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Strategy of Rice Productivity Increment Through Agronomical Treatment at Two Flooding Types of Tidal Swampland

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Abstract

The research objective is to increase rice productivity using ratoon system through N fertilizer and growth regulator treatments at two flooding types of tidal swampland. It was conducted from February to August 2020. Experiment design used in this research is Split Plot Design with three replications. The main plot is N fertilizer and rice variety (NV) which consisted of **N1V1**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/3 dosis at harvest for Inpari 30 variety; **N1V2**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/3 dose at harvest for Hipa 5 Ceva variety; **N2V1**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/6 dose at harvest +1/6 dose at 21 days after harvest for Inpari 30 variety; **N2V2**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/6 dose at harvest +1/6 dose at 21 days after harvest for Hipa 5 Ceva variety. The subplot is application of growth regulator GA3 (G) consisting of **G0** = without application of GA3; **G1** = application of GA3 once in 7 days;**G2** = application of GA3 once in 14 days. The research results showed that N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/3 dosis at harvest and application of growth regulator GA3 60 ppm with interval of once in 7 days to ratoon rice is capable to increase rice productivity using ratoon rice system at B and C flooding types at tidal swampland

Keywords: Tidal swampland; N fertilizing; Growth regulator application; Productivity.

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1. Introduction

Tidal swampland is suboptimal land that had potential to be developed for rice cultivation site. Area of tidal swampland in Indonesia is estimated of about 20.1 million hectares and about 9.53 million hectares is potential to be developed for agricultural land [1].

Tidal swampland based on land flooding types was consisted of 4 flooding types. A and B flooding types area only receive flooding during high tide, whereas A flooding type receives flooding during high tide as well as low tide. C and D flooding types were area which are not receive tidal seawater. C flooding type area receives tidal infiltration with soil watertable depth less than 50 cm, whereas D flooding type receives tidal infiltration with soil watertable depth higher than 50 cm [2]. Farmers at tidal swampland area of South Sumatra usually conduct rice cultivation on B and C flooding types land.

Rice production at tidal swampland 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 [3]. Moreover [4-6], stated that the main problems in increasing of rice productivity at tidal swampland are high soil acidity and relatively low nutrients availability [5, 6] as well as water flooding that becomes constraint at several flooding types at tidal swampland [4]. Therefore, one of the efforts to increase rice productivity can be done through agronomic treatments,

such as; proper fertilizer application and adaptive rice variety having high ratoon potential can solve the above problems.

According to Susilawati, *et al.* [7], new rice strains and varieties had better vegetative growth and produce higher ratoon compared to inhybrid rices with ratoon production of 52.8 % to 54.7% from the main crop. Moreover [8] stated that high ratoon productivity of hybrid rice is closely related to higher vigority compared to inhybrid rice and hybrid property genetically is superior than its origin. According to Susilawati, *et al.* [7], fertilizer dose level applied to the main crop and ratoon crop, especially N fertilizer has significant effect on ratoon growth. Nitrogen (N) is essential nutrient and plant requires higher N nutrient than other nutrients, besides it is a limiting factor for plant productivity [9]. Therefore, N fertilizer application is highly needed to increase rice growth and rice yield. Moreover, growth increment of origin organ and to accelerate assimilate translocation in order to optimize crop growth can be done by using growth regulator on ratoon rice. According to Warso [10], the use of 60 ppm GA3 is capable to increase rice yield.

The objective of this research is to increase rice productivity using ratoon system through N fertilizer and growth regulator treatments at two flooding type in tidal swampland.

2. Materials and Methods

This research was done at paddy field area of tidal swampland having different flooding types consisting of B and C flooding types, i.e. B flooding type located at -20 38’59, 132”S 1040 44’28,449”E and C flooding type located at -20 38’58,81”S 1040 44’26,745”E in Muara Sugih Village, Tanjung Lago Subdistrict, Banyuasin District, South Sumatra, Indonesia. Experiment design used in this research is Split Plot Design with three replications. The main plot is N fertilizer and rice variety (NV) which consisted of **N1V1**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/3 dosis at harvest for Inpari 30 variety; **N1V2**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/3 doseat harvest for Hipa 5 Ceva variety; **N2V1**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/6 doseat harvest +1/6 doseat 21 days after harvest for Inpari 30 variety; **N2V2**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/6 doseat harvest +1/6 doseat 21 days after harvest for Hipa 5 Ceva variety. The subplot is application of growth regulatorGA3 (G) consisting of **G0** = without application of GA3; **G1** = application of GA3 once in 7 days;**G2** = application of GA3 once in 14 days.

Rice seeds of Inpari 30 andHipa 5 Cepavarieties are incubated for 3 days and after germinate they are sown at bed having size of 1.2 m x 8 m in which bed is previously treated with N, P, K, Si and Zn as well as manure with doses of 60, 40, 40, 30 and 20 kg.ha^{-1}as well as 10 ton ha^{-1} [11]. Seedling having age of 21 days is move to every subplot (unit) of treatment with size of 9 m x 3 m which is previously given manure of 10 ton ha^{-1} and subsequently seedling is planted with upright position with planting distance of 25 cm x 25 cm using 2 seedlings per hole with depth of 2 cm according to the choice method [12]. N fertilizing at the main stem and ratoon stem is applied according to treatments, whereas P and K are given for all treatments during main stem planting with dose of 60 kg for each hectare [13].

Harvest time is done 5 days before 100% maturity or 25 days after flowering. Cutting of the main crop is done at height 15-20 cm from soil surface [14]. In addition, rice ratoon is given growth regulator (ZPT) with magnitude of 60 ppm GA3 with application interval according to treatments. ZPT spraying is started 3 days after the main crop cutting up to before harvest. Observation of agronomical properties is consisted of fully rice grains yield per plot which is converted into yield per hectare (g), number of productive tillers per stump, the number of grains per panicle (grains).

2.1. Statistical Analysis

Data is statistically analyzed by using *Analysis of Variance* (ANOVA) followed by Honestly Significance Different (HSD) at 5% significant level. All calculation of data is done by using SPSS 22.0 program and it is presented in forms table.

3. Results

The results of the analysis of variance in the effect of nitrogen fertilization and ZPT application on several rice varieties can be seen in table 1. The effect of nitrogen fertilizer application on main crops and ZPT application on ratoons on several varieties and their interactions showed no significant effect on all observed parameters, but in tabulation it can be seen in tables 3a, 3b and 4a, 4b.

Tabel-1. Analysis of variance results in term of The effect of N fertilizer and ZPT (GA3) applications on several components yield for several rice varieties using ratoon system at C (1) and B (2) type flooding in tidal swampland

The observed parameters	Variety x Nitrogen (Main crop)		Zpt (Ratoon)		Interaction	
	1	2	1	2	1	2
The number of Productive Tillers per stump	ns	ns	ns	ns	ns	ns
The number of grains per panicle (grains)	ns	ns	ns	ns	ns	ns
Grain yield per hectare	ns	ns	ns	ns	ns	ns

Remarks: ns = not significantly different

3.1. Soil Chemical Characteristics Prior to Treatment.

Table-2. Results of soil analysis at two flooding types in tidal swampland area

Analysis	Results			
	C-type flooding	Criteria*	B-type flooding	Criteria*
N total (%)	0.20	Very low	0.43	Very low
pH	4.56	Acid	4.41	Very low
C-Organic (%)	9.33	Very high	8.74	Very high
Available P (ppm)	32.14	Very high	37.34	Very high
K-dd (me/100g)	0.46	Medium	0.34	Low
Na-dd (me/100g)	1.97	Very high	2.15	Very high
Ca-dd (me/100g)	1.25	Very low	1.17	Very low
Mg-dd (me/100g)	1.11	Medium	1.06	Medium
CEC (me/100g)	24.86	High	23.01	High
Al-dd (me/100g)	0.40	Low	1.70	Low
Texture (%)				
-Sand	11.08		6.08	
-Loam	50.03		55.10	
-Clay	38.89		38.82	

Source: Soil Science Laboratory, Faculty of Agriculture, Lampung University, Lampung. 2020.
Criteria*: Soil Research Office, Bogor, 2009.

Analysis results of chemical soil properties prior to treatment for two types of experimental plots showed that soil fertility levels either on C-type flooding or B-type lands was very low, soil pH was in the range of very acid to acid with pH values of 4.56 and 4,41, respectively. Alkaline content such as Ca, Mg and K-dd was in the range of very low to medium which indicate low nutrients availability in experimental land, especially total N nutrient content for two flooding types in tidal swampland is very low (Table 1). It is expected that addition of ameliorants in form of manure at dose 10 kg/ha and N fertilizer application can overcome nutrients availability problem and can increase rice crop yield.

3.2. Yield Rice

Table-3a. The effect of N fertilizer and ZPT applications on rice yield for several rice varieties using ratoon system at B type flooding in tidal swampland

Treatment	Yield (ton/ha)				Total Yield (Main Crop + Ratoon Crop) (ton/ha)		
	Main Crop	Ratoon					
		G0	G1	G2	G0	G1	G2
N1V1	4.4	1.5	1.9	1.7	5.9	6.3	6.1
N1V2	4.6	2.2	2.8	2.6	6.8	7.4	7.2
N2V1	4.5	2.0	2.6	2.2	6.5	7.1	6.7
N2V2	4.3	2.3	2.9	2.5	6.6	7.2	6.8

Remarks: **N1V1**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/3 dosis at harvest for Inpari 30 variety; **N1V2**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/3 doseat harvest for Hipa 5 Ceva variety; **N2V1**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/6 doseat harvest +1/6 doseat 21 days after harvest for Inpari 30 variety; **N2V2**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/6 doseat harvest +1/6 doseat 21 days after harvest for Hipa 5 Ceva variety. The subplot is application of growth regulator GA3 (G) consisting of **G0** = without application of GA3; **G1** = application of GA3 once in 7 days;**G2** = application of GA3 once in 14 days.

The effect of zpt (GA3) application on yield of several rice varieties which is fertilized with N can be seen in Table 3a and 3b. The best rice yield productivity (rice yield on main rice crop + rice yield on ratoon rice per planting season) was found on N fertilizer treatment for main rice crop at dose of 135 kg/ha which is given 1/3 dose during planting + 1/3 doseat primordia phase + 1/3 dose at harvest (N1) which is sprayed with GA3 at 60 ppm concentration given at once a week interval (G1) for rice ratoon of Hipa 5 Ceva variety (V2) with magnitude of 7.4 ton/ha at B type flooding land in tidal swampland (Tabel 3a)

At C type flooding land, the best total yield or rice productivity (rice yield from main crop and ratoon crop per planting season) is found at N fertilizer treatment for main crop with dose of 135 kg/ha which is given 1/3 dose during planting + 1/3 dose during primordia phase + 1/3 dose during harvesting (N1) that is sprayed with GA3 at concentration of 60 ppm given at interval of once a week (G1) for ratoon rice of Hipa 5 Ceva variety (V2) with magnitude of 7.1 ton/ha (Table 3b).

Tabel-3b. The effect of N fertilizer and ZPT applications on rice yield for several rice varieties using ratoon system at C type flooding in tidal swampland.

Treatment	Yield (ton/ha)				Total Yield (Main Crop + Ratoon Crop) (ton/ha)		
	Main Crop	Ratoon					
		G0	G1	G2	G0	G1	G2
N1V1	3.8	2.3	2.5	2.4	6.1	6.3	6.2
N1V2	4.2	2.5	2.9	2.7	6.7	7.1	6.9
N2V1	4.0	2.2	2.7	2.4	6.2	6.7	6.4
N2V2	4.0	2.5	2.8	2.7	6.5	6.8	6.7

Remarks: **N1V1**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/3 dosis at harvest for Inpari 30 variety; **N1V2**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/3 doseat harvest for Hipa 5 Ceva variety; **N2V1**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/6 doseat harvest +1/6 doseat 21 days after harvest for Inpari 30 variety; **N2V2**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/6 doseat harvest +1/6 doseat 21 days after harvest for Hipa 5 Ceva variety. The subplot is application of growth regulator GA3 (G) consisting of **G0** = without application of GA3; **G1** = application of GA3 once in 7 days;**G2** = application of GA3 once in 14 days.

3.3. Components Yield Rice

Table-4a. The effect of N fertilizer and ZPT (GA3) applications on several components yield for several rice varieties using ratoon system at B type flooding in tidal swampland

Number of Productive Tillers per stump				
Treatment	**Main Crop**	**Ratoon**		
		G0	**G1**	**G2**
N1V1	21.2	7.7	11.7	11.0
N1V2	24.8	13.3	14.0	13.3
N2V1	19.6	9.7	12.0	11.7
N2V2	20.3	11.7	13.0	11.7
The number of grains per panicle (grains)				
Treatment	**Main Crop**	**Ratoon**		
		G0	**G1**	**G2**
N1V1	103.2	68.3	71.7	74.7
N1V2	117.1	73.0	82.1	77.3
N2V1	98.3	69.7	78.7	72.7
N2V2	113.4	71.3	79.7	78.3

Remarks: **N1V1**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/3 dosis at harvest for Inpari 30 variety; **N1V2**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/3 doseat harvest for Hipa 5 Ceva variety; **N2V1**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/6 doseat harvest +1/6 doseat 21 days after harvest for Inpari 30 variety; **N2V2**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/6 doseat harvest +1/6 doseat 21 days after harvest for Hipa 5 Ceva variety. The subplot is application of growth regulator GA3 (G) consisting of **G0** = without application of GA3; **G1** = application of GA3 once in 7 days;**G2** = application of GA3 once in 14 days.

Table-4b. The effect of N fertilizer and GA3 applications on several components yield for several rice varieties using ratoon system at C type flooding in tidal swampland.

Number of Productive Tillers per stump				
Treatment	**Main Crop**	**Ratoon**		
		G0	**G1**	**G2**
N1V1	21.4	9.3	12.3	11.0
N1V2	23.1	10.7	15.3	14.0
N2V1	21.5	10.0	12.3	11.7
N2V2	23.4	12.3	14.3	12.7
The number of grains per panicle (grains)				
Treatment	**Main Crop**	**Ratoon**		
		G0	**G1**	**G2**
N1V1	108.6	40.6	55.3	51.0
N1V2	114.3	48.1	68.5	58.4
N2V1	101.5	39.7	52.0	49.2
N2V2	114.76	45.2	60.8	51.9

Remarks: **N1V1**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/3 dosis at harvest for Inpari 30 variety; **N1V2**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/3 doseat harvest for Hipa 5 Ceva variety; **N2V1**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/6 doseat harvest +1/6 doseat 21 days after harvest for Inpari 30 variety; **N2V2**= N fertilizing, 1/3 dose during planting + 1/3 dose at primordia phase + 1/6 doseat harvest +1/6 doseat 21 days after harvest for Hipa 5 Ceva variety. The subplot is application of growth regulator GA3 (G) consisting of **G0** = without application of GA3; **G1** = application of GA3 once in 7 days;**G2** = application of GA3 once in 14 days.

Yield components of main crops and ratoons through the regulation of N fertilization ang application of GA3 in several rice varieties in several types of tidal swampland can be seen in Table 4a and 4b. Research results showed

that number of productive tillers per stump and the number of grains per panicle (grains) tend to be higher than other treatments on N fertilizer treatment which is applied 1/3 dose during planting + 1/3 dose during primordia phase + 1/3 dose during harvesting (A1) that is sprayed with GA3 at interval of once a week, either for B type flooding land or C type flooding land.

4. Discussion

Research results showed that the highest productivity was found at N fertilizer treatment which is applied 1/3 dose during planting + 1/3 dose during primordia phase + 1/3 dose during harvesting (A1) that is sprayed with ZPT GA3 at interval of once a week, either for B type flooding land or C type flooding land. According to Nakano, *et al.* [14], proper fertilizer application has effect on nutrients availability to produce assimilate that will transferred into seed part which subsequently produce rice yield. In addition, proper fertilizer application on the main crop has effect on ratoon growth, especially in case of N fertilizer. According to Bovairi, *et al.* [15], one of important nutrients element and that should be available for crop is nitrogen element. This element can be a limiting factor for crop production [16]. Therefore, regulation of N fertilizer application to the main rice crop is important and has effect on rice yield obtained at ratoon rice.

It is hoped that application of giberelin growth regulator(GA3) on ratoon rice can increase the growth and rice yield on ratoon rice through increase of rice tillers number and percentage of fully rice grains because these two parameters are closely related to rice yield. Results study from Toharudin and Sutomo [17], showed that proper increase of giberelin concentration can increase chlorophyll numbers within crop resulting in increase of crop photosynthesis. Photosynthesis results (assimilates) are subsequently used by crop and finally can increase rice yield. According to Warso [10], the use of 60 ppm GA3 is capable to increase rice yield.

High productivity is not only affected by fertilizing treatment and application of growth regulator (ZPG), but also is affected by rice variety. Research results showed that high productivity is tend to be obtained in hybrid variety (Hipa 5 Ceva) compared to other varieties. Results of study by Gribaldi, *et al.* [18] showed that hybrid variety of Hipa 5 Ceva was more adaptive to environmental condition with low soil pH. This is in accordance to opinion from Virmani and Kumar [19] which stated that hybrid rice had higher adaptation capability to environment with low soil pH. In addition, the highest productivity on hipa 5 ceva variety at N fertilizer treatment which is applied 1/3 dose during planting + 1/3 dose during primordia phase + 1/3 dose during harvesting (A1) that is sprayed with ZPT GA3 at interval of once a week, either for B type flooding land or C type flooding land, because the number of productive tillers and the number of grain per panicle in this study showed higher results than other treatments. So that with the high number of yield components, the grain yield obtained will also be high. According to Khairullah [20], Gribaldi, *et al.* [12], yield component per clump is one of the determinants of yield potential in rice plants.

5. Conclusion

Research results showed that N fertilizer treatment which is applied 1/3 dose during planting + 1/3 dose during primordia phase + 1/3 dose during harvesting for main rice crop and followed by GA3 application at dose of 60 ppm at interval of once a week for ratoon rice can increase rice productivity at two types of flooding land in tidal swampland. Hybrid variety (Hipa 5 Ceva) is the one that produce the highest yield with magnitude of 7.4 and 7.1 ton/ha/planting season for B and C types flooding land in tidal swampland.

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References

[1] Haryono, 2013. "Strategi and policies of the agricultural ministry in suboptimal land optimization to support national food security." In *Proceedings of The National seminar of suboptimal land , University of Sriwijaya, Palembang*. pp. 20-21.

[2] Gribaldi, 2020. *Tidal swampland: Ratoon system and rice productivity*. Lekeisha Publisher, Klaten Central Java, pp. 6-11.

[3] BBSDLP, 2011. *State of the art and grand design for swamp land development*. Bogor. (in Indonesian): Center of Agricultural Land Resource. p. 44.

[4] Dakhyar, N., Hairani, A., and Indrayati, L., 2012. "Prospect of land setting using surjan system at tidal lowland area." *Agrovigor*, vol. 5, pp. 113-118.

[5] Gribaldi, Nurlaili, Dewi, N., Danial, E., Sakalena, F., and Suwignyo, R. A., 2017. "Modified application of nitrogen fertilizer for increasing rice variety tolerance toward submergence stress." *International Journal of Agronomy*, vol. 2017, pp. 1-6.

[6] Sudana, W., 2005. "Potential and prospect of swampland as agricultural production source." *J. Agricultural Policy Analysis*, vol. 3, pp. 141-151.

[7] Susilawati, Purwoko, B. S., Aswiddinnor, H., and Santoso, E., 2011. "The perfomance of variety and strain of new rice in Indonesia within ratoon system." *J. Agron. Indonesia*, vol. 38, pp. 177-184.

[8] Satotodan, B. and Suprihatno, 2008. "Development of hybrid rice in Indonesia." *J. Food Crop Science and Technology*, vol. 3, pp. 27-40.

[9] Duan, Y. H., Zhang, Y. L., Ye, L. Y., Fan, X. R., Xu, G. H., and Shen, Q. R., 2007. "Responses of rice cultivars with different nitrogen use efficiency to partial nitrate nutrition." *Ann. Bot.*, vol. 99, pp. 1153-1160.

[10] Warso, 2014. "Fertilize paddy field rice for maximum harvest." Available: http://komunitas_bbp.blogspot.com/2014/02/pupuk-untuk-tanaman-padi-sawah.html

[11] Suwignyo, R. A., Wijaya, A., Sihombing, H., and dan, G., 2012. "Modification of nutrients application to improve vigor of rice seeds toward submergence stress." *Journal of Suboptimal Land*, vol. 1, pp. 1-11.

[12] Gribaldi, Suwignyo, R. A., Hasmeda, M., and Hayati, R., 2016. "Fertilization strategy to increase rice growth and production under two flooding condition on two lowland swamp types." *Int. J. Agrivita*, vol. 38, pp. 64-72.

[13] Setiawan, A., Moenandir, J., and Nugroho, H., 2012. "The effect of N, P and K fertilizers application on growth and yield of rice (*Oryza sativa* L.) Kepras." Available: http://pustakapertanianub.staff.ub.ac.id/files/2012/05/JURNAL.pdf

[14] Nakano, H., Morita, S., Kitagawa, H., and Takahashi, M., 2009. "Effect of cutting height and trampling over stubbles of the first crop on dry matter yield in twice harvest of forage rice." *Plant Prod. Sci.*, vol. 12, pp. 124-127.

[15] Bovairi, M., Shokuhfar, A., and Abadouz, G. R., 2016. "Effect of cutting height and seed cutting date on grain yield and yield components in berseem clover (Trifolium alexandrinum L.)." *Research on Crop Ecophysiology*, vol. 11, pp. 104-111.

[16] Ambarita, Y., Hariyono, D., and Aini, N., 2018. "N, P, K and urea fertilizers applicationon rice (Oryza sativa L.) using ratoon system." *Journal of Crop Production*, vol. 5, pp. 1228-1234.

[17] Toharudin, M. and Sutomo, M. H., 2013. "The application effect of nitrogen fertilizer and giberelin growth regulator on N uptake, growth and yield of rice crop (Oryza sativa L.)." *J. Agroswagati*, vol. 2, pp. 11-21.

[18] Gribaldi, G., Nurlaili, N., Sakalena, F., Dewi, N., and Asroh, A., 2020. "Strategy of nitrogen fertilizer application to increase growth and yield of rice in ratoon system at tidal swampland." *Australian J. of Crop Sci.*, vol. 14, pp. 1004-1010.

[19] Virmani, S. S. and Kumar, I., 2004. "Development and use of hybrid rice technology to increase rice productivity in the tropics." *IRRN*, vol. 29, pp. 10-20.

[20] Khairullah, I., 2006. *Flooding resistant rice (solution of harvesting failure during flooding)*. Sinar Tani, pp. 8–14.