Research Article

Growth and yield of rice fields with posbidik compost and jajar legowo planting system

Pertumbuhan dan hasil padi sawah dengan pemberian kompos posbidik dan sistem tanam jajar legowo

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Abstract: Posbidik compost is an innovative product that is expected to solve the scarcity of subsidized fertilizers for farmers. The principle of the jajar legowo planting system is to increase plant population and lowland rice production. This study aimed to determine the influence of posbidik compost and jajar legowo planting system on the growth and yield of Ciherang rice varieties. This study was conducted on irrigation paddy fields owned by farmers in West Toili District, Banggai Regency, in August-December 2020. This study used a factorial randomized block design consisting of 2 factors, namely posbidik compost consisting of 3 levels, namely: K1 = 5 tons/ha; K2 = 7.5 tons/ha; K3 = 10 tons / ha, and planting system legowo 2:1 line consisting of 3 levels, namely: L1 = 20 x 10 x 40 cm; L2 = 25 x 12.5 x 50 cm; L3 = 30 x 15 x 60 cm. The results showed that the interaction of posbidik compost and jajar legowo planting system does not affect the plant height; however, it affects the number of productive tillers, the weight of 1000 grains and productivity. The results showed that the best performance of the yield rice in the treatments of 7.5 tons/ha posbidik dose with planting space of 25 x 12.5 x 50 cm.

Keywords: Jajar legowo, organic fertilizer, production, rice.

Abstrak: Kompos posbidik merupakan produk inovasi yang diharapkan menjadi solusi atas kelangkaan pupuk subsidi bagi petani Prinsip sistem tanam jajar legowo adalah meningkatkan populasi tanaman dan produksi padi sawah. Penelitian ini bertujuan untuk mengetahui pengaruh pemberian kompos posbidik dan sistem tanam jajar legowo terhadap pertumbuhan dan hasil padi sawah varietas ciherang. Penelitian ini dilaksanakan pada lahan sawah irigasi milik petani di Kecamatan Toili Barat Kabupaten Banggai, pada bulan Agustus-Desember 2020. Penelitian ini menggunakan rancangan acak kelompok (RAK) pola faktorial yang terdiri dari 2 faktor yaitu kompos posbidik yang terdiri dari 3 taraf, yaitu : K1 = 5 ton/ha; K2 = 7,5 ton/ha; K3 = 10 ton/ha, dan sitem tanam jajar legowo 2:1 yang terdiri dari 3 taraf, yaitu: L1 = 20 x 10 x 40 cm; L2 = 25 x 12,5 x 50 cm; L3 = 30 x 15 x 60 cm. Hasil penelitian menunjukan bahwa interaksi kompos posbidik dan sistem tanam jajar legowo tidak berpengaruh nyata terhadap tinggi tanaman namun berpengaruh nyata terhadap jumlah anakan produktif, berat gabah 1000 butir dan berat gabah kering panen. Berat gabah kering panen dikonversikan kedalam ha-1 menunjukan hasil tertinggi (4,69 ton/ha) pada perlakuan dosis pupuk 7,5 ton/ha dengan jarak tanam 25 x 12,5 x 50 cm.

Kata kunci: Jajar legowo, pupuk organik, produksi, padi.

INTRODUCTION

Current rice cultivation technology carried out by farmers still focuses on chemical fertilizers (Ridwan & Rastono, 2017; Marwantika, 2020), although they are aware that the continuous use of chemical fertilizers can reduce soil quality (Ge *et al*. 2008; Li-li *et al*. 2017). Until now, farmers are still dependent on subsidized chemical fertilizers (Suyamto, 2017;

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Susilowati, 2018), but the government's efforts to protect farmers through fertilizer subsidy policies seem to have not been effective (Darwis & Saptana, 2010). This is proven by the frequent price spikes and lack of supply at the farmer level (Kariyasa, 2017). One of the efforts to overcome the scarcity of fertilizers that often occurs is compost (Nur & Lay, 2016). Compost is a potential organic material for lowland rice (Nangge *et al*. 2020). The results of Purnomo & Rusim's (2018) research that the application of compost fertilizer as much as 8 tons/ha can produce 11.16 tons/ha of dry grain.

Posbidik compost is an innovation product initiated by the Moilong District Government, Banggai Regency, by combining the synergy between academics, companies, and farmers in the quadruple helix model. However, the quality of the fertilizer and its effect on rice yields have not been tested until now. Posbidik compost is expected to be one of the solutions in overcoming the scarcity of subsidized fertilizers so that farmers can use this fertilizer to replace inorganic fertilizers. In addition to the shortage of fertilizers, a factor that affects the productivity of lowland rice is the use of spacing (Ikhwani *et al*. 2013; Suhendrata, 2018). To support low-lying rice plants with high productivity, it is necessary to apply several components of the right technology (Ali, 2017) to provide optimal results. Spacing is one factor that affects the yield of lowland rice (Azis *et al*. 2012). One of the rice cultivation techniques often applied is the jajar legowo planting system (Kartika *et al*. 2018). The principle of the jajar legowo planting system is to increase plant population (Ikhwani *et al*. 2013) and lowland rice production (Susilastuti *et al*. 2018; Sumarsih *et al*. 2020; Chairiyah *et al*. 2020).

Based on data from the Central Bureau of Statistics of Banggai Regency, the average productivity of lowland rice from 2017 was 4.92 tons/hectare. In 2018 there was no increase, but in 2019 there was an increase in productivity, reaching 5.25 tons/hectare (BPS Banggai, 2020). Based on data from the Agricultural Extension Center for West Toili Sub-district in 2020, the productivity of lowland rice specifically for West Toili Sub-district in 2019 reached 4.6 tons/ha with cultivation techniques using inorganic fertilizers. These figures are respectively low when compared to the average productivity of the Banggai Regency. So that the invention of cultivation techniques with an approach to using organic fertilizers, namely Posbidik compost and the jajar legowo planting system, can increase the productivity of lowland rice in West Toili District. This study aims to determine the effect of giving posbidik compost and jajar legowo planting system on the growth and yield of ciherang rice varieties.

MATERIALS AND METHODS

The study was carried out on irrigated rice fields owned by farmers in West Toili District, Banggai Regency, in August-December 2020. The study used a factorial randomized block design (RAK) consisting of 2 factors and each factor consisting of 3 levels. Factor I: giving posbidik compost (K), which consists of 3 levels, namely:
K_1 = 5 tons/ha or 4.5 kg/plot
K_2 = 7.5 tons/ha or 6.75 kg/plot
K_3 = 10 tons/ha or 9 kg/plot
Factor II: Spacing on the 2:1 row legowo system (L), which consists of 3 levels, namely:
L_1 = Planting distance 20 x 10 x 40 cm
L_2 = Planting distance 25 x 12,5 x 50 cm
L_3 = Planting distance 30 x 15 x 60 cm
Each treatment was repeated three times so that there were 27 experimental plots.

The posbidik compost used was analyzed for its nutrient content, including C-organic (%), N (%), C/N ratio, P_2O_5 (%), and K_2O at the Chemistry and Soil Fertility Laboratory, Hasanuddin University Makassar. According to the treatment, seedlings were planted on plots measuring 3 m x 3 m with a 2:1 row legowo planting system. Rice was planted with 2 seeds per hole upright and a planting depth of ± 2 cm. Fertilization was carried out 3 times, 4 days before planting, 4 and 7 weeks after planting with doses according to the treatment. Parameters observed included plant height (cm), number of productive tillers, the weight of 1000 grains, and productivity (tons/ha). The data obtained were analyzed for variance according to the design used, namely a factorial randomized block design (RAK). A Tukey test was performed to determine the differences between treatments. Lowland rice production is calculated by converting dry weight harvested per plot. Production results are converted into tons/ha units with the production formula (Valentino *et al*. 2020; Sataral *et al*. 2021).

$$\frac{10000\ \mathrm{m^2}}{a} x \frac{b}{1000\ kg}$$

Information :
a = Size of plot area (m^2)
b = Production/plot (kg)

RESULTS AND DISCUSSION

Nutrient Content of Posbidik Compost

The analysis of posbidik compost fertilizer content carried out at the Chemical and Soil Fertility Laboratory, Department of Soil Science, Faculty of Agriculture, Hasanuddin University, were C-organic 18.42%, Nitrogen 1.14%, P_2O_5 3.25% and K_2O 2.74%. The results of the posbidik compost content analysis have met the minimum technical requirements for organic fertilizers. Solid compost quality standards based on the Decree of the Minister of Agriculture of the Republic of Indonesia No. 261/KPTS/SR.310/M/4/2019 concerning Minimum Technical Requirements for Organic Fertilizers, Biological Fertilizers, and Soil Improvements are minimum 15% organic C and minimum 2% macro-nutrients (N + P_2O_5 + K_2O).

Plant height

The analysis of variance in plant height showed that the treatment with Posbidik compost and the rowing legowo planting pattern had no significant effect at the ages of 2, 3, 4, 5, 6, and 7 WAP. However, the average plant height continued to increase with increasing plant age (Table 1).

Table 1. Average plant height age 2 WAP – 7 WAP (cm)

Treatments	Observation					
	2 WAP	3 WAP	4 WAP	5 WAP	6 WAP	7 WAP
K_1L_1	22,22	32,44	42,11	47,11	49,78	57,33
K_1L_2	22,44	31,89	42,22	46,22	49,56	54,89
K_1L_3	21,56	32,33	40,78	51,11	54,67	59,00
K_2L_1	22,33	30,33	38,56	45,44	49,22	58,22

K_2L_2	22,11	31,22	40,56	45,89	51,44	58,44
K_2L_3	21,22	32,67	39,67	46,89	51,56	59,78
K_3L_1	22,00	30,56	38,44	45,11	49,56	59,33
K_3L_2	22,44	33,22	42,78	49,44	52,56	61,78
K_3L_3	20,22	30,78	37,22	45,78	48,44	60,11

This is related to a large number of plant populations, so that there is competition for nutrients that have an impact on plant height. In line with that, according to Ezward *et al*. (2017) the jajar legowo planting system tends to increase the number of tillers (not plant height) by utilizing edge plants to take advantage of sunlight. High plant growth does not guarantee tall plant productivity (Sudiarta *et al*. 2016).

Number of productive tillers

The analysis of variance showed that the treatment with posbidik compost and the jajar legowo planting system had a significant effect on the number of productive tillers. The highest number of productive tillers was found in K_2L_2 treatment with an average of 33.22, and the lowest was in K_1L_2 treatment, namely 25.11. The average number of productive tillers in the Ciherang variety of lowland rice is presented in (Table 2).

Table 2. The number of productive tillers of Ciherang variety.

Treatments	Average	*p-value*
K_1L_1	25,55 a	0,032
K_1L_2	25,11 a	
K_1L_3	26,44 ab	
K_2L_1	25,56 a	
K_2L_2	33,22 b	
K_2L_3	26,22 ab	
K_3L_1	26,67 ab	
K_3L_2	26,56 ab	
K_3L_3	26,22 ab	

Note: The numbers followed by different letters mean significantly different based on the Tukey test (*p-value* < 0.05).

The combination of K_1L_1, K_1L_2, and K_2L_1 treatments had a very significantly different effect on the K_2L_2 treatment combination. It should be noted that plant density, seedling age, and the number of seeds per planting hole can also increase the number of productive tillers. This is in line with Masdar *et al*. (2006) research, who said that the wider the spacing, the higher the number of productive tillers compared to the denser spacing. In rice plants, if the spacing used is more comprehensive, it will produce more tillers. Yetti & Ardian (2010) said that the number of tillers would be maximized if the plant has good genetic characteristics and favourable environmental conditions or plant growth and development. Supported the research by Hatta (2011), the maximum number of tillers can also be determined by the spacing because the spacing can determine solar radiation, mineral nutrients and the cultivation of the plant itself.

Weight of dry grain per 1000 grains (grams)

Table 3 shows that the treatment with posbidik compost and the jajar legowo planting system showed the higher weight of 1000 grains of grain was found in the K_2L_2 treatment combined with an average of 35.66 and the lowest in the K_3L_2 treatment combined with an average of 23.39 gr.

Table 3. Weight of dry grain per 1000 grains

Treatments	Average	*p-value*
K_1L_1	27,98 ab	0,042
K_1L_2	29,35 ab	
K_1L_3	29,02 ab	
K_2L_1	27,84 ab	
K_2L_2	35,66 b	
K_2L_3	28,64 ab	
K_3L_1	29,42 ab	
K_3L_2	23,39 a	
K_3L_3	30,55 ab	

Note: The numbers followed by different letters mean significantly different based on the Tukey test (*p-value* < 0.05).

These two treatment combinations gave very significant different effects. In this case, the use of organic matter, posbidik compost and the jajar legowo planting system impacts increasing dry grain weight per 1000 grains. According to Masdar *et al*. (2006), the height of the seeds depends on the amount of dry matter contained in the seeds, dry matter obtained from photosynthesis which can then be used for filling seeds. The research by Pratiwi's (2016) which shows that the treatment of cropping patterns with the addition of manure can also increase the weight of 1000 grains of grain which is higher than the treatment of cropping patterns without manure.

The difference in grain weight per 1000 grains is due to differences in fertilizer dosage and spacing applied. Increasing the planting density per unit area from one side can increase the number of plant populations per unit area so that it will be able to increase the production of these plants. However, to a certain extent, planting density increases competition for space, sunlight, and even nutrient competition. This can result in a decrease in production. Proper spacing of rice plants can save on seeds and simplify maintenance (Muyassir, 2012).

The weight of harvested dry grain is converted into tons/ha.

The analysis of variance showed that the treatment with posbidik compost fertilizer and the jajar legowo planting system had a significant effect on the dry weight of the harvest. The weight of dry paddy harvested paddy rice converted into tons/ha was higher in the K2L2 treatment combination (fertilizer dose of 7.5 tons/ha or 6.75 kg/plot with a spacing of 25 x 12.5 x 50 cm) with production the best is 4.69 tons/ha.

The two treatments in Table 4 showed significantly different responses to lowland rice production. Implementing the jajar legowo planting system can facilitate the implementation of maintenance, fertilization, and control of plant pests and diseases carried out in the rice plant aisle area. Spacing on rice plants is one of the important factors that determine the quality and quantity of yield. In this study, the best spacing obtained was in line with the results of Suhendrata's (2018) research that the productivity of tiles based on spacing shows that the highest productivity is achieved at a spacing of 20 x 15 x 40 cm, which is 9,840 tons/ha GKP or 8,250 tons/ha GKG.

Table 4. Average production of lowland rice converted into tons/ha.

Treatments	Average weight per plot (kg)	Productivity (ton/ha)
K_1L_1	3,59 a	3,99
K_1L_2	3,61 ab	4,01
K_1L_3	3,82 ab	4,24
K_2L_1	3,81 ab	4,23
K_2L_2	4,22 b	4,69
K_2L_3	3,54 a	3,94
K_3L_1	3,45 a	3,83
K_3L_2	3,72 ab	4,14
K_3L_3	3,65 ab	4,06

Note: The numbers followed by different letters mean that they are significantly different based on the Tukey test (*p-value* (0.032) < 0.05).

The provision of posbidik compost can provide nutrients needed for lowland rice to increase rice production. Idawati *et al*. (2017) reported that the nutrients N, P and K in compost were quite well applied to increase soil productivity. In addition, the C-organic content in organic fertilizers can increase soil CEC (Azis *et al*. 2012). Nutrient N plays an essential role in slowing the ageing process of leaves and maintaining photosynthesis during the grain filling phase (Soplanit & Nukuhaly, 2012). In addition, nitrogen also functions in the translocation of proteins and carbohydrates to cause the seeds to be fuller and denser (Wahyuni *et al*. 2015).

CONCLUSIONS

The interaction of posbidik compost and jajar legowo planting system had no significant effect on plant height but significantly affected the parameters of the number of productive tillers, 1000 grain weight of grain and weight of dry grain harvested. The weight of dry grain harvested was converted into tons/ha, which showed that the K_2L_2 treatment showed the highest yield (4.69 tons/ha). So it can be said that K_2L_2 treatment (fertilizer dose of 7.5 tons/ha or 6.75 kg/plot with a spacing of 25 x 12.5 x 50 cm) is the best treatment for lowland rice production parameters.

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