Effect of Pruning Seedling Leaves 21 Days After Sowing on the Growth of Rice Plants (*Oryza Sativa* L.)

Heru Wahyudi, Hanifah Mutia Z.N.A, Desi S.P.S. Sembiring

Abstract

This study aims to determine the effect of leaf pruning on the growth of rice plants (*Oryza sativa* L.) on irrigated rice fields. The study was carried out in Kampung Lalang Village, Sunggal District, Deli Serdang Regency, in July–September 2025 using a non-factorial Group Random Design (RAK) with three treatments and nine replicates, namely: P0 (without pruning), P1 (pruning 5 cm from rice shoots), and P2 (pruning 10 cm from rice shoots). The observed parameters were plant height and number of seedlings. The results of the study showed that the pruning treatment did not affect the growth parameters. At the observation of week 7, the height parameters of the plants did not differ significantly between treatments, with an average of 94.33 cm (P0), 95.06 cm (P1), and 94.94 cm (P2). The highest number of saplings was obtained in the P2 treatment with an average of 8.78 saplings per clump, indicating that pruning is able to stimulate lateral shoot growth through increased cytokinin hormone activity. P2 treatment improves the formation of chicks. Thus, the treatment of pruning 10 cm leaves from rice shoots can be recommended as an agronomic technique to stimulate vegetative growth.

***Keywords**: rice, seedlings, pruning, leaves, growth*

Heru Wahyudi
Post-Graduate, Panca Budi University, Indonesia
Email:heruwahyudi1989@gmail.com

Hanifah Mutia, Z.N.A, Desi Sri Pasca Sari Sembiring
Email: hanifahmutia@dosen.pancabudi.ac.id, desisripascasari@dosen.pancabudi.ac.id

Introduction

Rice plants are annuals that belong to the grassy group. Rice has a short lifespan, which is less than one year. Rice plants can be classified into several groups based on the state of the rice, the way and place of planting, and according to its age. This ancient agricultural crop comes from two continents, namely tropical and subtropical Asia and West Africa. Historical evidence shows that rice cultivation in *Zheziang* (China) began in 3000 years BC. Fossils of rice and grain grains were found in Hastinapur, Uttar Pradesh, India, around 100-800 BC [1].

The food crisis is a serious problem in food fulfillment around the world, including Indonesia. As a developing country, Indonesia is affected by the global food crisis, which has a significant impact on food security, especially rice production and rice consumption. In 2024, Indonesia's rice production is expected to decline by 0.9% to 52.66 million tons, compared to 53.98 million tons in 2023 [2]. This decline is caused by several factors, including a decrease in the area of harvested land, the impact of extreme weather such as the El Nino phenomenon, as well as pest attacks and natural disasters such as floods. In addition, the COVID-19 pandemic has also affected economic and agricultural activities [3]. One of the provinces that felt the impact of the decline in rice production was North Sumatra Province. In 2023, North Sumatra experienced a decrease of 0.38% or 7.9 thousand tons compared to rice production in 2022, which was 2.1 million tons. This also has an impact on rice production in North Sumatra Province which decreased by 0.38% or 4.5 thousand tons compared to rice production in 2022 which was 1.2 million tons [4].

The legowo row planting system is a rice planting pattern that arranges the rows of plants alternately with one empty row after two or more rows of plants. The term legowo comes from the Javanese language, namely lego which means wide and dowo which means elongated. One unit of legowo rows consists of several rows of plants interspersed with one empty row. Based on the number of planting rows in each unit, this system is known as legowo 2:1, legowo 4:1, and other patterns. The arrangement aims to increase the proportion of fringe plants so that the reception of sunlight, air circulation, and plant maintenance efficiency are better [5]. The legowo 2:1 row planting system (Jarwo 2:1) provides 3 significant advantages for rice farmers by increasing the plant population by 33.31% (from 160,000 to 213,300 clumps/ha) compared to the conventional system. The main principle is to regulate planting spacing and manipulate planting sites to create more "edge crops" that get optimal sun exposure, resulting in higher productivity and better grain quality [6].

The technique of pruning leaves on rice seedlings before planting has been known traditionally and has begun to be applied in intensive planting systems such as SRI (*System of Rice Intensification*). Pruning aims to reduce transplant stress, spur the growth of new roots and shoots, and make planting easier. However, this practice has not been widely studied scientifically, especially to find out how much impact it has on vegetative growth and rice crop production. Therefore, this research is important to provide a deeper understanding of the effect of pruning rice seedlings on the growth and production of rice plants. The purpose of this study is to determine the effect of leaf pruning on the vegetative growth of rice.

Literature Review

Rice plants (*Oryza sativa* L.) are annuals of the *Poaceae family* that have main organs in the form of roots, stems, leaves, panicles, flowers, and grains. The root system of rice includes a type of fibrous root that develops from the seminal roots in the germination phase, then is replaced by adventitious roots (*nodal roots*) that grow from the stem books during the vegetative phase. Most root systems develop in the top soil layer (±0–20 cm), so they play an important role in absorbing water and nutrients and supporting plant growth. Rice roots also have *aerenchyma* tissue that functions to facilitate oxygen transport to the root tissues so that plants can adapt to flooded land conditions. Root growth and development are influenced by genetic factors, water availability, soil aeration, and cultivation management, especially fertilization. An optimally developed root system will increase the efficiency of water and nutrient absorption, support vegetative growth, and contribute to the formation of yield components and plant productivity [7].

Rice stalks (*culm*) are cylindrical in shape, hollow at the *internode*, and are composed of books (*nodes*) and segments where *tillers* and leaves appear. Rice leaves are arranged alternately on each stem book and consist of leaf *sheaths*, *leaf blades*, ligulas, and *auricles*. The leaf blades are narrowly elongated (*lanceolate*) with parallel leaf bones and serve as the main organs of photosynthesis, as well as play a role in the process of transpiration and gas exchange. Leaf characteristics, such as length, width, leaf angle, and leaf position to stem affect the plant's ability to capture sunlight, affecting the efficiency of photosynthesis, vegetative growth, and the formation of plant yields. Healthy leaf conditions are generally characterized by a uniform green color, while discoloration or damage to the leaves can indicate a physiological disorder, nutrient deficiency, or attack by plant pest organisms. Leaves are the main organs of photosynthesis that produce assimilates as a source of energy to support the growth and development of rice plants. The results of photosynthesis are distributed to various plant organs, such as roots, stems, saplings, and panicles, thus influencing vegetative growth and yield formation. Therefore, maintaining healthy leaf conditions through proper cultivation management is essential to maintain photosynthesis efficiency and support rice plant productivity [8].

Panicle is a reproductive organ that functions as a place for the formation of flowers and grain. Panicles develop from the point of growth in the reproductive phase and consist of a main shaft (*rachis*), primary branches, secondary branches, and spikelets, each of which generally produces one fertile flower. The initiation of panicles begins with the formation of primordia panicles, then develops through branch differentiation until it enters the flowering phase (*heading*) and full flowering (*anthesis*). The number of branches, the number of spikelets, and the success of flowering and filling of grain are important components that determine the potential yield of rice plants. The development of panicles is influenced by genetic factors, environmental conditions, and cultivation management so that optimal panicle formation contributes to increasing plant productivity [7].

The application of proper cultivation techniques is one of the important factors in increasing the growth and productivity of rice plants. The regulation of the planting system and appropriate nutrient management has been proven to be able to support plant growth and increase yield components, so it is an important part of efforts to increase rice productivity [9].

Research Methodology

The research was conducted in Kampung Lalang Village, Sunggal District, Deli Serdang Regency with an altitude of ±25 meters above sea level, starting from September to November 2025. The materials used are Inpari 33 variety rice seeds, Urea Fertilizer, TSP, KCL, insecticides, molluscides, and herbicides. The tools used are tugal and peg wood, raffia rope, meter, sprayer, scales, and stationery.

This study used a Non-Factorial Group Random Design (RAK) with 3 treatments and 9 replications, so that the total number of plots was 27 plots, the treatment consisted of P0: No pruning (control), P1: Pruning leaves 5 cm from shoots, and P2: Pruning leaves 10 cm from shoots.

The linear model used to draw conclusions on the Non-Factorial Group Random Design (RAK) in this study, namely:

$$Y_{ij} = \mu + \rho_i + \alpha j + \varepsilon_{ij}$$

Description :

Y_{ij} = Observation value on the i-i block with the j-th trimming treatment

m = General average value

r_i = Influence of the i-i block (i = 1, 2, ..., and 9)

AJ = Effect of the jth pruning treatment (j = 0, 1, and 2)

E_{ij} = Effect of error of the i-block and the j-cropping treatment

To determine the effect of treatment, the data obtained was analyzed with the ANOVA test at the level of 5%. If the results of the variety analysis show a real difference, a follow-up test is carried out using *the Tukey* Test [10] using *the SPSS Statistics* 25 application from the *software company IBM* from New York.

The research is carried out through several stages of rice cultivation starting from preparation to harvest. Land cultivation is carried out by first clearing the land from weeds and plant residues beforehand, then tillage is carried out by ploughing and scratching so that the soil structure is loose, flat, and ready for planting. Sowing rice seeds is selected from superior varieties, then sown on prepared beds. This stage aims to obtain uniform, healthy, and ready to transplant seeds. The planting of rice seedlings from the seedbed is transferred to the experimental plot according to the predetermined planting distance. Planting patterns are arranged to support optimal growth and make maintenance easier.

Leaf pruning was carried out according to the treatment established in the study, for example without pruning (control), pruning 5 cm from the shoot, and pruning 10 cm from the shoot. This action aims to examine the effect of pruning on vegetative growth. Plant maintenance is carried out regularly so that plant growth is optimal through embroidery activities, weeding weeding, balanced fertilization, and pest and disease control. The observation of the parameters carried out is tPlant size (cm) and number of saplings (seedlings).

Results

Based on the results of Table 1, the pruning process has no real effect on the height of rice plants. The highest crop in the last observation in week 7 was found in the P1 treatment (pruning 5 cm from the shoot) which was 95.06 cm and the lowest plant was in the P0 treatment (without pruning) which was 94.33 cm. Pruning leaves in the early vegetative phase (21 HSS) serves to reduce transpiration and minimize transplant stress, so that plants are able to adapt more quickly to the new growing environment. This is in line with research that states that pruning rice seedlings before planting can stimulate adventitious root growth and improve nutrient absorption ability, which ultimately accelerates crown growth [11].

Table 1. Average Height of Rice Plants

Treatment	Average Height of Rice Plants (cm)			
	Week to–			
	4	5	6	7
P0	81,22	87,78	92,33	94,33
P1	82,39	88,06	92,39	95,06
P2	82,28	89,72	92,44	94,94

Ket: Numbers followed by different letters in the same column show a significant difference from the Tukey Test at the level of α=5%

Meanwhile, in the P2 treatment (pruning 10 cm from the shoots), although the height of the plant is relatively equivalent to P1, it is likely that the plant has lost most of the photosynthetic tissue, so the plant takes longer for young leaf recovery. According to studies that have been conducted, excessive reduction in leaf area decreases the initial biomass accumulation and inhibits the rate of net photosynthesis [12].

Physiologically, the increase in plant height at P1 indicates a balance between vegetative activity and optimal photosynthesis capacity. Plants are able to utilize energy and photosynthate to lengthen stems and propagate leaves. Thus, P1 treatment can be considered the most effective in spurring optimal plant tall growth because it is able to balance between initial stress reduction and photosynthetic tissue recovery. This is in line with research that states that pruning increases the activity of the hormones cytokinin and auxins that play a role in cell growth and stem elongation [13].

P1 treatment has not reduced the leaf area excessively so that the plant's ability to photosynthesize is maintained during the adaptation process after transplanting. The remaining leaves are able to provide enough photosynthesis to support stem growth as well as the formation of new tissue. This is in accordance with the statement that pruning seedlings in the SRI planting system is able to accelerate the formation of adventitious roots so that the efficiency of water absorption and nutrients increases after the plants are moved to the field. A faster developing root system allows the plant to immediately enter the active growth phase so that the height increase of the plant takes place more steadily [11].

The results of this study also show that the difference in plant height between treatments is relatively small. This indicates that rice plants have good adaptability to pruning treatments as long as they are still carried out at a not too extreme level. According to research that has been carried out that the success of pruning is not only determined by the size of the plant that is cut, but also influenced by the plant's ability to recover leaf area so that the balance between root growth and crown is maintained [14].

Table 2. Average Number of Rice Plant Saplings

Treatment	Average Number of Rice Plant Saplings (Seedlings)			
	Week to–			
	4	5	6	7
P0	4,50	6,39	7,56	8,50
P1	4,56	6,17	7,17	8,44
P2	4,83	6,50	7,61	8,78

Ket: Numbers followed by different letters in the same column show a significant difference from the Tukey Test at the level of α=5%

Table 2 states that the number of chicks increases with each observation week. In week 7, the highest number of offspring was obtained in the P2 treatment, which was 8.78 offspring, followed by P0 as many as 8.50 offspring, and P1 as many as 8.44 offspring. The number of saplings is an important parameter in determining the potential rice yield because each productive sapling has the potential to produce panicles. Pruning 10 cm from the shoots is able to stimulate the formation of new saplings. Physiologically, this is related to the mechanism of decreased apical dominance after the leaf shoots are cut, which promotes lateral meristem activation in the trunk books. Pruning also reduces internal competition for photosynthates between main shoots, so that assimilation can be allocated to the formation of seedlings. Thus, an increase in the number of saplings in P2 indicates stimulation of lateral bud formation, but does not necessarily guarantee that all saplings are productive. At P1, although the number of saplings is lower, the quality of the saplings formed tends to be more uniform and strong, as the plants are subjected to lighter stress and the assimilate distribution is more efficient. Agronomistically, P1 can be considered optimal because it maintains a balance between the number and vigor of productive saplings, while P2 tends to produce more saplings but potentially not all of them are productive. This is in line with the results of studies that state that excessive reduction in canopy area can decrease the initial biomass accumulation and slow down the rate of net photosynthesis of rice plants [12]. In line with research in the publication SRI Technology and Seedling Pruning, pruning leads to an increase in the *root-shoot ratio*, strengthens the root system, and accelerates the emergence of new saplings [11].

P1 treatment resulted in a slightly lower number of saplings but showed more balanced vegetative growth. This condition indicates that the plant is able to allocate photosynthate in a more proportional manner between the growth of stems, leaves, roots, and the formation of saplings. According to research that has been carried out, the balance of photosynthetic distribution has more effect on the formation of productive saplings than just increasing the number of saplings alone [15].

The number of saplings increased in all treatments during the observation period. The P2 treatment produced the highest number of saplings compared to other treatments, although statistically no significant difference was shown. These results show that leaf pruning is able to reduce apical dominance so as to stimulate the activity of lateral growth points that develop into new saplings. Physiologically, pruning causes changes in the distribution of growth hormone within the plant. Reduced shoot dominance causes the activity of cytokinin hormones at the base of the plant to increase, stimulating the formation of new shoots. In the recent study, it was explained that the balance between auxin and cytokinin is one of the main factors that determine the formation of saplings in rice plants. When the dominance of shoots is reduced due to pruning, the growth of lateral shoots becomes more active so that the number of saplings increases [13].

Conclusion

The results showed that pruning the leaves of rice seedlings gave a different response to vegetative growth. Light pruning of 5 cm is more effective in increasing plant height because the balance between the formation of new leaves and the efficiency of photosynthesis can be well maintained, while pruning by 10 cm has more effect on the formation of seedlings. Thus, the success of pruning is determined not only by the ability of the plant to form saplings, but also by the balance of photosynthetic distribution between vegetative growth and the formation of reproductive organs.

References

[1] Purwono and H. Purnamawati, *Cultivation of 8 types of superior food crops*. Jakarta: Penebar Swadaya, 2007.

[2] Indonesia's Central Statistics Agency, "The rice harvest area in 2024 is estimated at 10.05 million hectares with rice production of around 52.66 million tons of milled dry grain (GKG)," https://www.bps.go.id/. April 23, 2026. https://www.bps.go.id/id/pressrelease/ 2024/10/15/2376/rice-harvest-area-year-2024-estimated-as large-than-10-05-million-hectares-d engan-produksi-padi-sekitar-52-66-juta-ton-gabah-kering-giling--gkg--.html.

[3] Dahiri and L.S. Risandi. "Covid-19 Pandemic and the Agricultural Sector: Increase in NTP Is Not Proportional to the GDP of the Agricultural Sector," *Industry and Development Budget Issue Brief*, vol. 1, no. 1, p. 1-2, 2021.

[4] The Central Statistics Agency of Indonesia, "In 2023, the rice harvest area will reach around 406.11 thousand hectares with rice production of 2.087 million tons of milled dry grain (GKG)," https://www.bps.go.id. April 23, 2026. https://sumut.bps.go.id/id/pressrelease/ 2024/03/01/1210/on-2023--rice-harvest-area-reaching-about-406-11-thousand-hectare-de ngan--produksi-padi-sebesar-2-087-juta-ton-gabah-kering-giling--gkg-.html.

[5] Abdulrachman, S., N. Agustiani, I. Gunawan, and M.J. Mejaya, "Legowo Planting System," https://repository.pertanian.go.id/home. April 21, 2026. https://repository.pertanian.go.id/server/api/core/bitstreams/b3b5589d-cee1-4536-9b63-298145279abf/content.

[6] Sunaryo, "Farmers' Knowledge of Setting the Planting Distance of the Legowo Row System in Rice Field Cultivation (*Oryza sativa* L.) in Madigondo Village, Takeran District, Magetan Regency," https://tphpkp.magetan.go.id. 24 April 2026. https://tphpkp.magetan.go.id/wp-content/uploads/2023/07/ARTIKEL-TA-FIK-3-SUNA RYO-5.pdf.

[7] Yoshida, S., *Fundamentals of Rice Crop Science*. Los Baños, Philippines: International Rice Research Institute (IRRI), 1981.

[8] Chang, T., E.A. Bardenas, "The Morphology And Varietal Characteristics Of The Rice Plant," https://www.irri.org. 23 April 2026. http://books.irri.org/97110 40085_content.pdf.

[9] Sasvita, W., C. Hanum, T. Sabrina, "Growth and Yield of Red and Black Rice in Several Legowo Row Planting Systems and Nitrogen Sources". in *National Seminar on Biology and Biology Education UKSW*. Salatiga, Central Java, 2018, 93-98.

[10] Hanafiah, K.A., *Experimental Design: Theory and Application*. Depok, West Java: Rajawali Press, 2011.

[11] Erawati, "SRI (*System Of Rice Intentionation*)," https://distankan. bulelengkab.go.id. April 24, 2026. https://distankan.bulelengkab.go.id/ information/details/articles/sri-planting-system-of-rice-intencification-58.

[12] Wang, Y., Liu, Z., Chen, L., Zhao, H., "*Root Cutting And Dry Matter Allocation In Transplanted Rice," Plant, Soil, And Environment,* vol. 70, no. 1, pp. 1–10, 2024.

[13] Jamilah, F. Winengsih, M. Ernita, "Cutting in the Vegetative Phase in Rice Cultivation Supports the Availability of Forage for Animal Feed," *Journal of Agrotechnology*, vol. 13, no. 2, pp. 85 – 94, 2023.

[14] Suyanto, A., S. Rahayu, F. "Increasing Rice Crop Productivity in Tidal Swamp Land through Balancing Haraberkan and Crop Crown Pruning," *Journal of Tropical Agrotek*, vol. 11, no. 4, pp. 539–546, 2023.

[15] Yuta, A.P.N., J. Jeksen, H.D. Beja, "A Comparative Study of Pruning Systems in the Cultivation of Rice Plants (*Oryza sativa* L.)," *Journal of Agriculture*, vol. 19, no. 2, pp. 190-204, 2024.