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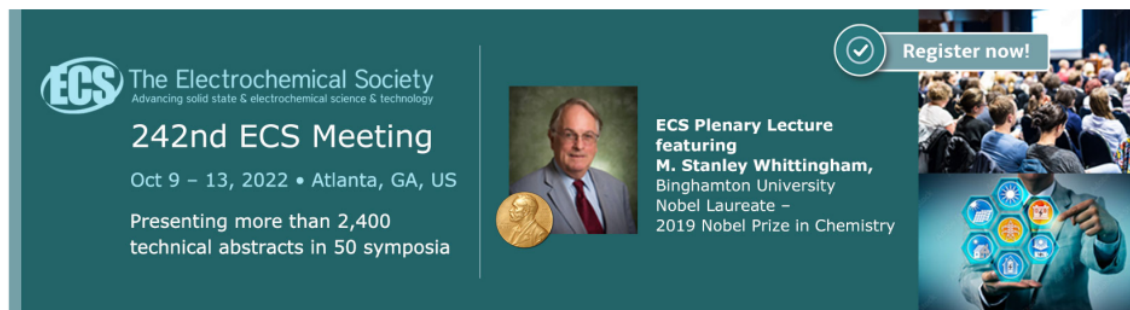
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## Growth and production of paddy rice (*Oryza sativa* L.) in various planting systems and types of liquid organic fertilizers

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**Abstract.** This study aims to determine the growth and production of rice in various planting systems and types of liquid organic fertilizer. The research was conducted in Rijang Panua Village, Kulo District, Sidenreng Rappang Regency from May to August 2016. The research was conducted based on a split plot design with main plot set was planting system consisted of three levels, namely: the tile planting system (20 cm x 20 cm), the *legowo* planting system 4:1 (40 cm x 20 cm x 20 cm), and 2:1 *legowo* planting system (40 cm x 20 cm x 20 cm). Subplot was type of liquid organic fertilizer made from three types of raw material, namely Gliricidia tree leaves, banana weevils, and Gliricidia leaves + banana weevil. The results show that there was a significant interaction effect between the two treatments on parameters of plant height, number of grains per panicle, production per plot and production per hectare. The combination of 2:1 *legowo* planting system and the liquid organic fertilizer made from Gliricidia leaves + banana weevil gave the highest yields on production per hectare (5.55 ton.ha<sup>-1</sup>). Highest number of productive tillers and an earlier flowering age were observed in the 2:1 *legowo* planting system (32.26 tillers and 60 days after sowing).

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### 1. Introduction

Rice (*Oryza sativa* L.) is the staple food source of nutrition and energy for more than 90% of the population in Indonesia. This makes rice plants a strategic commodity that plays an important role in the economy and national food security so that it becomes the main basis for future agricultural revitalization. National rice demand which tends to increase every year requires efforts to increase rice production. To meet these needs, five strategies have been implemented, namely: (1) Increasing production by encouraging technological innovation and providing subsidized fertilizers, (2) Expansion of the area, (3) Institutional and financing as well as increased coordination, (4) Development and expansion of seed logistics / seeds, (5) Development and strengthening of bio-industry and bio-energy [1].

The increase in national rice productivity in recent years has fluctuated due to lack of availability of location-specific technology and the relatively low level of recommended technology adoption. The application of technology at the farm level generally does not differ from year to year, so that many components of lowland rice cultivation technology need to be improved. The use of superior varieties is one example of rice production technology. The National Seed Agency since 1971 until now has released 263 New Superior Varieties (VUB) of rice, but only 10-15 varieties are widely grown on a large scale (> 100,000 ha per year). Rice VUB dominates 90% of the harvested area of the total area of 12 million hectares with an increase in productivity of 0.75 ton.ha<sup>-1</sup>. Farmers tend to only choose certain varieties among the many existing varieties, without the desire to replace them with more superior



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varieties, even though with the selection of varieties that are in accordance with the conditions of the land they have, the opportunity to increase production will be more open [1].

Another factor that is no less important is the spacing. Rice varieties in conditions of narrow spacing will experience a decline in growth quality, such as fewer tillers and panicles, shorter panicle lengths, and of course the number of grains per panicle is reduced compared to conditions of wide (optimal) spacing. Facts in the field prove that a wide spacing will increase the capture of solar radiation by the plant canopy [2], thereby increasing plant growth such as the number of productive tillers, volume and total root length, increasing plant dry weight and grain weight per hill [3].

One of the causes of low rice production in Indonesia is that farmers are still cultivating rice not according to regulations, such as soil processing and fertilizer dosing that is not in accordance with recommended regulations and farmers are still predominantly using conventional systems. The conventional rice cultivation system is more wasteful in water use, because in that system the rice fields are constantly inundated with water so that the oxygen content in the soil decreases, which indirectly affects plant growth. In addition, it causes disrupted root development, reduces the number of total tillers and productive tillers and slows down harvest time. Conventional transfer of seedlings from the nursery is generally carried out when the seeds are 20-30 days old with 5-7 seeds per plant or even more. Seeds that are too long in the nursery before being transferred to the land cause the seedlings to produce tillers while they are still in the nursery so that when the seeds are removed, the growth of the tillers will be disturbed. Planting too many seeds in one plant hole causes competition, both in nutrients, light and space to grow so that the tillers that are formed are not optimal [3].

Sidenreng Rappang Regency is one of the rice production centers in South Sulawesi. Farmers in Sidenreng Rappang district generally still use the tandur jajar (backward planting) system, but the results are uncertain, so there is a need for alternatives to several cropping systems that might be used to increase rice production, including the tile planting system, legowo 2: 1, or legowo 4: 1. The legowo 2: 1, and legowo 4: 1 can increase rice production. Sarlan et al. [4] stated that the legowo planting system is one of the components of integrated crop management in lowland rice which, when compared to other planting systems, has the advantage of increasing rice productivity up to 10-15%.

In addition to the planting system, the use of fertilizers, especially liquid organic fertilizers (LOF), greatly affects soil biological properties such as the activity of soil organisms, the number and development of microorganisms. The activity of these microorganisms is very important in changing organic matter, weathering proteins into amino acids, the nitrification process which ultimately frees nutrients such as N, P, and S, as well as micro elements. The use of raw materials for making LOF such as *Gliricidia* leaves, banana weevil, bamboo shoots, maja fruit, and goat urine has enormous benefits in providing macro and micro nutrient elements and contains microorganisms that have the potential to decompress organic matter, stimulate growth, and agents, pest and plant disease control so it is good to be used as a decomposer and organic pesticides.

The use of LOF from various types of organic materials as a source of nutrients in rice plants is one of the technologies that is easy, cheap, practical, environmentally friendly, sustainable, and profitable. Liquid organic fertilizer is a fertilizer that can be made in a short time, making it effective and efficient for farmers in increasing soil and plant fertility. In addition, liquid organic fertilizers can improve soil physical, chemical and biological properties, help increase crop production, improve the quality of plant products, reduce the use of inorganic fertilizers and as an alternative to manure [5].

Solachudin et al. [6] stated that the availability of sufficient and balanced nutrients and supported by favorable environmental factors such as growing space, CO<sub>2</sub> and sunlight, will affect better plant growth and the photosynthesis process in the form of assimilates which are then used by plants for the growth process and the rest is stored in storage organs for fruit formation. Furthermore, Solachudin et al. [6] added that the application of liquid organic fertilizer in combination with the legowo row planting system 2: 1 gave a better effect on several growth and production variables of rice plants such as plant height, number of productive tillers, panicle length, dry grain weight per clump and dry grain weight per hectare. Sarlan et al. [4] stated that the legowo system is a technological engineering to obtain a plant population of more than 160,000 per hectare. In addition to increasing cropping population, the

application of legowo lines is also able to increase the smooth circulation of sunlight and air around the pingir plants so that the plants can photosynthesize better. In addition, plants that are on the edge are expected to provide higher production and better grain quality, because the row planting system has an open space of 25-50%, so that plants can receive sunlight optimally which is useful in the photosynthesis process.

Apart from engineering the planting system technology to increase crop production, soil fertility needs to be considered. The application of liquid organic fertilizers to the planting system can optimize the growth and development of rice plants because the increased interception of light and CO<sub>2</sub> into plants will increase plant metabolism and biosynthesis. The phenomenon of increasing population and plant metabolism in the modification of the legowo planting system which affects the growth and production of rice is very interesting in an effort to increase rice production [7].

The application of liquid organic fertilizers to rice plants in the legowo planting system will accelerate the synthesis of amino acids and proteins thus accelerating the process of plant growth. Nutrients contained in liquid organic fertilizers are very important in maintaining good turgor pressure so as to allow the smooth process of metabolism and cell elongation [8]. Likewise with the use of the legowo planting system, both the 2: 1, 4: 1, and 6: 1 planting systems will have an effect in supporting the acceleration of the energy transfer process for the synthesis of carbohydrates, proteins and the photosynthetic process.

## 2. Methodology

### 2.1. Study site

This experiment was carried out in Rijang Panua Village, Kulo District, Sidenreng Rappang Regency, South Sulawesi Province from May to August 2016. The research location is a rainfed land located at an altitude of 44 m above sea level with a sandy clay texture and has an optimum temperature between 20 -25 °C, and a rainfall of 1,957 mm per year.

### 2.2. Experiment method

This study was in the form of an experiment using a split plot design. The planting system as the main plot consists of three (3) levels, namely: tiles (m1), legowo 4: 1 (m2), and legowo 2: 1 (m3). While the type of Liquid Organic Fertilizer (LOF) as a sub-plot consisting of three levels of treatment, namely: Gliricidia leaf (p1), banana weevil (p2), Gliricidia + banana weevil (p3). From these two factors, 9 treatment combinations were obtained, each treatment was repeated 3 (three) times so that in total there were 27 experimental plots. Each plot consisted of 6 plant samples so that the entire observation consisted of 162 sample plants.

### 2.3. Preparation of Liquid Organic Fertilizer (LOF)

Liquid organic fertilizer is prepared by mixing 1.5 liters of coconut water, 5 liters of rice washing water, 100 g of sugar / brown sugar, 10 liters of goat's urine and enough shrimp paste into a 50 L bucket previously filled with 5 L of water, then stirred until homogeneous. 50 cc of EM4 solution was prepared separately in another container, stirred evenly and let stand for 30 minutes. After approximately + 30 minutes, the EM4 solution was added into the 50 L bucket then stirred gently and closed. A hole is made in the bucket lid to attach the gas exhaust hose and temperature transfer which is connected to a bottle filled with water. Add enough paralon glue to prevent gas leakage. Make a hole in the bottle cap, then plug the other end of the hose so that the end of the hose is immersed in water. The main ingredients of LOF are added according to each treatment (banana weevil, Gliricidia leaf and banana weevil + Gliricidia leaf) which were previously chopped until smooth. To anticipate leaks on the edges of the bucket the edge of the bucket was sealed using duct tape before the bucket was placed on a flat place and out of direct sunlight.

### 2.4. Rice seed nursery

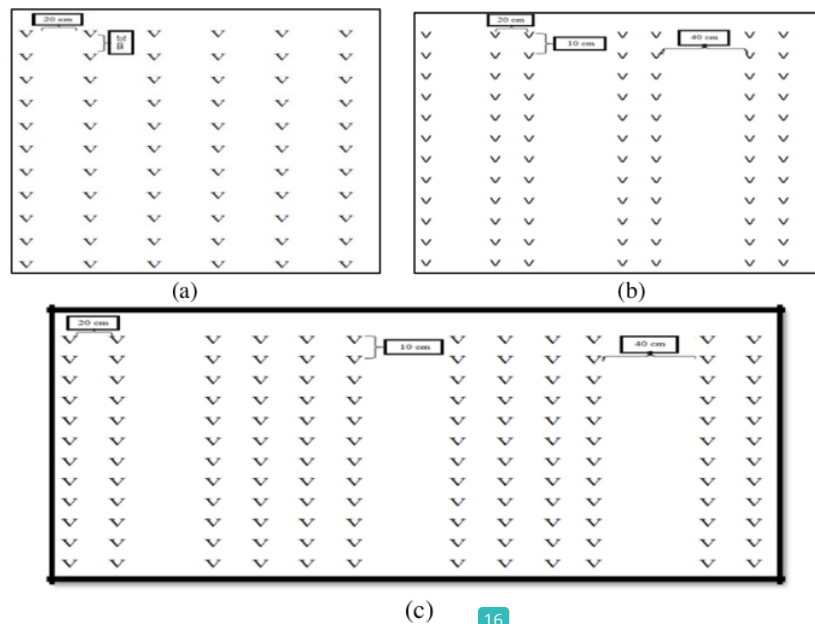
Sowing rice seeds is carried out 1-2 weeks before planting. The seeds used in this nursery are the ciherang variety of rice seeds. Before sowing, it is first soaked in water for approximately 24 hours, aiming to select seeds and to break dormancy in rice seeds. The drowned seeds are separated from the floating seeds, the drowned seeds are used as seeds for sowing. After soaking, it is carried out for approximately 48 hours to obtain uniform seed sprouts, then sowing is carried out by spreading directly into the prepared nursery plots.

### 2.5. Land preparation

Prior to soil cultivation, land sanitation was carried out in the research site for two days, namely dismantling all rat holes in the paddy fields with a radius of 100 m from the research location. Soil tillage was carried out based on complete soil tillage using a tractor. The experimental plots were made of 27 plots with a size of 5.4 m x 4 m, the distance between subplots of 50 cm, the distance between the main plots of 75 cm, while the distance between groups was 100 cm.

### 2.6. Planting rice seeds

Seedlings were planted in the plots according to the treatments, namely the tile planting system, legowo 4: 1, and legowo 2: 1. Planting the seedlings using the tile planting system was carried out using a spacing of 20 cm x 20 cm. Planting with the 2: 1 legowo system was set using spacing of 40 cm x (20 cm x 10 cm). Planting with the 4: 1 legowo system was set with spacing of 40 cm x (20 cm x 10 cm) (figure 1).



**Figure 1.** (a) Tile planting system, (b) 4: 1 legowo planting system, (c) 2: 1 legowo planting system.

## 3. Results

### 3.1. Effect of planting system and liquid organic fertilizer on the growth of rice

Legowo planting system and liquid organic fertilizers made from Gliricidia leaves and banana significantly affected the growth of rice shown by plant height, number of leaves, number of productive

tiller, and days to flowering parameters. On the other hand, these treatments did not have a significant effect on age of harvest.

**Table 1.** Plant height (cm) in various planting systems and types of liquid organic fertilizers.

Planting system (M)	Liquid Organic Fertilizers (LOF) (P)			LSD <sub>0.05</sub> [M]
	Gliricidia leaves (p1)	Banana weevils (p2)	Gliricidia leaves + Banana weevils (p3)	
Tile (m1)	110.64 <sup>a</sup> <sub>y</sub>	111.73 <sup>a</sup> <sub>y</sub>	108.09 <sup>b</sup> <sub>y</sub>	2.15
Legowo 2:1 (m2)	110.38 <sup>a</sup> <sub>y</sub>	115.78 <sup>a</sup> <sub>x</sub>	112.22 <sup>b</sup> <sub>x</sub>	
Legowo 4:1 (m3)	113.87 <sup>a</sup> <sub>x</sub>	110.84 <sup>b</sup> <sub>x</sub>	111.18 <sup>b</sup> <sub>x</sub>	
LSD <sub>0.05</sub> [P]	1.54			

Numbers followed by the same letter on the same row (a, b, c) or column (x, y) are not significantly different in the LSD<sub>0.05</sub> test.

Table 1 shows that the interaction between the treatment of the 4: 1 legowo planting system and the treatment of liquid organic fertilizer from banana weevils (m2p2) produces the highest plant (115.78 cm) which is significantly different from other combinations. While the shortest plant (108.09 cm) was found in the treatment of the tile planting system and the liquid organic fertilizer of Gliricidia leaves + banana weevil (m1p3).

The response of three varieties of rice plant to the planting system and type of liquid organic fertilizers is shown in table 2. Table 2 shows average of number of leaves, number of productive tillers, days to flowering and harvest age as affected by the treatments.

**Table 2.** Average of number of leaves, number of productive tillers per clump, flowering age, and age of rice harvest in various planting systems and types of liquid organic fertilizers.

Treatments	Number of Leaves (leaves)	Number of productive Tillers (tillers)	Days to flowering (DAP)	Harvest age (DAP)
<b>Planting system</b>				
Tile (m1)	4.83	25.46 <sub>y</sub>	60.00 <sub>y</sub>	93.31
Legowo 2:1 (m2)	4.92	28.15 <sub>y</sub>	62.67 <sub>x</sub>	93.33
Legowo 4:1 (m3)	5.26	32.26 <sub>x</sub>	62.78 <sub>x</sub>	93.89
LSD <sub>0.05</sub>	ns	3.38	1.94	ns
<b>Liquid Organic Fertilizer</b>				
Gliricidia leaves (p1)	5.20 <sub>a</sub>	27.39 <sub>b</sub>	61.11	93.56
Banana weevils (p2)	5.02 <sub>ab</sub>	28.43 <sub>ab</sub>	62.22	93.34
Gliricidia leaves + Banana weevils (p3)	4.81 <sub>b</sub>	30.06 <sub>a</sub>	62.11	94.67
LSD <sub>0.05</sub>	0.24	1.92	ns	ns

Numbers followed by the same letter on the same column are not significantly different in the LSD<sub>0.05</sub> test. ns = not significant. DAP = days after planting.

The treatment of the legowo planting system 2: 1 (m3) resulted in the highest number of productive tillers (32.26 stems) and was significantly different from other planting systems (table 2), while the lowest number of productive tillers (25.46 stems) was found in the tile planting system (m1) but still the same legowo system 4: 1 (m4). The type of liquid organic fertilizer for Gliricidia leaves + banana weevil (p3) produced the highest number of productive tillers (30.06 stems) which was significantly different from the LOF of Gliricidia leaves (p1). Although still the same as banana weevil LOF (p2). The lowest number of productive tillers (27.39 stems) was found in the LOF type of Gliricidia leaves (p1).

The type of liquid organic fertilizer from Gliricidia leaves (p1) has the highest number of leaves (5.20) and is significantly different from the LOF of Gliricidia leaves + banana weevils (p3), but is still

not different significantly as the treatment of LOF of banana weevils (p2). The lowest number of leaves (4.81) was found in the liquid organic fertilizer type of Gliricidia leaf + banana weevil (p3). Treatment of the tile planting system (m1) had the fastest flowering age (60.00 DAT) which was significantly different from the treatment of other planting systems. The slowest flowering age (62.78 DAT) was found in the 2: 1 (m3) legowo planting system, although it was not significantly different from the 4: 1 (m2) legowo planting system. Ciharang varieties planted with the tile planting system and given liquid organic fertilizer from banana weevils (m1p2) have a shorter harvest life (92.67 DAS), while the longest (94.33 DAS) is found in the Legowo 2 planting system. : 1 fertilized with Gliricidia leaf LOF + banana weevil (m3p3).

### 3.2. <sup>14</sup> Effect of planting system and liquid organic fertilizer on the rice productivity.

The analysis of variance showed that the treatment of the <sup>13</sup> planting system and the type of liquid organic fertilizer and their interactions had a significant effect on the number of grains per panicle and the productivity of rice plants (table 3).

**Table 3.** Average of <sup>2</sup> number of grains per panicle, production per plot, and production per hectare of rice in various planting systems and types of liquid organic fertilizers.

Planting system	Liquid organic fertilizer (P)			LSD <sub>0.05</sub> [M]
	Gliricidia leaves (p1)	Banana weevils (p2)	Gliricidia leaves + banana stems (p3)	
<u>Number of grain per panicle (grain)</u>				
Tile (m1)	141.67 <sup>a</sup> <sub>y</sub>	140.06 <sup>ab</sup> <sub>xy</sub>	134.72 <sup>b</sup> <sub>y</sub>	7.18
Legowo 2:1 (m2)	130.83 <sup>b</sup> <sub>z</sub>	138.11 <sup>a</sup> <sub>y</sub>	133.22 <sup>ab</sup> <sub>y</sub>	
Legowo 4:1 (m3)	167.89 <sup>a</sup> <sub>x</sub>	145.78 <sup>b</sup> <sub>x</sub>	146.78 <sup>b</sup> <sub>x</sub>	
LSD <sub>0.05</sub> [P]	5.37			
<u>Production per plot (kg)</u>				
Tegel	9.07 <sup>a</sup> <sub>x</sub>	8.95 <sup>a</sup> <sub>y</sub>	8.70 <sup>a</sup> <sub>z</sub>	0.84
Legowo 4 : 1	9.49 <sup>b</sup> <sub>x</sub>	8.52 <sup>c</sup> <sub>y</sub>	10.77 <sup>a</sup> <sub>y</sub>	
Legowo 2 : 1	8.73 <sup>c</sup> <sub>x</sub>	10.60 <sup>b</sup> <sub>x</sub>	11.98 <sup>a</sup> <sub>x</sub>	
LSD <sub>0.05</sub> [P]	0.69			
<u>Production per hectare (ton/ha)</u>				
Tegel	4.20 <sup>a</sup> <sub>x</sub>	4.14 <sup>a</sup> <sub>y</sub>	4.03 <sup>a</sup> <sub>z</sub>	0.39
Legowo 4 : 1	4.39 <sup>b</sup> <sub>x</sub>	3.95 <sup>c</sup> <sub>y</sub>	4.98 <sup>a</sup> <sub>y</sub>	
Legowo 2 : 1	4.04 <sup>c</sup> <sub>x</sub>	4.91 <sup>b</sup> <sub>x</sub>	5.55 <sup>a</sup> <sub>x</sub>	
LSD <sub>0.05</sub> [P]	0.32			

Numbers followed by the same letter on the same row (a, b, c) or column (x, y) are not significantly different in the LSD<sub>0.05</sub> test.

Table 3 shows that rice planted with the 2: 1 <sup>11</sup> legowo planting system and fertilized with liquid organic fertilizer from Gliricidia leaves (m3p1) has the highest number of grains <sup>11</sup> panicle (167.89 seeds) and is significantly different from other treatment combinations. The least number of grains per panicle (130.83 seeds) was found in the combination of the 4: 1 legowo planting system and Gliricidia leaf liquid organic fertilizer (m2p1).

The interaction of the treatment of the 2: 1 legowo planting system and the liquid organic fertilizer of Gliricidia leaves + banana weevil (m3p3) resulted in the highest production of gabag per plot (11.98 kg) which was significantly different from other treatment combinations, while the lowest production per plot (8.52 kg) was found in the treatment combination of the 4: 1 legowo planting system with the treatment of banana weevil liquid organic fertilizer (m2p2).

The interaction of the treatment of the 2: 1 legowo planting system and the liquid organic fertilizer of Gliricidia leaves + banana weevil (m3p3) resulted in the highest production per hectare (5.55 tonnes) which was very significantly different from other treatment combinations, while the lowest production per plot (3.95 tonnes) contained in the treatment combination of the 4: 1 legowo planting system with the treatment of banana weevil liquid organic fertilizer (m2p2).

#### 4. Discussion

Efforts to increase rice production can be done by using several types of planting systems and the use of liquid organic fertilizers. Selection of the right planting system can affect the growth and production of rice because it also affects the level of lighting and nutrient absorption of rice plants. The use of several types of specific organic materials can be combined with several types of cropping systems to increase rice production. The results of the experiment showed that the planting system had a significant to very significant effect on the growth and production of rice plants. This can be seen in the characters of average plant height, number of productive tillers, flowering age, production per plot and production per hectare.

The highest average number of productive tillers (table 2) was obtained in the treatment of the 2: 1 legowo planting system, namely 32.26 stems, which was significantly different from the results obtained in the treatment of the tile planting system and the 4: 1 legowo planting system. This is because the rice planted in the 2: 1 legowo planting system has wider space between rows so that it allows plants to get more light, water and nutrients compared to the tile and legowo 4: 1 planting systems. Lack of competition between plants will allow plants to grow more optimally, which is characterized by higher planting and a higher number of productive tillers than other cropping systems. This condition has an impact on the formation of tillers per plant and productive tillers per plant. The maximum number of tillers or the number of productive tillers is also determined by the spacing [9], because the spacing determines solar radiation, mineral nutrients and plant cropping systems.

According to Kuswara and Ali [10], that the arrangement of plants in the 2: 1 legowo planting system will increase the number of productive tillers, because plant roots do not compete with each other in absorbing nutrients, as well as leaves there is no competition in getting sunlight. In addition, a narrow spacing pattern such as a tile cropping system will result in less sunlight penetrating into the plant growth system compared to a wide cropping pattern (legowo planting system). Plants planted with wide spacing will receive more light which causes the development of stem tissue cells to tend to shorten due to decreased auxin activity, and vice versa in plants planted at narrow spacing as well as in tile planting systems will receive less light which will result in the development of stem tissue cells the stem tends to elongate as a result of higher auxin activity. Auxin is a plant phytohormone which can induce the development of cell elongation [11].

Treatment of liquid organic fertilizer has a significant to very significant effect on several plant characters, including: plant height, number of productive tiller, number of leaves, number of seeds per panicle, production per plot and production per hectare. The results showed that the use of LOF had a significant effect on rice growth and production. The response of plants is different due to different types of materials for making LOF. Use of liquid organic fertilizer from Gliricidia leaves + banana weevil produces the highest number of productive tillers (30.06 stems) which is significantly different from the use of liquid organic fertilizer for Gliricidia leaves. This is because the combined liquid organic fertilizer applied contained more macro and micro nutrients than the LOF made from single type of raw material. The N nutrient contained in LOF functions to accelerate plant growth which in this case increases height plant, number of tillers, increase leaf size and grain size as well as improve plant and grain quality, number of seed buds, and increase production. LOF also increases the amount of grain and the percentage of filled grain, providing food for microbes (microorganisms that work to destroy organic matter in the soil) [12].

Plants planted with the legowo planting system and given liquid organic fertilizers had a very significant effect on vegetative and generative growth. The 2: 1 legowo planting system and the type of liquid organic fertilizer from Gliricidia leaves + banana weevil produced the highest production per plot

(table 3) and per hectare (table 3) (11.98 kg and 5.55 tonnes, respectively, which differed significantly from other treatment combinations. While the lowest production (8.52 kg and 3.95 tonnes) was found in the treatment of the 4: 1 legowo planting system and the type of liquid organic fertilizer from banana weevils. The high production per plot and per hectare in the 2: 1 legowo planting system is supported by several production components including the number of productive tillers, which are more than other planting systems. This is because the population of the 2: 1 legowo planting system is 33.33% more than the tile planting system. The 2: 1 legowo planting system has 333,325 ha<sup>-1</sup> clumps, while the tile planting system with a spacing of 20 x 20 cm is only 250,000 clumps ha<sup>-1</sup>, so that the number of permalai unhulled grains that is formed will increase as well and will ultimately affect the production per hectare as well. The high production per plot and per hectare is due to the increasing number of passageways in the 2: 1 row planting system resulting in more sunlight reaching the leaf surface, especially on the edge of the alley, thereby increasing photosynthetic efficiency [13]. Furthermore, Sumiyati et al. [14] stated that the rate of nutrient uptake by plant roots in the legowo row system tends to increase with increasing sunlight intensity.

## 5. Conclusion

- Planting system and liquid organic fertilizer significantly interacted in affecting the plant height, number of grains per panicle, production per plot and production per hectare. The 2: 1 legowo planting system and the LOF types of Gliricidia leaves + banana weevils gave the highest yields on grain production per plot and production per hectare, namely 11.98 kg.plot<sup>-1</sup> and 5.55 ton.ha<sup>-1</sup>.
- The planting system had a significant effect on the number of productive tillers and flowering age, namely the 2: 1 legowo planting system produced the highest number of productive tillers (32.26 stems), and the fastest flowering age (60.00 DAP) was found in the tile planting system.
- The type of raw materials used to produce the liquid organic fertilizer had a significant effect on the number of productive tillers and the number of leaves per plant. The LOF type of Gliricidia leaves + banana weevil produced the highest number of productive tillers (30.06 stems), while the highest number of leaves was found in the LOF type of Gliricidia leaves, namely 5.20 leaves.

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