Rice Production with Jajar Legowo Planting System without Insertion on Irrigated Paddy Fields

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Abstract. The Jajar Legowo planting system brings many benefits regarding productivity and planting techniques. Applying Jajar Legowo varies depending on the level of understanding and ease of application. This study aims to determine rice production with several planting systems of Jajar Legowo without insertion (legowo) in irrigated paddy fields. This study compared a Legowo planting system in several types of legowo (legowo 2:1, 4:1, and 6:1) with the regular cropping system or squares. Observational data were analyzed using ANOVA at a 95% confidence level, followed by Duncan's test if there was a significant difference. The results of the analysis showed that the Legowo planting system showed no significant. The highest production of 5.71 tons/ha of milled dry grain (MDG) was obtained in the square planting system, and the lowest was in the legowo 6:1 planting system (5.51 tons MDG per hectar).

1 Introduction

Irrigated rice fields are suitable land for rice farming because water is available all the time. Rice farming on irrigated rice fields is also more profitable and has higher productivity than on other types of rice fields [1]. However, the conversion of rice fields that occurs can threaten Indonesia's food security. Mulyani's research results [2] stated that in the 2000-2015 period, the agricultural land conversion rate reached 96,512 ha year-1. The reduction in rice fields every year requires technology to increase rice productivity to maintain national food security

Jajar Legowo is a technology for optimizing rice plant growth to increase productivity and farmers' income [3]. The primary objective of the Jajar Legowo System is to enhance plant population by modifying plant spacing and positioning so that the rice plants appear to be on edge (plant edges) or that there are more plants on edge. In other words, between the rows of rice plants, there is a wide and elongated alley along the rows of plants. Plants that should have been planted in empty rows were moved as interplants in rows [4]. In this way,

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the number of plant populations per unit area space and creating alleys in some rows, it is possible to boost the the air and sunlight circulation around the edges of the plants,which will improve their ability to to photosynthesize [5].

According to [6], there are a number of ways that can be used to boost rice yield. The results of research by [7] stated that the quantity of tillers, leaf color, full grain, total grain, and 1000 grain weight were significantly influenced by planting distance. The application of cultivation technology by arranging plant spacing through the jajar legowo can increase rice productivity [8-10]. According to numerous research, the Jajar Legowo planting method can boost output by 1 to 1.5 tons per hectare, or more than 30 percent, compared to conventional planting methods. The study of [11] showed that compared to conventional planting methods, the Jajar Legowo planting strategy boosted yields by 16.44%. Pratiwi [12] stated that the application of the Jajar Legowo planting system was able to produce the highest rice (10.2 t/ha) compared to SRI and conventional planting move (tapin). The Jajar Legowo planting system facilitates maintenance and increases farmer acceptance. The results of [13] show that the implementation of the Jajar legowo system can generate income of IDR 30,452,381 per planting season with an average land area of 1ha.

The fundamental tenet of the jajar legowo cropping method was to use fringe plants and maximize the number of plants per unit space. However, depending on the farmers' level of comprehension and interpretation of the jajar legowo cropping system, the use in the field exhibits numerous variances. Table 1 lists a variety of jajar legowo varieties.

Table 1. Variation in Plant Population per Hectare and Plant Population Growth Rate for Each Planting System

Planting System	Total population of rice plants (clumps)	arise in the number of plant compared to the square planting system (%)
Square (25x25) cm	160,000	
Jajar legowo 2:1 Type 1 (25x12,5x50) cm	213,300	33.31
Jajar legowo 2:1 Type 2 (25x25x50) cm (legowo 2:1)	120,000	-25.00
Jajar legowo 4:1 Type 1 (25x12,5x50) cm	192,000	20.44
Jajar legowo 4:1 Type 2 (25x25x50) cm (legowo 4:1)	137,143	-14.28
Jajar legowo 4:1 Type 3 (25x12,5x50 full) cm	256,000	60.00
Jajar legowo 6:1 Type 1 (25x12,5x50) cm	182,857	14.28
Jajar legowo 6:1 Type 2 (25x25x50) cm (legowo 6:1)	147,692	-7.69
Jajar legowo 6:1 Type 3 (25x12,5x50 full) cm	265,850	66.16

Source: [4]

A cropping design known as the Jajar Legowo Planting System Type 1 only provides additional insert plants to both rows of edge plants. Jajar legowo type 2 is a planting system that removes one row from several rows without adding other plants to the two rows of edge plants (without inserts). Meanwhile, jajar legowo type 3 is a legowo system with the entire row receiving full inserts. The population of rice plants is decreased via the Jajar Legowo Type 2 planting system between 7.69% and 25%, but it is precisely this cropping system that farmers widely apply.

Farmers believe that by implementing this cropping system, there are several advantages to be gained, including that the number of seeds used is less, so it saves seeds; it is not too dense, so the potential for tillers and yields will be higher; shaking can be 2-way; and higher results are expected. These various benefits should be balanced with high productivity, but to date there was no research that shows high results from a small population. This study aims to determine rice production with the jajar legowo cropping system type 2 in irrigated rice fields to be compared with the regular cropping system or squares. So the study can provide recommendations on whether the type of jajar legowo is more adaptable and profitable based on agronomic and socioeconomic studies for sustainability

2 Method

The study was conducted at planting season III from July to October 2021 in Singasari Village, Karanglewas District, Banyumas Regency, Central Java Province. The study was conducted with the use of Inpari 32 Superior Variety. Transplanting used the young seeds (18–20 days after seed/DAS). Inorganic fertilizers were used based on soil nutrient status (300 kg ha^{-1} Urea, 200 kg ha^{-1} NPK Phonska). Pest and diseases were managed based on the kind and intensity of the attack. The study employed a one-factor randomized block design, namely the planting system consisted of T1 = 25 x 25 cm square as a control, T2 = legowo 2:1, T3 = legowo 4:1, and T4 = legowo 6:1 (Table 2). Each treatment was repeated four times, and each replicate was taken from 10 sample plants.

Table 2. Treatment of rice planting systems.

Planting System	Spacing (cm)	Plant population per hectare (plants)
T1: Square	25x25	160,000
T2: Legowo 2:1	(75:2) x 25	106,667
T3: Legowo 4:1	(125:4) x 25	128,000
T4: Legowo 6:1	(175:6) x 25	137,143

The study was conducted on farmers' land. Production of rice seeds was carried out jointly using the Inpari 32 rice variety. Soil preparation was carried out perfectly, and fertilization was done using organic cow manure. Planting was done when the seedlings are 15–21 days old, using a Legowo 2:1, 4:1, and 6:1 and a square planting system. The first fertilization was carried out when the plants were 10 days old using Urea and Phonska, and the second fertilization was carried out when the plants were 45 days old. Observational data included plant height and number of tillers at 45 and 60 days after planting (DAP) and plant production data per hectare. The observational data were subjected to ANOVA analysis with a 95% confidence level, ans if a notable distinction was detected, Duncan's test was subsequently employed.

3 Result and Discussion

3.1 Characteristics of Research Locations

The research location is an irrigated paddy field located at coordinates 7°23'25.3"S and 109°10'19.4"E in Singosari Village, Karanglewas District, Banyumas Regency. Situated at an altitude of 158 meters above sea level. The source of irrigation, apart from rain, also comes from the Logawa River. The availability of water is abundant, so rice can be planted three

times in one year. Even because of the abundance of water, some rice fields are managed for fisheries.

Based on observations of rainfall data for ten years from 2011–2021 [14] (POWER, 2023), the research area receives about 2,658 mm of rain on average anuually, with a monthly average of about 222 mm (43–385 mm). The distribution of rain in a year has an average of six wet months (exceeding 200 mm/month) in November–April and two dry months (less than 100 mm/month) in August–September. According to the Oldeman climate classification, this area belongs to the C2 climate type, indicating that the farmer may only planting rice once in a year, and have to be careful to plant crops again during the dry months

3.2 Plant Height and Number of Saplings

The Jajar Legowo planting system treatments without insertion had no discernible impact on plant height at 45 and 60 days after observation, according to the analysis of variance. However, at 45 and 60 DAP, it had a considerable impact on the quantity of tillers. These findings are consistent with studies by [15, 12, 16], which found that seedling age and spacing together had an impact on the quantity of tillers and panicles inside a clump. The best results were obtained in the treatment of pure Jajar legowo with seedling ages of 10, 14, and 22 das ; Tegel 25 cm x 25 cm with seedling ages of 10 DAS; and Tegel 30 cm x 30 cm with the age of the seedlings (10, 14, 18, and 22 DAS) significantly affecting the number of tillers aged 35 das and 45 das and the number of clumping panicles.

Based on the results of statistical analysis, plant height, number of panicles, panicle length, 1000 grains weight, harvested day grain (HDG) weight, and milled day grain (MDG) weight were not significantly different. The results of the analysis of the various effects of planting spacing with legowo row patterns on plant height and the number of panicles are listed on Table 3 and Figure 1. The number of rice plants per unit area can influence tillering, with higher densities resulting in fewer tillers per plant. The conditions play a role in reducing competition for resources, enhancing air circulation, and increasing light penetration through the Jajar legowo planting method. Wide spacing can be an advantageous strategy for optimizing rice tillering and increasing overall rice yields when combined with precise fertilizer management, water management, and pest and disease control [17-19]

Table 3. The impact of the Jajar Legowo planting method on plant height and tiller count.

Planting System	Plant Height (cm)		Number of tillers (stems)	
	45 DAP	60 DAP	45 DAP	60 DAP
T1: Square	63.40a	99.37a	19.93b	18.57b
T2: Legowo 2:1	66.32a	96.22a	24.13ab	21.70ab
T3: Legowo 4:1	71.70a	98.33a	28.60a	26.87a
T4: Legowo 6:1	65.73a	93.17a	26.63ab	27.63a

Table 3 and Figure 1 shows that the Legowo planting system statistically did not show any significant difference in the effect on plant height in all the Jajar legowo planting systems. However, descriptively, Legowo 4:1 showed the tendency for the highest plant height values at 45 DAP observations. At 60 DAP, the highest value was achieved in the Square planting system.

Plant density has been proven in several studies to have a considerable impact on rice plant height. Higher plant densities, in general, result in taller plants due to competition for light and resources. Plants that compete for sunlight tend to grow taller to obtain better access to light. Excessive plant density, on the other hand, might result in diminished plant height

and overall growth because plants may not receive enough nutrients and water to support their development [20]

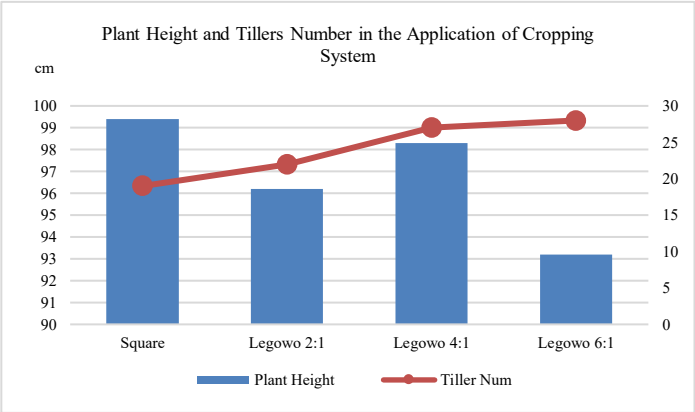

Fig. 1. Plant height and tillers number in the application of several cropping systems

3.3 Plant Production

The analysis of variance in rice production per hectare (Table 4) showed no significant differences between the legowo cropping systems and the square planting system. When compared to the jajar legowo planting system, the square planting technique continues to deliver the maximum output. Because there was no increase in the number of plants per unit space, the production obtained with the Jajar legowo planting strategy was not superior square. The term follows the opinion of [19], which is supported by the results of [20, 6], that the population of Jajar legowo plantations becomes larger, resulting in more production consequences. It was also reported that the grain yield would increase along with the population per unit of land area. According to [20], productive tillers, productivity, and farmers' income were higher by the 2:1 jajar legowo planting scheme with a wide spacing (20 x 15 x 40 cm) compared to narrow spacing (20 x 10 x 40 cm and 20x40 cm)

Table 2. Impact of the Jajar Legowo planting system with no insertion on crop production per hectare

Planting system	**Yield (t/ha) MDG**	**Production Increase (%)**
T1 : Square (25x25) cm	5.71a	
T2 : Legowo 2:1 (25x25x50) cm	5.66a	-0.88
T3 : Legowo 4:1 (25x25x50) cm	5.59a	-1.24
T4 : Legowo 6:1 (25x25x50) cm	5.51a	-1.43

The all-legowo cropping technique has a lower average rice yield than the square cropping system, ranging from 0.8% to 1.4%. This occurred as a result of the legowo cropping system being used, which led to a decline in the number of rice plants compared to the square cropping system.

Controlically, rice planting using the Jajar legowo system without insertion was similar to the control (the Square system). The benefits of applying the Jajar Legowo planting system without insertion include that it uses fewer seeds, which saves seeds, that the planting system is not too tight, which increases the potential for tillers and yields, and that rocking can be

done. Planting Jajar Legowo rice without insertion reduces yields, but this reduction is not significant compared to the benefits obtained by doing so.

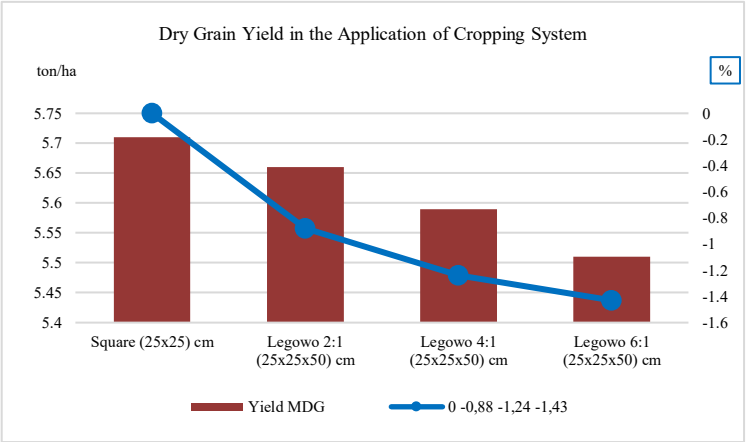

Fig. 2. Dry miled grain yield in the application of several cropping systems

4 Conclusion

The Legowo planting system showed no significant difference in production or plant height at the observations 45 and 60 days after planting. The production yields between treatments were not significantly different, but the highest production was achieved in the square planting system, namely 5.71 tons MDG/ha. The population decline in the practice of implementing the legowo cropping system at the study site has had an impact on decreasing the yield of the square planting system.

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