8	3.5	4.0	2.1	4.1	3.5
N2	2.8	2.5	3.0	3.7	4.3	3.3
N3	3.8	2.7	3.9	3.0	4.9	3.7

N4	2.6	3.2	3.0	3.1	4.5	3.3
V average	3.3 a	3.0 a	3.5 a	3.0 a	4.4 b	
($LSD_{.05}$: 0.67)						

Numbers followed by the same letter at the same row are not significantly different based on LSD test at α level of 5%.

Table 6. The effect of fertilizing and rice variety on several rice yield components at tidal lowland area.

Treatment	Yield component			
	1	2	3	4
N1V1	93ab	1.8 a	89 bcd	2.8
N1V2	91ab	1.9 b	90 bcde	2.6
N1V3	85 a	1.9 b	90 bcde	2.6
N1V4	63 a	1.2 a	95 de	2.3
N1V5	116 b	2.0 b	92 cde	2.5
N2V1	80 a	1.5 a	93 cde	2.4
N2V2	92 ab	1.5 a	92 cde	2.3
N2V3	60 a	1.8 a	88 bc	2.0
N2V4	64 a	1.8 a	85 b	1.9
N2V5	99 ab	2.3 b	94 cde	2.3
N3V1	103 b	2.0 b	94 cde	2.5
N3V2	105 b	1.5 a	94 cde	2.8
N3V3	103 b	1.9 b	91 bcde	2.5
N3V4	62 a	1.7 a	76 a	2.6
N3V5	125 b	2.0 b	92 cde	2.5
N4V1	105 b	1.7 a	94 cde	2.9
N4V2	98 ab	1.5 a	93 cde	2.5
N4V3	73 a	1.4 a	94 cde	2.4
N4V4	85 a	1.7 a	92 cde	2.3
N4V5	107 b	1.9 b	96 e	2.3

1. Number of grains per panicle. $LSD_{.05}$=39.69, 2. grain weight per panicle (g). $LSD_{.05}$=0.69, 3. Percentage of filled grains (%). $LSD_{.05}$= 6.13 and 4. 100 grains weight (g). Numbers followed by the same letter at the same column are not significantly different based on LSD test at α level of 5%.

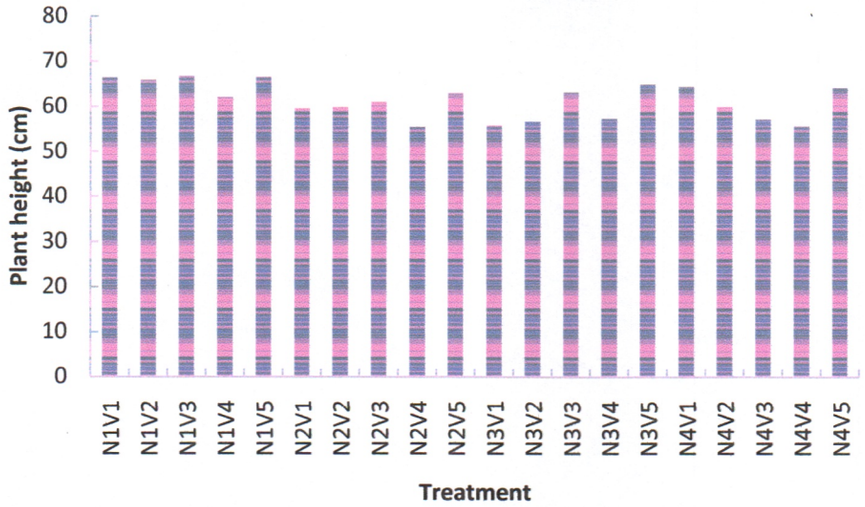

Figure 1. Plant height (cm) of several rice varieties using N fertilizing treatments at age of 42 Day After Planting (DAP). V1: Inpari 30, V2: Inpara 3, V3: Inpari 33, V4: Inpari 43, V5: Hipa 5 Ceva. (N1 = fertilizing of ½ dose at planting + ½ dose at primordial phase; N2 = 1/3 dose at planting + 1/3 dose at primordial phase + 1/3 dose at harvest) at dose of 90 kg N ha^{-1} and (N3 = ½ dose at planting + ½ dose at primordial phase; N4 = 1/3 dose at planting + 1/3 dose at primordial phase + 1/3 dose at harvest) at dose of 135 kg N ha^{-1}.

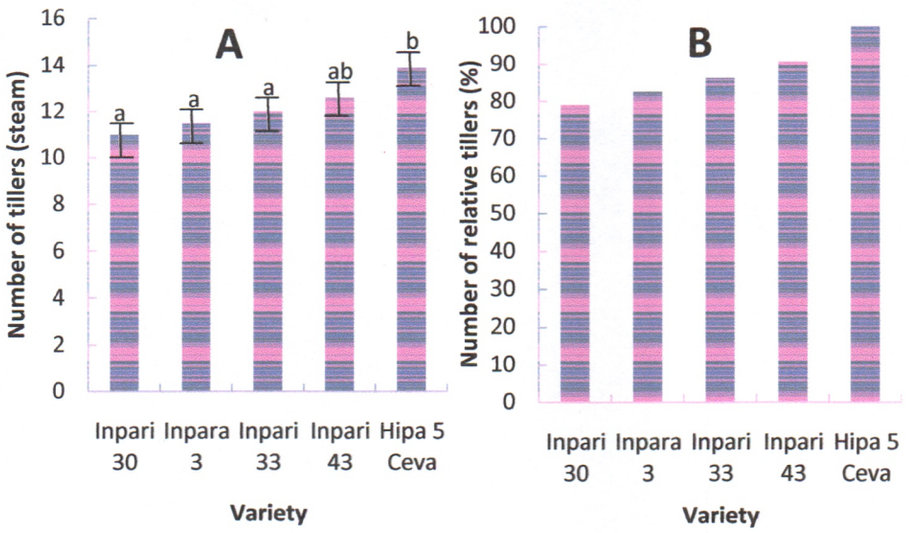

Figure 2. Number of tillers (A) and number of relative tillers (B) of several rice varieties related to N fertilizing at tidal lowland area. $LSD_{0.05}$ = 1.40.

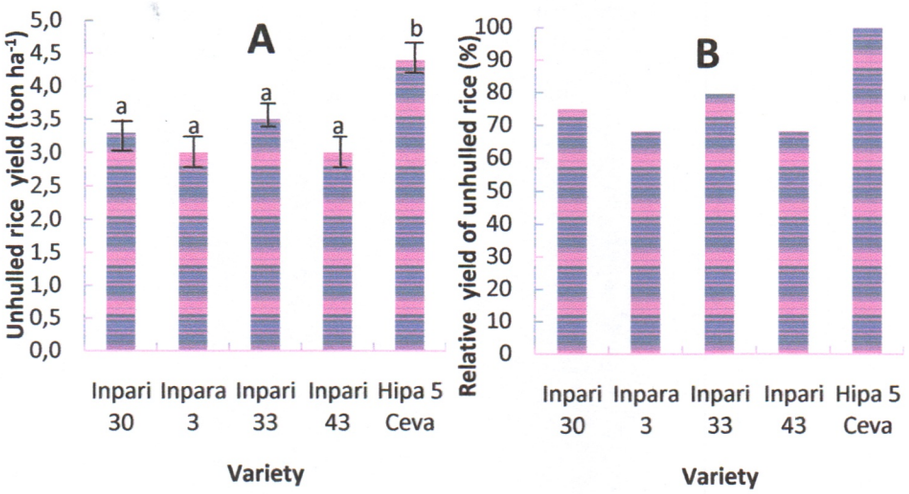

Figure 3. Unhulled rice yield (A) and relative yield of unhulled rice (B) of several rice varieties related to N fertilizing at tidal lowland area. $LSD_{0.05}$ = 0,67.