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Pertumbuhan dan Hasil Padi Sawah Varietas IPB 3S Dengan Pemberian Pupuk NPK dan Kompos Jerami

Growth and Yield of Paddy IPB 3S Varieties with the Application of NPK Fertilizer and Straw Compost

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ABSTRAK

Salah satu cara untuk meminimalisir penggunaan pupuk anorganik adalah dengan pemberian kompos jerami padi ke tanah. Kompos jerami padi merupakan bahan organik yang potensial untuk tanaman padi sawah. Penelitian ini bertujuan untuk mengetahui pengaruh pemberian kombinasi pupuk NPK dan kompos jerami pada pertumbuhan dan hasil padi sawah varietas IPB 3S. Penelitian ini dilaksanakan pada lahan petani di Desa Dowiwi Kecamatan Simpang Raya Kabupaten Banggai. Penelitian menggunakan rancangan acak kelompok faktorial dengan dua factor. Faktor A (NPK) yang terdiri atas empat taraf yaitu A1 (62,5 kg/ha), A2 (125 kg/ha), A3 (187,5 kg/ha) dan A4 (250 kg/ha). Faktor B pupuk kompos jerami (B) yang terdiri atas empat taraf yaitu B1 (1,25 ton/ha), B2 (2,5 ton/ha), B3 (3,75 ton/ha), dan B4 (5 ton/ha). Hasil penelitian menunjukkan pemberian kompos jerami dapat meningkatkan tinggi tanaman dan berat gabah kering per 1000 butir. Interaksi NPK dan kompos jerami (NPK 62,5 kg/ha + 5 ton/ha) mampu mengurangi penggunaan pupuk NPK sebesar 75% pada hasil panjang malai dan berat gabah kering per 1000 butir.

Kata kunci: Kompos Jerami, Pupuk NPK, Padi Sawah IPB 3S

ABSTRACT

Minimizing the used of inorganic fertilizers is by applying rice straw compost to the soil. The rice straw compost is a potential organic matter for lowland rice plants. This study was aimed to determine the effect of the combination of NPK fertilizer and rice straw compost on the growth and yield of IPB 3S rice variety. This research was carried out on farmers' land in Dowiwi village, Simpang Raya sub-district, Banggai district. The study used a factorial randomized block design with two factors. Factor A (NPK) consisting of four levels namely A1 (62.5 kg / ha), A2 (125 kg / ha), A3 (187.5 kg / ha) and A4 (250 kg / ha). Factor B of rice straw compost (B) consisting of four levels, namely B1 (1.25 tons / ha), B2 (2.5 tons / ha), B3 (3.75 tons / ha), and B4 (5 tons / Ha). The results showed that rice straw compost can be increased plant height and 1000 grains weight. The interaction of NPK and rice straw compost (NPK 62.5 kg / ha + 5 tons / ha) was able to minimize the used of NPK fertilizer by 75% in panicle length and 1000 grains weight.

***Keywords**: Rice straw compost, NPK, IPB 3S rice variety*

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INTRODUCTION

The role of superior varieties in increasing rice production is undoubted because the role of superior varieties together with fertilizer and water to increase productivity reaches 75%. Meanwhile, the role of increasing productivity (technology) in increasing rice production reached 56.10%, expansion of the area of 26.30%, and 17.60% by the interaction between the two (Susanto et. Al., 2003). This information showed that superior varieties, especially lowland rice, are the key to success in increasing rice production in Indonesia.

IPB 3S rice is a new variety of rice in Indonesia which has a yield potential of up to 11.2 tons/ha, making this variety important for dissemination. At present, this variety has been planted in many regions of Java and began to be planted in Sumatra, Sulawesi and Kalimantan (Surahman et. Al., 2017), and proper cultivation techniques are needed to get maximum results.

Rice straw can be used for making organic fertilizer, but farmers often transport straw out of rice fields or burn it (Sitepu et. Al., 2017). The use of straw compost has been shown to increase soil productivity (Juwita, 2014). To speed up the process of making organic fertilizer is carried out by fermentation using Degra ABG decomposer. The use of NPK fertilizer and rice straw compost is an effort to improve nutrient balance in the soil. In addition, the use of straw compost is also used to substitute NPK fertilizer.

The use of N and P fertilizers with high doses without returning the rest of the harvest accelerates the depletion of other nutrients in the soil such as macro-nutrients K, S, Ca, Mg, and Si and micro-nutrients Zn and Cu (Hartatik and Widowati, 2015). This study aims to determine the effect of the combination of NPK fertilizer and straw compost on the growth and yield of IPB 3S variety.

MATERIALS AND METHODS

This research was carried out on irrigated paddy fields in Dowiwi Village, Simpang Raya District, Banggai Regency, from June to October 2018. The study used a factorial randomized block design with two factors and three replications. The first factor is the dose of NPK fertilizer (A) which consists of four levels, namely A1 (62.5 kg/ha), A2 (125 kg/ha), A3 (187.5 kg/ha) and A4 (250 kg/ha). The second factor is the dose of straw compost (B) consisting of four levels, namely B1 (1.25 tons/ha), B2 (2.5 tons/ha), B3 (3.75 tons/ha), and B4 (5) ton/ha).

Table 1. Interaction treatment of NPK fertilizer and rice straw compost

A/B	B_1	B_2	B_3	B_4
A_1	A_1B_1	A_1B_2	A_1B_3	A_1B_4
A_2	A_2B_1	A_2B_2	A_2B_3	A_2B_4
A_3	A_3B_1	A_3B_2	A_3B_3	A_3B_4
A_4	A_4B_1	A_4B_2	A_4B_3	A_4B_4

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The process of making rice straw compost is done by collecting straw and mixing it with a Biodegra decomposer, and after three days the mixing is done. Seeding is carried out for up to 14 days and then transferred to the experimental field. Planting was carried out by the twin seed method in the experimental field with a spacing of 20 x 20 cm, and each hole was planted with one seedling stem which was approximately 3 to 4 cm deep. Fertilization is done with basic fertilizer compost rice straw before planting and fertilization with NPK fertilizer is done at the age of plants 1 WAP, 4 WAP and 7 WAP.

Observation variables included plant height (cm) measured every week at 2 WAP - 7 WAP plant ages, number of tillers per clump was calculated every week since the plant was 3 WAP until panicle came out, panicle length (cm) was measured from panicle base to panicle tip, total productive tillers per clump is calculated from all tillers that produce panicles at harvest are taken from sample plants, and the 1000 dry grain weight was weighed from 1000 grains of rice taken from sample plants.

The data obtained were analyzed for variance according to the design used, namely factorial randomized block design (RAK) using Minitab 16 software. If the p-value $<\alpha$ 0.05 or p-value $<\alpha$ 0.01, then a Tukey test was performed to determine differences between treatment.

RESULTS AND DISCUSSION

Plant height

Plant height is one part of the growth that showed a change in the agronomic character of a plant variety and to support this growth fertilizer needs to be applied (Sabran et al. 2015). Results of variance analysis showed that the application of straw compost had a significant effect on rice plant height, while the interaction of straw compost and NPK fertilizer had no significant effect. Application of straw compost is significantly different from without NPK fertilizer in increasing rice plant height. Based on the Tukey test (Table 2), straw compost B3 treatment (3.75 tons/ha) can increase the height of rice plants from the age of 2-4 WAP that is 8.47 to 32.65 cm. These results indicated that the application of rice straw compost is effective in increasing plant height.

According to Sitepu et al. (2017) that the use of rice straw compost is effective in increasing plant height, and is able to increase NPK nutrient efficiency by up to 50%. In addition, the results of Kaya's research (2013) showed that the application of straw compost and NPK fertilizer can affect the height of rice plants because the element of phosphorus as an energy source helps plants in the development of the vegetative phase.

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Table 2. Average plant height (cm) of IPB 3S lowland rice aged 2 WAP - 5 WAP

Observation time	Treatment A x B	Treatment				NPK
		B1	B2	B3	B4	
2 WAP	A1	8,2	8,71	8,66	8,45	8,50 tn
	A2	8,04	8,49	8,28	8,22	8,26 tn
	A3	8,07	8,09	8,49	7,83	8,12 tn
	A4	8,14	8,46	8,47	8,13	8,30 tn
	Straw Compost	8,11 a	8,44 ab	8,47 b	8,15 ab	
3 WAP	A1	16,21	16,72	16,63	16,49	16,51 tn
	A2	16,03	16,48	16,64	16,21	16,34 tn
	A3	16,07	16,08	16,5	15,84	16,12 tn
	A4	16,17	16,46	16,47	16,16	16,32 tn
	Straw Compost	16,12 a	16,43 ab	16,56 b	16,18 ab	
4 WAP	A1	32,02	33,02	32,81	31,84	32,42 tn
	A2	31,58	32,56	32,13	31,93	32,05 tn
	A3	31,67	31,83	32,63	31,18	31,83 tn
	A4	31,91	32,51	33,03	31,93	32,35 tn
	Straw Compost	31,79 ab	32,48 ab	32,65 b	31,72 a	
5 WAP	A1	47,66	47,77	47,09	46,5	47,26 tn
	A2	46,55	46,98	47,45	46,71	46,92 tn
	A3	46,39	46,97	47,12	45,95	46,61 tn
	A4	46,74	47,67	47,19	47,02	47,15 tn
	Straw Compost	46,83 ab	47,35 b	47,21 ab	46,55 a	

Note: Numbers followed by the same letters in columns and rows indicate no significant difference in the Tukey test of 5%

Number of tillers per Clump

Variance analysis results showed that the application of NPK fertilizer and straw compost fertilizer independently did not significantly affect the parameters of the number of tillers per clump. (Hosseini and Aziz, 2013) reported that compost which has a C/N ratio value above 20 is strongly discouraged or should be avoided for use on agricultural land because it will harm plant growth. This is because compost which has a C/N ratio value that is too high will cause nitrogen immobilization. This immobilization occurs due to competition between plants and microbes to consume N, hence plants only get a little nitrogen from the soil. In Table 3, it can be seen that the interaction between the two treatments significantly affected the age of 3, 4 and 5 WAP in increasing the number of tillers per cluster of IPB 3S lowland rice varieties.

This is in line with the results of research by Pranata and Kurniasih (2019) who reported that rice straw compost can increase the total number of tillers per clump. This is because straw compost contains many organic matters needed by plants hence it can improve soil aeration and produce the formation of the number of tillers high.

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Table 3. Average number of tillers per cluster (tillers) of IPB 3S lowland rice aged 3 WAP - 5 WAP

Observation time	Treatment A x B	Treatment				NPK
		B1	B2	B3	B4	
3 WAP	A1	4,01 ab	4,03 ab	4,08 ab	3,96 a	4,02
	A2	4,11 b	3,96 a	3,99 ab	3,99 ab	4,01
	A3	4,03 ab	4,08 ab	3,99 ab	4,04 ab	4,03
	A4	3,99 ab	4,07 ab	4,01 ab	4,01 ab	4,02
	Straw Compost	4,03 tn	4,03 tn	4,02 tn	4,00 tn	
4 WAP	A1	6,99 ab	7,00 ab	7,05 ab	6,96 ab	7,00 tn
	A2	6,99 ab	7,11 b	6,97 ab	6,99 ab	7,01 tn
	A3	7,04 ab	7,00 ab	7,07 ab	7,05 ab	7,04 tn
	A4	7,03 ab	7,01 ab	6,92 a	7,03 ab	7,00 tn
	Straw Compost	7,01 tn	7,03 tn	7,00btn	7,01 tn	
5 WAP	A1	9,89 ab	9,93 b	9,93 b	9,94 b	9,92 tn
	A2	9,95 b	9,91 b	9,96 b	9,95 b	9,94 tn
	A3	9,92 b	9,94 b	9,91 b	9,55 a	9,83 tn
	A4	9,95 b	9,92 b	9,91 b	9,95 b	9,93 tn
	Straw Compost	9,93 tn	9,93 tn	9,93 tn	9,85 tn	

Note: Numbers followed by the same letters in columns and rows indicate no significant difference in the Tukey test of 5%

Straw compost can increase the amount of nitrogen in the soil which plays an important role for rice plants to increase grain yield and quality through increasing the number of tillers (Kaya, 2013). In addition, Idawati et al. (2017) reported that the nutrients of P, K, Na, Ca, Mg, Mn and Cu in compost were higher hence compost was good enough to be applied to increase soil productivity where soil productivity would affect the growth of a plant, in this case, the number of tillers per clump of rice fields.

Number of productive tillers

The variance analysis showed that the treatment of NPK fertilizer and straw compost had no significant effect, while the interaction between the two treatments had a significant effect on the number of productive tillers (Table 4). The highest number of productive tillers was A1B2 interaction treatment (8.90). Arafat and Sirappa (2003) reported the application of rice straw compost combined with NPK fertilizer significantly increased the number of tillers and tended to increase grain yield. In addition, Amrah (2008) reported that the application of rice straw compost with NPK fertilizer produced the highest number of tillers in lowland rice compared to the treatment of straw compost alone.

Application of straw compost and NPK fertilizer affect the increase of C-organic soil, phosphate solubilizing bacterial population, availability of P and yield of rice plants (Noviani et al. 2018). P in natural phosphate both increases the number of tillers. The more P application in natural phosphate will increase the release of inorganic P around the roots of rice which can be used by rice plants to grow the number of tillers.

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Table 4. Average number of productive tillers of IPB 3S lowland rice

Treatment	Treatment				NPK
A x B	B1	B2	B3	B4	
A1	8,59 a	8,90 b	8,71 ab	8,76 ab	8,74 tn
A2	8,73 ab	8,83 ab	8,88 b	8,73 ab	8,79 tn
A3	8,81 ab	8,81 ab	8,79 ab	8,71 ab	8,78 tn
A4	8,81 ab	8,69 ab	8,84 ab	8,81 ab	8,79 tn
Straw Compost	8,74 tn	8,81 tn	8,80 tn	8,75 tn	

Note: Numbers followed by the same letters in columns and rows indicate no significant difference in the Tukey test of 5%

Table 5. Average length of panicles (cm) of IPB 3S lowland rice

Treatment	Treatment				NPK
A x B	B1	B2	B3	B4	
A1	30,48 ab	30,51 ab	30,37 ab	31,27 b	30,66
A2	30,38 ab	30,40 ab	30,51 ab	30,16 a	30,36
A3	30,69 ab	30,50 ab	30,69 ab	30,21a	30,52
A4	30,33 a	30,22 a	30,15 a	30,25 a	30,24
Straw Compost	30,47	30,41	30,43	30,47	

Note: Numbers followed by the same letters in columns and rows indicate no significant difference in the Tukey test of 5%

The Length of Paddy Panicle

The application of NPK fertilizer applied to lowland rice plants has a very significant effect, and the interaction of NPK fertilizer and straw compost has a significant effect on panicle length. However, straw compost has no significant effect. The highest average length of paddy panicles of IPB 3S variety was produced by A1B4 treatment with straw compost treatment with an average of 31.27 cm and significantly different from A2B4 treatment with an average of 30.16 cm. Based on the panicle length category, IPB 3S variety observed was long panicle with a long category. Panicles included in the panicles are long (> 30 cm), medium (21 cm - 30 cm) and short (<20 cm) (Diptaningsari, 2013).

Weight of dried grain per 1000 grains

Based on the results of variance analysis, the treatment of straw compost and the interaction of straw compost with NPK significantly affected the weight of dry grain per 1000. The average weight of dry grain per 1000 grains of the highest IPB 3S variety was produced by A1B4 treatment with the treatment of straw compost with an average of 27.52 and significantly different from A2B3 treatment with an average of 26.18. The dry grain weight per 1000 grains observed had the highest average at the B4 treatment level (26.99 g). This is in line with the results of the study by Hartatik and Setyorini (2008) who reported that NPK treatment combined with straw compost significantly increased the weight of dry grain.

Table 6. Average weight of dry rice grain per 1000 of IPB 3S lowland rice

Treatment A x B	Treatment				NPK
	B1	B2	B3	B4	
A1	26,31 ab	26,23 ab	26,26 ab	27,52 b	26,58
A2	26,89 ab	26,80 ab	26,18 a	26,71 ab	26,65
A3	26,60 ab	26,27 ab	26,69 ab	26,48 ab	26,51
A4	26,71 ab	27,34 ab	26,22 ab	27,24 ab	26,88
Straw Compost	26,63 ab	26,66 ab	26,34 a	26,99 b	

Note: Numbers followed by the same letters in columns and rows indicate no significant difference in the Tukey test of 5%

Ma'sum et al. (2016) also reported that straw compost of 5 tons/ha could increase fresh weight, dry weight of grain and also increase net assimilation rate and canopy growth rate. In addition, the results of the study of Barus (2012) showed that the application of straw compost with various bio-activators can increase the weight of grain compared to without the application of straw compost. The P and K elements due to the application of NPK and straw compost play a role in the supply and transfer of energy throughout the biochemical process of rice, one of which is accelerating the cooking and development of grain hence the grain weight increases as well as for the formation of sugar, starch and various enzymes hence the number of grains per panicle and the percentage of filled grain can be increased (Booromand and Grough, 2012).

CONCLUSION

Application of rice straw compost at a dose of 3.75 tons/ha (B3) can increase the height growth of rice plants aged 2 WAP - 4 WAP. Application of NPK together with rice straw compost increased the number of tillers, the number of productive tillers, panicle length and the weight of 1000 dry grains. The combination of NPK fertilizer and 62.5 kg/ha + 5 tons/ha (A1B4) rice straw compost can increase rice yield (panicle length and dry grain weight of 1000 grains) hence the use of rice straw compost can substitute the use of NPK by 75%.

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