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Physiological and Morphological Characteristics of Several Rice Varieties (*Oryza sativa* L.) In the System of Rice Intensification (SRI) Cultivation using Different Numbers of Seeds

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Abstract

Rice (*Oryza sativa* L.) is a vital food crop that serves as the staple food for over half of the world's population due to its rich nutritional value. This study aims to determine the physiological and morphological characteristics of several rice varieties cultivated using the System of Rice Intensification (SRI) with varying seed densities. The research will be conducted in Geulumpang Payong Village, Jeumpa District, Bireuen Regency, situated at an altitude of approximately 0-969 meters above sea level (masl), from August to December 2024. The study will employ a Randomized Block Design (RBD) methodology. Two factors will be tested: rice varieties (Ciherang, Inpari 49, and Mustajab) and the number of seedlings per planting hole (4, 3, 2, and 1 seedling). A total of 12 treatments were conducted, with each treatment replicated three times, resulting in 36 experimental units. Each experimental plot measured 2 m x 2 m, with a planting distance of 25 cm x 25 cm, accommodating 81 plants per plot. Four sample plants were selected from each plot for analysis. The data obtained from the research were statistically analyzed using the F-test with SAS V9.12 software. If the analysis of variance indicated significant differences at the 5% level, a subsequent Duncan's Multiple Range Test (DMRT) was performed. The results suggested that the variety, number of seedlings, and their interaction did not show significant differences across all parameters. However, the Inpari 49 and Mustajab varieties, along with the treatment of four seedlings per planting hole, demonstrated relatively favorable outcomes.

Keywords: Ciherang, Effective, Food, Inpari 49, Planting Holes

1. Introduction

Rice (*Oryza sativa* L.) is one of the essential food crop commodities whose production is consistently aimed to be sufficient throughout the year. According to Malik (2017), approximately 95% of Indonesia's population relies heavily on rice as their primary source of food. It serves as the primary source of carbohydrates for the global population. While rice can be substituted with other foods, it holds a unique value for those who typically consume it, making it difficult to replace it with alternative food sources.

Based on data from the Central Statistics Agency of Indonesia (2023), the rice harvest area is estimated to be 10.20 million hectares, yielding approximately 53.63 million tons of dry-milled grain (GKG). When converted into rice for food consumption, rice production in 2023 is projected to be 30.90 million tons. The harvest results indicate a surplus of 0.70 million tons compared to the rice requirement data from the national food balance forecast by the National Food Agency (BPN, 2024), which is 30.84 million tons. According to data from the Central Statistics Agency (2023), rice production from January to December 2023 was 1,404.23 thousand tons, a decrease of 6.97% compared to the Same Period in 2022, when production was 1,509.46 thousand tons. Rice production in January-April 2024 is estimated to experience an increase of 24.98% compared to the same period in the previous year

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(604.93 thousand tons in 2023 and 756.03 thousand tons in 2024). Rice production still needs to be continuously increased by using cultivation techniques and supporting methods, one of which is the System of Rice Intensification (SRI) planting pattern.

Superior varieties with high yields and guaranteed quality are essential for farmers to meet their needs and reduce production costs. The genetic superiority of one variety over another superior variety is the result of genetic assembly carried out by plant breeders. Several superior varieties have been distributed at present, including the Ciherang variety, the Mustajab variety, the Inpari 49 variety, and the Inpari 50 variety. Each variety has superior characteristics in terms of high yield potential, resistance to certain pest organisms, and advantages in certain echolocation, as well as possessing other important agronomic, physiological, and morphological characteristics (Atman, 2007).

The use of superior varieties, such as Ciherang, Inpari 49, and Mustajab, is one alternative to increase rice production and farmer income. Each of these varieties has advantages, including resistance to pests and diseases, optimal harvest age, and high yield potential. Higher, and the taste of the rice is delicious, fragrant, and soft. According to Sembiring et al. (2023), superior varieties are one of the innovative technologies that are reliable for increasing rice productivity, both by increasing the potential or yield of plants and their tolerance and resistance to biotic and abiotic stresses.

The low production of paddy fields in Bireuen Regency is also caused by land conversion, the use of local varieties, the planting of seedlings, and practices that are not in accordance with recommendations. Cultivation techniques have not been optimally carried out by farmers, resulting in rice plants not fully realizing their potential capabilities according to their genetic potential. One way to increase rice productivity is through a program intensification, often referred to as the Rice System Intensification (SRI).

The System of Rice Intensification (SRI) is one of the intensification methods that allows the genetic capabilities of plants to be expressed optimally. The SRI rice cultivation technique is able to increase plant productivity by changing the management of plants, soil, water, and nutrients. The technology primarily focuses on enhancing rice production by improving four main components and two additional components, namely the age of transplanting young seedlings (7-14 days), planting one seedling per hole, wide plant spacing, water management (including water conservation), weed control, and the provision of fertilizers. organic (Berkelaar, 2001).

In general, farmers assume that the more seeds per hole, the higher the results will be, but they are not aware that this will result in the wastage of seeds and seedlings used. In addition, the results will not be optimal because not all parts of the plant are exposed to sunlight, and the photosynthesis process will not occur to the same extent. This result will also lead to competition for elements, such as nutrients, if the plants are too thick. For example, in rice plants that are too thick or bushy, the fruit will not be filled perfectly but will have many empty seeds due to the lack of sunlight received by the leaves and panicles during the fruit-filling process (Adinurani et al., 2017).

Based on the research results of Atman and Yarda (2006), planting with 1 seedling per hole provides.. the highest grain yield (5.45 tons per ha), especially in the treatment with planting 1 seedling per planting hole, resulting in panicle length, number of grain per panicle, weight of 1000 seeds and higher grain yield than planting 3, 5, 7 and 9 seeds per hole planting. Meanwhile, according to research by Yunidawati and Koryati (2022), planting three seedlings per planting hole yields more productive results. The use of 3 seedlings per planting hole tends to produce better vegetative growth, such as a higher number of leaves, shoots, and dry weight of straw, than planting 1 or 2 seedlings per hole. This study aims to determine the physiological and morphological characteristics of several rice varieties in the context of the System of Rice Intensification (SRI) cultivation with varying seed densities.

2. Material and Methods

This research will be conducted in the village of Geulumpang Payong, Jeumpa District, Bireuen Regency, located at an altitude of ±0-969 meters above sea level (masl). Physiological analysis was conducted at the Laboratory of the Faculty of Agriculture, Malikussaleh University, located at coordinates 4°55′00″N 97°00′00″E/4.9167 °N 97°. This research was conducted from August to December 2024. The materials used in this study were rice seeds. Ciherang variety, Inpari 49, and Mustajab were treated with manure, NPK Phoska, and Urea fertilizers (NPK 300 kg/ha + Urea 275 kg/ha) and pesticides. The tools used include tractors, hoes, rakes, hand sprayers, meters, digital scales, chlorophyll speedometers, labels, nameplates, ovens, and all tools that support the research.

This study was conducted using the Randomized Block Design (RAK) method. Two factors were tested: varieties (Ciherang, Inpari 49, and Mustajab) and the number of seedlings per planting hole (4, 3, 2, and 1). Thus, 12 treatments were obtained, and each treatment was repeated three times, resulting in 36 experimental units. Each experimental plot, measuring 2 m x 2 m with a planting distance of 25 cm x 25 cm, has 81 plants per plot, with 4 sample plants from each plot. The data obtained from the research results were analyzed statistically using the F-test with SAS V9.12 software and Excel. If the results obtained in the analysis of variance are significantly different at the 5% level, then it is carried out. If the results of the F test have a real effect, then further testing is carried out using DMRT. The parameters observed were leaf area index, flowering age, leaf chlorophyll content, net assimilation rate (NAR), and relative growth rate (RGR). The research flow diagram is presented in Figure 1 below.

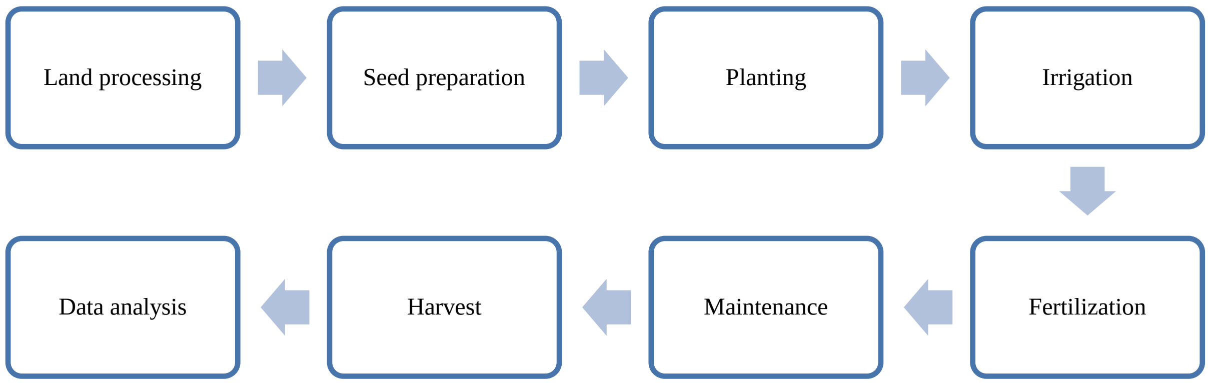

Figure 1. Research flow diagram

3. Results and Discussion

3.1. Leaf Area Index

The results of the analysis of variance showed that the treatment of varieties, the number of seedlings, and the interaction of both were not significantly different in the leaf area index of rice plants. The average leaf area index of several rice varieties cultivated using the system of rice intensification (SRI) with varying numbers of seedlings is presented in Table 1.

Based on Table 1, the highest leaf area index is found in the Mustajab Variety at 0.18, followed by the Inpari 49 Variety at 0.17, and the lowest in the Ciherang Variety at 0.16. The leaf area index increases with increasing plant age. The Mustajab variety shows the highest leaf area, which continues to expand. This result is due to the genetic factors of the plant itself and environmental factors that are conducive to the growth of the variety. Suryani & Anwar (2017) stated that the genetic factors of each variety affect leaf expansion, which also increases the photosynthetic capacity of rice plants.

Table 1. Average Leaf Area Index of Several Rice Varieties (*Oryza sativa* L.) In the System of Rice Intensification (SRI) Cultivation with Different Number of Seeds

Varieties	Number of Seeds				Average
	4 seeds/planting hole	3 seeds/planting hole	2 seeds/planting hole	1 seedling/planting hole	
Ciherang	0.18 ± 0.01	0.15 ± 0.02	0.15 ± 0.02	0.18 ± 0.01	0.16 ± 0.01 a
Inpari 49	0.19 ± 0.05	0.18 ± 0.02	0.15 ± 0.01	0.15 ± 0.02	0.17 ± 0.01 a
Efficacious	0.16 ± 0.01	0.18 ± 0.02	0.20 ± 0.01	0.19 ± 0.02	0.18 ± 0.01 a
Average	0.18 ± 0.01 a	0.17 ± 0.01 a	0.17 ± 0.02 a	0.17 ± 0.01 a	

Description: Numbers followed by the same letter in the same column are not significantly different according to the 5% DMRT test. This study used 3 replications.

Table 1 shows that the highest leaf area index was observed in 4 seedlings per planting hole at 0.18 and the lowest in 3, 2, and 1 seedlings per planting hole at 0.17. The more seedlings planted, the greater the ILD value. The highest ILD at the ages of 20 and 30 DAP was observed in the number of seedlings in B1 (4 seedlings per planting hole), which was not significantly different from B2 (3 seedlings per planting hole) and B3 (2 seedlings per planting hole). However, at the age of 50, DAP, the highest ILD, was in the B2 treatment (3 seedlings per planting hole). This result shows that at the beginning of the plant's vegetative growth, the number of plant shoots is limited, so the leaves do not cover the light entering all parts of the plant. Consequently, by 50 DAP, the leaves are already dense enough to cover the incoming sunlight. Following the opinion of Anggraini et al. (2013), the population has a significant influence on the value of the leaf area index. The denser the plants, the higher the value of the leaf area index. This condition occurs because the distance between the plant crowns is decreasing, allowing the plant crowns to cover a greater area of the land where the stand is located. The leaf area index does not have an optimum value, depending on the type of land used and the planting distance used. The ILD value of a plant is closely related to the dry weight of the plant. The dry weight of the plant will increase with the increase in the ILD rate, but if the ILD continues to grow, the dry weight will decrease. This decrease in dry weight is caused by the rate of photosynthesis decreasing because the leaves shade each other, resulting in reduced light availability.

3.2. Flowering Age (Days)

The results of the analysis of variance showed that the variety, the number of seedlings, and the interaction of both were not significantly different in terms of the flowering age of rice plants. The average flowering age (in days) of several rice varieties cultivated using the system of rice intensification (SRI) with varying numbers of seedlings is presented in Table 2.

Based on Table 2, it is evident that the fastest flowering age is observed in the Mustajab Variety at 72.08 days, followed by the Ciherang Variety at 72.83 days, and the longest is the Inpari 49 Variety at 73.08 days. All varieties tested flowered faster than the variety descriptions indicated. This result is greatly influenced by the genetic properties of the plant itself, even though it is planted under the same land conditions, namely using the same method. Plant varieties have different abilities in terms of utilizing growth facilities and adapting to their surrounding environment, which has a significant influence on their potential (Kumalasari et al., 2017). Plant flowering is an inseparable part of plant growth. Darjanto and Satifah (1990) stated that the genotype and external factors, such as temperature, water, fertilizer, and light, partly determine the transition from the vegetative to the generative phase. Nurahmi (2010) stated that differences in flowering age among plants can occur due to the influence of temperature, light, and the nutrients absorbed by the plant.

Table 2. Average Flowering Age (Days) of Several Rice Varieties (*Oryza sativa*) L.) In the System of Rice Intensification (SRI) Cultivation with Different Number of Seeds

Varieties	Number of Seeds				Average
	4 seeds/planting hole	3 seeds/planting hole	2 seeds/planting hole	1 seedling/planting hole	
Ciherang	73.00 ± 0.58	72.67 ± 0.67	72.67 ± 0.88	73.00 ± 0.58	72.83 ± 0.10 a
Inpari 49	73.00 ± 1.15	72.67 ± 0.67	73.00 ± 0.58	73.67 ± 0.88	73.08 ± 0.21 a
Efficacious	72.00 ± 0.58	72.00 ± 0.58	71.33 ± 0.33	73.00 ± 0.00	72.08 ± 0.34 a
Average	72.67± 0.33 a	72.45 ± 0.22 a	72.33 ± 0.51 a	73.22 ± 0.22 a	

Description: Numbers followed by the same letter in the same column are not significantly different according to the 5% DMRT test. This study used 3 replications.

Table 2 shows that the fastest flowering age is 72.33 days for 2 seedlings per planting hole, followed by 72.45 days for 3 seedlings per planting hole, then 4 seedlings per planting hole, and the longest is 73.22 days for 1 seedling per planting hole. The number of seedlings per planting hole affects the intensity of light received by plants and photosynthetic activity. Mahatir et al. (2023) stated that planting with a smaller number of seedlings allows for a more even distribution of light to all parts of the plant, increasing photosynthetic efficiency. Conversely, planting with a larger number of seedlings can cause the leaves of the plants to overlap, reducing light penetration to the lower leaves and inhibiting the overall photosynthesis process. Khakim et al. (2019) in their research stated that the leaf area formed on plants affects the level of efficiency of solar radiation absorption. Sunlight radiation falls on the soil surface so that the level of effectiveness of the leaf area in absorbing solar radiation is attributed to the land area.

3.3. Leaf Chlorophyll

The results of the analysis of variance showed that the variety, the number of seedlings, and the interaction of both were not significantly different in terms of the chlorophyll content of rice plant leaves. The average leaf chlorophyll content of several rice varieties in the cultivation system of rice intensification (SRI) with varying numbers of seedlings is presented in Table 3.

Table 3. Average Leaf Chlorophyll of Several Rice Varieties (*Oryza sativa* L.) In the System of Rice Intensification (SRI) Cultivation with Different Number of Seeds

Varieties	Number of Seeds				Average
	4 seeds/planting hole	3 seeds/planting hole	2 seeds/planting hole	1 seedling/planting hole	
Ciherang	4.59 ± 0.50	4.74 ± 0.35	4.53 ± 0.45	5.99 ± 0.83	4.96 ± 0.34 a
Inpari 49	6.06 ± 0.51	4.48 ± 0.30	4.57 ± 0.39	4.95 ± 0.31	5.01 ± 0.36 a
Efficacious	4.41 ± 0.31	4.67 ± 0.59	5.02 ± 0.74	4.67 ± 0.35	4.69 ± 0.13 a
Average	5.02 ± 0.52 a	4.63 ± 0.08 a	4.71 ± 0.16 a	5.02 ± 0.40 a	

Description: Numbers followed by the same letter in the same column are not significantly different according to the 5% DMRT test. This study used 3 replications.

Table 3 shows that the highest leaf chlorophyll content of rice plants is in the Inpari 49 variety at 5.01 cm, followed by the Ciherang variety at 4.96 cm, and the lowest in the Mustajab variety at 4.69 cm. This result can be attributed to the genetic factors of the variety that enable higher chlorophyll production. However, insignificant differences between varieties are likely due to environmental factors, such as light intensity, humidity, and water availability, which affect light absorption and chlorophyll formation more than the variety factor itself. According to Wangiyana et al. (2009), plants that are not exposed to light cannot form chlorophyll, resulting in pale leaves. However, if the light intensity is too high, chlorophyll will be damaged.

Table 3 shows that the highest leaf chlorophyll of rice plants is found in 4 and 1 seedlings/planting hole of 5.02, followed by 2 seedlings/planting hole of 4.71 and the lowest in 3 seedlings/planting hole of 4.63. This result is because the rice plants are planted under the same light conditions, ensuring that the chlorophyll content of rice plants from all varieties is also the same. Chlorophyll is the main component of chloroplasts responsible for photosynthesis, and its relative content is directly related to photosynthesis. The decrease in chlorophyll content results in a reduction in the ability to respond to changes in sunlight radiation, thereby inhibiting photosynthesis. Chlorophyll plays a role in the process of plant photosynthesis. Increasing the amount of chlorophyll causes the rate of photosynthesis to grow, resulting in faster and more optimal plant growth (Koryati, 2004).

3.4. Net Assimilation Rate (NAR) (μg/cm 2 /day)

Based on the results of the analysis of variance, it is shown that the variety, number of seeds, and the interaction of both are not significantly different in the net assimilation rate (NAR) of rice plants. The average net assimilation rate (NAR) of several rice varieties in the cultivation system of rice intensification (SRI) with different seed numbers is presented in Table 4.

Table 4. Average Net Assimilation Rate (NAR) (μg/cm2 / day) of Several Rice Varieties (*Oryza sativa* L.) In the System of Rice Intensification (SRI) Cultivation with Different Number of Seeds

Net Assimilation Rate (NAR)	Varieties	Number of Seeds				Average
		4 seeds/ hole	3 seeds/ hole	2 seeds/ hole	1 seedling/planting hole	
LAB 1	Ciherang	0.10 ± 0.01	0.10 ± 0.02	0.08 ± 0.01	0.11 ± 0.01	0.10 ± 0.01 a
	Inpari 49	0.09 ± 0.01	0.11 ± 0.01	0.09 ± 0.01	0.08 ± 0.01	0.09 ± 0.01 a
	Efficacious	0.10 ± 0.01	0.11 ± 0.01	0.10 ± 0.02	0.12 ± 0.03	0.11 ± 0.00 a
	Average	0.10 ± 0.00 a	0.11 ± 0.00 a	0.09 ± 0.01 a	0.11 ± 0.01 a	
LAB 2	Ciherang	0.08 ± 0.01	0.09 ± 0.03	0.07 ± 0.01	0.08 ± 0.01	0.08 ± 0.00 a
	Inpari 49	0.07 ± 0.01	0.08 ± 0.01	0.08 ± 0.01	0.07 ± 0.01	0.08 ± 0.00 a
	Efficacious	0.08 ± 0.01	0.10 ± 0.02	0.08 ± 0.02	0.10 ± 0.03	0.09 ± 0.01 a
	Average	0.08 ± 0.00 a	0.09 ± 0.01 a	0.08 ± 0.00 a	0.08 ± 0.01 a	
LAB 3	Ciherang	0.04 ± 0.01	0.05 ± 0.03	0.03 ± 0.01	0.04 ± 0.01	0.04 ± 0.00 a
	Inpari 49	0.03 ± 0.01	0.03 ± 0.00	0.04 ± 0.01	0.03 ± 0.01	0.03 ± 0.00 a
	Efficacious	0.04 ± 0.01	0.05 ± 0.02	0.03 ± 0.01	0.06 ± 0.03	0.05 ± 0.01 a
	Average	0.04 ± 0.00 a	0.04 ± 0.01 a	0.03 ± 0.00 a	0.04 ± 0.01 a	

Description: Numbers followed by the same letter in the same column are not significantly different according to the 5% DMRT test. This study used 3 replications.

Table 4 shows that the highest net assimilation rate in LAB 1, LAB 2, and LAB 3 was observed in the Mustajab variety, at 0.11, 0.09, and 0.05 μg/cm²/day, respectively. The lowest LAB in LAB 1 was observed in the Inpari 49 variety at 0.09 μg/cm²/day. In comparison, in LAB 2, the lowest value was observed in the Ciherang and Inpari 49 varieties at 0.08 μg/cm²/day. In LAB 3, the lowest value was recorded in the Inpari 49 variety at 0.03 μg/cm²/day. This result is suspected to be due to a similar genetic adaptation to the environmental conditions in which the experiment was conducted. Although each variety has distinct genetic characteristics, the three varieties may exhibit nearly equivalent photosynthetic abilities under specific conditions, such as optimal temperature, humidity, or nutrient availability. The net assimilation rate is associated with leaf area and dry matter produced from a particular period. Inhibition of leaf expansion will decrease the capacity of the leaves to absorb light (Maisura et al., 2015). Plant growth is greatly influenced by environmental conditions where the plant grows (Gardner et al., 2001)

Table 4 shows that LAB 1 is highest in 3 and 1 seedlings per planting hole at 0.11 μg/cm²/day and lowest in 2 seedlings per planting hole at 0.09 μg/cm²/day. In LAB 2, the highest value is observed in 3 seedlings per planting hole at 0.09 μg/cm²/day, and the lowest value is observed in 4, 2, and 1 seedlings per planting hole at 0.08 μg/cm²/day. LAB 3 is highest in 4, 3, and 1 seedlings/planting hole at 0.04 μg/cm2 / day and lowest in 2 seedlings/planting hole at 0.03 μg/cm2 / day. This result is due to the decreasing efficiency of photosynthesis as the plant ages, where most of the energy is used for growth and reproduction, no longer for CO_2 absorption and biomass production. Gardner et al. (1991) stated that the net assimilation rate of a plant is not constant over time and decreases as the plant growth phase increases.

3.5. Relative Growth Rate (LTR)

Analysis of variance showed that varieties, the number of seedlings, and the interaction of both were not significantly different in the relative growth rate (RGR) of rice plants. The average relative growth rate (AGR) of several rice varieties in the cultivation system of rice intensification (SRI) with different numbers of seedlings is presented in Table 5.

Table 5 shows that the highest LTR 1 value was observed in the Inpari 49 variety at 4.04 and the lowest in the Mustajab variety at 3.84. The highest LTR 2 value was observed in the Ciherang variety at 3.35 and the lowest in the Mustajab variety at 3.21. The highest LTR 3 was in the Ciherang variety at 1.80 and the lowest in the Mustajab variety at 1.22. It is suspected that the highest relative growth rate occurs in the early growth phase (LTR1), then decreases in the subsequent growth phases (LTR2 and LTR3), due to the increase in leaf area of the rice plant. Gardner et al. (1991) suggest that the decrease in the relative growth rate is caused by an increase in leaf area, which in turn increases the leaf area index. This result occurs because the plants shade each other's leaves below, reducing the need for photosynthesis; however, the respiration process increases, resulting in more photosynthesis being used. The relative growth rate is the speed of plant growth over a specific period, typically during the vegetative phase, when growth occurs rapidly before entering the generative phase (Sugito, 1995).

Table 5. Average Relative Growth Rate (LTR) of Several Rice Varieties (*Oryza sativa* L.) In the System of Rice Intensification (SRI) Cultivation with Different Number of Seeds

Relative Growth Rate (LTR)	Varieties	Number of Seeds				Average
		4 seeds/ hole	3 seeds/ hole	2 seeds/ hole	1 seedling/planting hole	
LTR 1	Ciherang	3.85 ± 0.55	5.05 ± 0.33	3.27 ± 0.33	3.50 ± 0.25	3.92 ± 0.40 a
	Inpari 49	3.93 ± 0.55	3.99 ± 0.33	4.77 ± 0.58	3.47 ± 0.47	4.04 ± 0.27 a
	Efficacious	4.21 ± 0.59	3.83 ± 0.30	3.19 ± 0.312	4.15 ± 0.79	3.84 ± 0.23 a
	Average	4.00 ± 0.11 a	4.29 ± 0.38 a	3.74 ± 0.51 a	3.71 ± 0.22 a	
LTR 2	Ciherang	3.33 ± 0.67	4.71 ± 0.46	2.41 ± 0.42	2.94 ± 0.30	3.35 ± 0.49 a
	Inpari 49	3.03 ± 0.62	3.16 ± 0.30	4.09 ± 0.56	3.05 ± 0.46	3.33 ± 0.25 a
	Efficacious	3.73 ± 0.58	3.26 ± 0.44	2.64 ± 0.25	3.20 ± 0.76	3.21 ± 0.22 a
	Average	3.36 ± 0.20 a	3.71 ± 0.50 a	3.05 ± 0.53 a	3.06 ± 0.08 a	
LTR 3	Ciherang	1.75 ± 0.84	2.48 ± 0.45	1.25 ± 0.36	1.71 ± 0.13	1.80 ± 0.25 a
	Inpari 49	1.42 ± 0.99	1.56 ± 0.36	1.57 ± 0.79	1.14 ± 0.09	1.42 ± 0.10 a
	Efficacious	1.23 ± 0.42	1.22 ± 0.35	0.82 ± 0.53	1.60 ± 1.12	1.22 ± 0.16 a
	Average	1.47 ± 0.15 a	1.75 ± 0.38 a	1.21 ± 0.22 a	1.48 ± 0.17 a	

Description: Numbers followed by the same letter in the same column are not significantly different according to the 5% DMRT test. This study used 3 replications.

Table 5 indicates that LTR 1 is highest at 3 seedlings per planting hole, with a value of 4.29, and lowest at 1 seedling per planting hole, with a value of 3.71. LTR 2 reaches its peak at 3 seedlings per planting hole, recording a value of 3.71, while it is lowest at 2 seedlings per planting hole, with a value of 3.05. LTR 3 shows its highest value at 3 seedlings per planting hole, at 1.75, and its lowest at 2 seedlings per planting hole, at 1.21. This variation is believed to be attributed to competition among seedlings within a single planting hole, suggesting that the increased number of plants in B2 does not significantly enhance LTR due to the limited availability of light, water, and nutrients. Hidayat (2016) stated that increasing the number of seedlings without improving resource availability leads to heightened competition, which ultimately inhibits growth and reduces the physiological efficiency of plants. As the plants develop, the relative growth rate diminishes and becomes statistically insignificant due to the shading of one another, resulting in a decrease in the production of assimilates from photosynthesis (Khakim et al., 2019).

4. Conclusion

Inpari 49 and Mustajab varieties demonstrated favorable results across several parameters. The Inpari 49 variety exhibited the highest performance in terms of flowering age and leaf chlorophyll content. Conversely, the Mustajab variety achieved the best results for leaf area index and net assimilation rate. Additionally, the treatment involving four seedlings per planting hole yielded the highest outcomes for leaf area index, flowering age, leaf chlorophyll, and net assimilation rate.

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