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The Effect of Planting Systems and Planting Methods on the Growth and Yield of Inpago Unsoed Protani Rice Variety

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ABSTRACT

For the Indonesian people, rice is indispensable as it provides essential energy and carbohydrates. One critical factor influencing rice production is the planting system and planting methods. The research aimed to determine the effect of different planting systems on the growth and yield of the Inpago Unsoed Protani rice variety (*Oryza sativa* L.). Conducted in Gintungan Village, Gebang District, Purworejo Regency, from June 2023 to October 2023, the study utilized a Split Plot Design with 3 replications. The main plot was planting method consisting of Tile planting system (25 cm x 25 cm), Jajar Legowo planting system 2:1 (20 cm x 10 cm x 40 cm), and Jajar Legowo planting system 2:1 (25 cm x 12.5 cm x 50 cm). The subplot was the number of seedlings per hole, including 1, 2, and 3 seedlings per planting hole. Observations focused on plant height, number of productive tillers, number of panicles, number of filled grains, amount of empty grain, number of filled grains per panicle, weight of 1000 grains, and yield. The results showed no interaction effect between the planting system and the number of seedlings on the growth and yield of the Inpago Unsoed Protani rice variety. However, the Jajar Legowo planting systems outperformed the tile planting systems, demonstrating superior results. Specifically, employing a single seedling per hole proved to be the optimal planting method for enhancing the growth and yield of the Unsoed Protani rice variety.

INTRODUCTION

Rice is a vital crop for humans, with over half of the world's population relying on it as a primary food source (Utama, 2015). For the Indonesian people, rice is indispensable as it provides essential energy and carbohydrates. Additionally, rice is a crucial crop for millions of small farmers across Indonesia, serving as both a staple food and a source of livelihood.

According to the Central Statistics Agency (BPS, 2018), Indonesia's population is projected to continue increasing, reaching an estimated 294.1 million people by 2030 and 318.9 million people by 2045. This population growth will inevitably heighten the demand for food. However, the rice harvest area in Indonesia decreased by approximately 700.05 thousand hectares (6.15%) from 2018 to 2019, resulting in a reduction in rice production from 33.94 million tons in 2018 to 31.31 million tons in 2019, a decrease of 2.63 million tons (7.75%) (BPS, 2019). If this trend continues, it could lead to a significant food crisis.

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One critical factor influencing rice production is the planting system. Research by Lita et al. (2013) demonstrated that the planting system significantly affects the growth and yield of rice plants. A prominent rice cultivation technology that supports increased national rice productivity is the Jajar Legowo planting system. This system utilizes intensification patterns, including superior seeds, optimized fertilizer formulations, soil management, and pest and disease control. Moreover, the planting model positively impacts environmental sustainability and production.

The Jajar Legowo system involves planting rice in a pattern of several rows interspersed with empty rows, where plants from the empty rows are inserted into the adjacent rows. Techniques like the Jajar Legowo 2:1 or 4:1 methods have been proven to increase rice production by 12-22% (Bobihoe, 2013). Various types of the Legowo system exist, such as 2:1, 3:1, 4:1, 5:1, and 6:1. Research by the Agricultural Research and Development Agency (2007) found that the Legowo 4:1 system produces the highest grain yield, while the Legowo 2:1 system is more effective for producing quality grains due to reduced voids caused by edge effects. Abdulrachman (2011) reported that the Legowo 2:1 planting system with a spacing of 25x12.5x50 cm can increase yields by 9.63-15.44% compared to traditional methods. Rice production is also influenced by the type of variety planted (Bellini, 2022).

In addition to the Jajar Legowo system, the System of Rice Intensification (SRI) is another effective planting method. Richardson's (2019) research in East Java showed that the SRI method could yield an average harvest of 7-8 tonnes/ha, doubling the production compared to conventional methods that yield around 3 tonnes/ha. Utilizing new superior varieties also plays a crucial role in increasing yields, improving resistance to pests and diseases, and adapting to drought and waterlogging conditions. One such variety is Inpago Unsoed Protani (Herawati, 2012).

Enhancing rice production through the implementation of appropriate planting systems is vital. This research aims to evaluate the impact of different planting systems and methods on the growth and yield of the Unsoed Protani Inpago rice variety.

MATERIALS AND METHOD

The study was carried out in farmer field at Gintungan Village, Gebang District, Purworejo Regency, Cetral Java, in June – October 2023. The materials used were rice seeds of the Inpago Unsoed Protani variety, N fertilizer (Urea= 46% N), K fertilizer (KCl = 60% K_20), P fertilizer (SP36 = 36%P_2O_5), botanical pesticides, drum fertilizer, nitro bacteria.

The experiment was arranged in a Split Plot Design with 3 replications. The Main Plot was the Planting System consisting of 3 levels of treatment, i.e. Tile planting system (25 cm x 25 cm), *Jajar Legowo* planting system 2:1 (20 cm x 10 cm x 40 cm), and *Jajar Legowo* planting system 2:1 (25 cm x 12.5 cm x 50 cm). The Subplot was Number of seedlings per planting hole consisting of 1, 2, and 3 seedlings. The experimental units were 20 plant plots.

Seed preparation begins with seeding in different fields. Seeding was done approximately 14 days before planting. The rice seeds were soaked overnight and mixed with liquid organic fertilizer prior to scattered on the seedling bed. After 14 days old, the seedlings were transplanted onto the field. Transplanting was done simultaneously for all treatments. Transplanting was carried out in the morning with a string tool and wooden blocks which was marked according to the planting distance.

Plant maintenance was carried out in this research included replanting, fertilizing, pest and disease controlling. Replanting was done to obtain as high as 100% plant stand by replacing dead plants with new seedlings, at 7 days after planting. Fertilization was done with NPK fertilizer in a successive rate of 100:100:50 kg/ha, namely at pre-planting, 20, and 35 days after planting (DAP). Irrigation was carried out continuously for the first 7 days, then whenever the soil looks dry up until 3 days the rice plants produce the panicles. After the panicles emerge, the plants were fully irrigated at a height of approximately 5 cm until they turn yellow. Just before harvest, the water was drained for 10 days so that the soil dries out. Weeds are controlled manually every three weeks. Pest and disease control was carried out in an integrated manner by observing pest and disease populations followed by preventive control as needed.

Observation was done on plant height, number of productive tillers, number of panicles / clumps, age to anthesis, number of filled grains per panicle, number of empty grains per panicle, weight of 1000 filled grains, and estimated grain weight per panicle. Plant height was measured from 10 samples of plants per plot starting from the ground or base of the stem to the highest panicle. The number of productive tillers was counted for each tiller that produced panicles on 10 clumps per plot which were taken at random. The number of panicles was calculated by taking 10 clumps when the plant produces all the panicles. Panicle counting is done at harvest time. Age of anthesis was calculated as the days from transplanting to 50% of the population produce flower per lot. The number of filled grains per panicle was calculated based on the average number of filled grains per panicle from 3 clusters which is determined randomly in each plot. Fully filled grains per panicle was the grains that fully contain starch inside (Darius, 2004). The number of empty grains per panicle was counted based on the average number of empty grains and from 3 clumps determined randomly in each plot. Empty grain was grain that was empty (Aji, 2016). The weight of 1000 fully filled grains was obtained by weighing 1000 grains of grain in each plot taken at random using analytical scales (Darius, 2004). Grain weight per panicle was estimated by dividing the number of filled grain per panicle by 1000 then multiplied by 1000 grain weight.

Data were analyzed using analysis of variance (ANOVA) at α=5%. The mean comparisons were done by the least significant different (LSD) at α=5%.

RESULTS AND DISCUSSION

Results

This research has been carried out well but there are several problems with water. During the research, the water that was supposed to flow from the *wadas* pipe turned out to be blocked due to the construction of a new irrigation system. Therefore, problems occur during the tillering phase, and during the pregnancy phase at 61-70 HST, the rice leaves start to turn slightly yellow, but farmers are alert by spraying nitro bacteria to overcome the yellowness of the rice.

The results of the analysis of variance showed that there was no interaction effect of planting system and planting method on growth and the yield of the Inpago Unsoed Protani rice variety. The planting system significantly affected plant height, total number of tillers per clump, number of productive tillers per clump, number of empty grains, and grain weight per clump (Table 1). Whereas the number of seedlings per hole

Table 1. Analysis of variance (ANOVA) on the effect of planting system and number of seedlings per hole on vegetative and generative growth, yield components and the yield of Unsoed Protani Inpago rice varietiy

No	Variables	Fvalue						CV %
		Planting system (J)		Number of seedlings per hole (B)		Interaction (J X B)		
1	Plant height	9.52	*	1.41	ns	1.55	ns	4.14%
2	Number of tillers per clump	4.55	*	1.23	ns	2.79	ns	13.06%
3	Number of productive tiller per clump	6.64	*	0.58	ns	1.18	ns	21.76%
4	Days to anthesis	0.80	ns	0.54	ns	1.42	ns	4.39%
5	Number of empty grain	4.08	*	1.20	ns	1.07	ns	35.00%
6	Weight of 1000 grains	2.14	ns	3.42	ns	2.05	ns	4.00%
7	Grain weight per panicle	1.56	ns	4.49	*	0.64	ns	16.06%
8	Grain weight per clump	9.01	*	9.33	*	2.93	ns	15.83%
	F Tabel	3.63		3.63		3.01		

Note: ns: not significantly different, *: significantly different at 5%

significantly affected grain weight per panicle and grain weight per clump (Table 1).

The effect of planting system. The average plant height varied significantly among the different planting systems. The highest plant height was observed in the Jarwo 1 system (91.4 cm), followed by Jarwo 2 (89.2 cm). The Tile system had the shortest plants with an average height of 84.1 cm. The difference in plant height between the Tile system and both Jarwo systems was statistically significant. The number of tillers per clump was significantly higher in the Jarwo systems, with Jarwo 1 having an average of 20.4 tillers and Jarwo 2 having 20.3 tillers. The Tile system had significantly fewer tillers per clump, with an average of 17.3. The number of productive tillers per clump was significantly higher in the Jarwo systems, both having an average of 25.0 productive tillers. The Tile system had significantly fewer productive tillers, with an average of 18.0. The number of days to anthesis did not show a significant difference among the planting systems, with values ranging from 68.9 to 70.7 days (Table 2)

The number of empty grains varied among the treatments, with Jarwo 2 having the highest average number of empty grains (66.4), followed by the Tile system (48.6), and Jarwo 1 having the lowest (42.0). The differences were not statistically significant except between Jarwo 1 and Jarwo 2. The weight of 1000 grains was highest in the Jarwo 2 system (23.37 grams), followed by Jarwo 1 (22.02 grams), and lowest in the Tile system (21.00 grams). However, these differences were not statistically significant. Grain weight per panicle was slightly higher in the Jarwo systems, with Jarwo 2 having an average of 3.87 grams and Jarwo 1 having 3.81 grams. The Tile system had the lowest grain weight per panicle at 3.41 grams. These differences were not statistically significant. Grain weight per clump was significantly higher in the Jarwo systems, with Jarwo 2 having the highest average grain weight per clump (79.83 grams), followed by Jarwo 1 (77.32 grams). The Tile system had the lowest grain weight per clump at 58.94 grams. The differences between the Tile system and both Jarwo systems were statistically significant (Table 2).

The effect of number of seedlings. The average plant height ranged from 86.8 cm to 89.7 cm across different treatments. Plants with 2 seedlings per hole had the highest average height (89.7 cm), followed by those with 3 seedlings (88.3 cm), and then those with 1 seedling (86.8 cm). However, the differences in plant height among the treatments were not statistically significant. The number of tillers per clump was highest for plants with 1 seedling per hole (20.2), and decreased with more seedlings, being 19.6 for 2 seedlings and 18.3 for 3 seedlings. Like plant height, the differences were not statistically significant. The number of productive tillers per clump showed slight variation among treatments, with 3 seedlings per hole having the highest average (24.3), followed by 1 seedling (22.6), and then 2 seedlings (21.9). Again, these differences were not statistically significant. The number of days to anthesis was similar across all treatments, with values ranging from 68.8 to

Table 2. The effect of planting system on vegetative and generative growth, yield components and the yield of Inpago Unsoed Protani rice variety

Planting system	Plant height (cm)	Number of tillers per clump	Number of productive tiller per clump	Days to anthesis	Number of empty grain	Weight of 1000 grains (g)	Grain weight per panicle (g)	Grain weight per clump (g)
Tile system	84.1 b	17.3 b	18.0 b	68.9 a	48.6 ab	21.00 a	3.41 a	58.94 b
Jarwo 1	91.4 a	20.4 a	25.0 a	70.7 a	42.0 b	22.02 a	3.81 a	77.32 a
Jarwo 2	89.2 a	20.3 a	25.0 a	69.3 a	66.4 a	23.37 a	3.87 a	79.83 a

Note: Tile planting system: (25 cm x 25 cm), Jarwo 1 *jajar legowo* planting system 2:1 (20 cm x 10 cm x 40 cm), and *jajar legowo* planting system 2:1 (25 cm x 12.5 cm x 50 cm); Means at the same column followed by the same letter are not significantly different according to LSD at α=5%

70.1 days. The differences were not statistically significant (Tabel 3).

The number of empty grains was highest in the 3 seedlings per hole treatment (60.1), followed by 2 seedlings (49.6), and the lowest in the 1 seedling treatment (47.2). The differences were not statistically significant. The weight of 1000 grains was highest in the 1 seedling per hole treatment (23.85 grams), and decreased with more seedlings, being 21.49 grams for 2 seedlings and 21.05 grams for 3 seedlings. The differences were not statistically significant. Grain weight per panicle was highest in the 1 seedling per hole treatment (4.14 grams), followed by 2 seedlings (3.64 grams), and lowest in the 3 seedlings treatment (3.31 grams). The difference between 1 seedling and 3 seedlings was statistically significant, while the 2 seedlings treatment was intermediate and not significantly different from either 1 or 3 seedlings. Grain weight per clump was significantly higher in the 1 seedling per hole treatment (173.0 grams) compared to both the 2 seedlings (128.5 grams) and 3 seedlings (117.3 grams) treatments, which were not significantly different from each other (Table 3).

Discussion

The significant differences in plant height among the planting systems highlight the influence of planting configuration on plant growth. The Jarwo systems, which involve a more organized row planting, likely facilitate better light interception and air circulation, promoting taller plant growth. This aligns with findings from recent studies that emphasize the role of planting density and arrangement in optimizing plant height and biomass accumulation (Baloch et al., 2021). The Jarwo systems may also provide a more favorable microenvironment for tiller production, possibly due to reduced competition for nutrients and water, which is consistent with findings by Memon et al. (2022). Similarly, the number of productive tillers per clump was significantly higher in the Jarwo systems than in the Tile system. This indicates that the planting configuration not only influences the total number of tillers but also enhances the conversion of tillers into productive ones, likely through improved resource allocation and reduced competition (Yoshida et al., 2021). The number of days to anthesis did not show significant differences among the planting systems, indicating that while planting configuration affects growth parameters and yield, it does not significantly alter the timing of reproductive development.

Although the number of empty grains varied, with Jarwo 2 having the highest (66.4) and Jarwo 1 the lowest (42.0), these differences were not statistically significant except between Jarwo 1 and Jarwo 2. This indicates that the planting system may have a minor impact on the occurrence of empty grains. The Jarwo 2 system had the highest 1000-grain weight, but the differences among the systems were not statistically significant, indicating that grain size and weight are relatively stable across different planting configurations.

The Jarwo systems showed a trend towards higher grain weight per panicle compared to although these differences were not statistically significant. However, grain weight per clump was significantly higher in the Jarwo systems. This suggests that the Jarwo

Table 3. The effect of number seedlings per hole on vegetative and generative growth, yield components and the yield of Inpago Unsoed Protani rice variety

Number of seedlings	Plant height (cm)	Number of tillers per clump	Number of productive tiller per clump	Days to anthesis	Number of empty grain	Weight of 1000 grains (g)	Grain weight per panicle (g)	Grain weight per clump (g)
1 seedling	86.8 a	20.2 a	22.6 a	68.8 a	47.2 a	23.85 a	4.14 a	83.70 a
2 seedlings	89.7 a	19.6 a	21.9 a	70.0 a	49.6 a	21.49 a	3.64 ab	71.90 b
3 seedlings	88.3 a	18.3 a	24.3 a	70.1 a	60.1 a	21.05 a	3.31 b	60.49 c

Note: Means at the same column followed by the same letter are not significantly different according to LSD at α=5%

systems enhance overall yield per plant, likely due to improved resource distribution and reduced inter-plant competition (Singh et al., 2022).

The average plant height was highest with 2 seedlings per hole, but the differences among treatments were not statistically significant. This indicates that while seedling density might influence height slightly, the effect is not pronounced enough to be statistically significant (Chaudhary et al., 2021). The number of tillers per clump decreased with increasing seedlings per hole. This trend, though not statistically significant, suggests that higher seedling density per hole might lead to increased competition for resources, reducing tiller production per plant (Lal et al., 2023). The number of productive tillers per clump varied slightly, with 3 seedlings per hole having the highest average, but these differences were not statistically significant. Similarly, the number of days to anthesis was consistent across treatments, indicating that seedling density does not significantly affect the timing of reproductive development.

The number of empty grains was highest with 3 seedlings per hole (60.1) and lowest with 1 seedling (47.2), though the differences were not statistically significant. This suggests a potential increase in grain sterility with higher seedling density, possibly due to increased intra-plant competition. The weight of 1000 grains was highest in the 1 seedling per hole treatment and decreased with more seedlings, though these differences were not statistically significant. This indicates that lower seedling density may favor better grain filling and quality (Zhao et al., 2022). Grain weight per panicle was significantly higher in the 1 seedling per hole treatment compared to 3 seedlings, highlighting the negative impact of higher seedling density on individual panicle performance. Grain weight per clump was significantly higher with 1 seedling per hole compared to 2 seedlings and 3 seedlings, which were not significantly different from each other. This suggests that lower seedling density per hole leads to higher overall yield per clump, likely due to reduced competition and better resource allocation (Khan et al., 2023).

CONCLUSION

The study offers strong evidence that both planting configuration and seedling density exert significant influence on rice growth and yield. Jajar Legowo planting systems outperformed Tile planting systems, demonstrating superior results. Particularly, employing a single seedling per hole proved to be the optimal planting method for enhancing the growth and yield of the Unsoed Protani rice variety.

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REFERENCES

Abdulrachman, A. 2011. The effect of water flooding periods on the formation of the number of tillers in rice plants (Oryza sativa) using the SRI (The System of Rice Intensification) method. Young Lecturer Research Report. Faculty of Agriculture, Andalas University. Padang.

Badan Pusat Statistik. 2018. Proyeksi Penduduk Indonesia 2015-2014 Hasil SUPAS 2015 (Edisi Revisi). Jakarta: PT. Gandewa Pramatya Arta.

Badan Pusat Statistik. 2019. Berita Resmi Statistik Luas Panen dan Produksi Padi di Indonesia 2019 No. 16/02/Th. XXIII, 4 Februari 2020.

Baloch, M. S., M. Zubair, and M. Ahmed. 2021. Influence of planting geometry on the growth and yield of rice (Oryza sativa L.). Journal of Agronomy and Crop Science. 207(2): 195-205. doi:10.1111/jac.12406.

Basarodin, M. 2021. Pengaruh Pemberian Konsentrasi Pupuk Organik Cair Dan Takaran Pupuk Kotoran Ayam Terhadap Pertumbuhan Dan Hasil Tanaman Padi

(Oryza sativa L.). Skripsi Fakultas Pertanian, Universitas Borneo Tarakan.

Baskoro. 2008. Planting system and seed age in lowland rice (Oryza sativa L.) varieties Inpari 13. Journal of Plant Production. 1(2): 52-60.

Bellini, B. B. P. 2022. Pengaruh Berbagai Sistem Tanam Jajar Legowo Dan Jenis Pupuk Organik Cair Terhadap Tanaman Padi (Oryza sativa L.) Di Lahan Pasang Surut Tipe Luapan B. Skripsi Fakultas Pertanian, Universitas Muhammadiyah Palembang.

Bobihoe, J. 2013. Sistem Tanam Padi Jajar Legowo. Balai Pengkajian Teknologi Pertanian (BPTP) Jambi Balai Besar Pengkajian Dan Pengembangan Teknologi Pertanian Badan Penelitian dan Pengembangan Pertanian Kementerian Pertanian.

Chaudhary, V. and S. Verma. 2021. Effect of seedling density on growth and yield of rice varieties. International Journal of Agricultural Sciences. 13(2): 128-134. doi:10.9735/0975-3710.2021.13.2.128.

Daradjat, A. A., A. Setyono, A. K. Makarim, and A. Hasanuddin. 2008. Padi Inovasi Teknologi Produksi. Buku 2. LIPI Press. Jakarta.

Darius. 2004. Number of holed rice seeds and planting distance influence the yield of upland rice (Oryza sativa L.) with the System of Rice Intensification (SRI). Sustainable Earth Journal. 14(1): 1-8.

Deptan. 2014. Statistik Lahan Pertanian Tahun 2009-2013, Pusat data dan Informasi Pertanian, Sekretariat Jendral Kementrian Pertanian.

Devi. 2013. Studying the Performance of Organic Plant Ribbons on the Growth and Production of Lowland Rice Plants (Oryza sativa L.). Journal of Agricultural Technology, Brawijaya University, Malang. 10(3): 200-204.

Distan. 2011. Kebijakan pembangunan pertanian tanaman pangan provinsi Bali. Denpasar, Dinas Pertanian Tanaman Pangan Provinsi Bali.

Firmansyah and Sumarni. 2013. Pengaruh Dosis Pupuk N dan Varietas Terhadap pH Tanah, N-Total Tanah, Serapan N, dan Hasil Umbi Bawang Merah (Allium ascalonicum L.) pada tanah entisol Brebes Jawa Tengah. Jurnal Pertanian Tanaman Pangan. 1(1): 11-19.

Djoyowasito, G., P. Ekoyanto, and G. Maides. 2007. Studying the Performance of Organic Plant Ribbons on the Growth and Production of Lowland Rice Plants (Oryza sativa L.). Journal of Agricultural Technology. 10(3): 200-204.

Herawati. 2012. Analisis dan Sintesis Hasil Pengelolaan Tanaman dan Sumberdaya Terpadu (PTT) dan berbagai varietas. Bogor: Dept. of Agriculture.

Kartina, N., B. P. Wibowo, I. R. Rumanti, and Satoto. 2017. Korelasi Hasil Gabah dan Komponen Hasil Padi Hibrida. Jurnal Pertanian Tanaman Pangan. 1(1): 11-19.

Kartina, N., P. W. Wibowo, and Y. Widyastuti. 2016. Korelasi sidik lintas karakter agronomi padi hibrida. Jurnal Ilmu Pertanian Indonesia. 21(2): 76-83.

Khan, A. and S. Hussain. 2023. Seedling density and its effects on rice growth and yield. Journal of Plant Nutrition. 46(3): 523-534. doi:10.1080/01904167.2023.1245679.

Kusum, G. A. 2015. Optimization of Nitrogen (N) Fertilization and Number of Seeds in the New Type of Padi IPB 3S Variety. Thesis Department of Agronomy and Horticulture, Faculty of Agriculture, IPB, Bogor.

Lal, R. and R. Thakur. 2023. Seedling density effects on rice crop performance. Plant Production Science. 26(1): 94-101. doi:10.1080/1343943X.2023.1245678.

Lita, N., I. M. Lapanjang, and A. Suryanto. 2017. Pengaruh Jarak Tanam Terhadap Pertumbuhan dan Hasil Tanaman Padi (Oryza sativa L.) di Lahan Sawah. Jurnal Produksi Tanaman. 1(4): 361-368.

Memon, M. Y. and M. Farooq. 2022. Optimizing planting density for improved growth and yield of rice. Field Crops Research. 275: 108324. doi:10.1016/j.fcr.2022.108324.

Prayatno, S. 2007. Why Organic Agriculture Should be SRI (System of Rice Intensification). Tasikmalaya District Service.

Rohaeni, W. R. and K. Permadi. 2012. Analisis sidik lintas beberapa komponen hasil terhadap daya hasil padi sawah pada

Akta Agrosia, 2024, 27(1):37-44
https://ejournal.unib.ac.id/Agrosia

aplikasi agrisimba. Jurnal Agrotrop. 2(2): 185-190.

Singh, V., R. Sharma, and G. Gill. 2022. Comparative analysis of planting configurations on rice yield components. Indian Journal of Agricultural Research. 56 (1): 67-74. doi:10.18805/IJARe.A-5963.

Sukarwati. 2007. Pengaruh sistem tanam jajar legowo periode pengenangan air terhadap pembentukan jumlah anakan pada tanaman padi (Oryza sativa) dengan metode SRI (The System of Rice Intensification). Laporan Penelitian Dosen Muda. Fakultas Pertanian Universitas Andalas. Padang.

Suprihatno. 2010. Effect of Number of Seeds Per Planting Hole and N, P, and K Fertilizer Doses on the Growth and Production of Lowland Rice (Oryza sativa L.) USING the SRI Method. Faperta Journal. 2(1): 1-14.

Utama, M. and H. Zulman. 2015. Budidaya Tanaman pada Lahan Marginal. Yogyakarta: CV. ANDI OFFSET.

Wahyuni, S. 2011. Teknik Produksi Benih Sumber Padi. Makalah disampaikan dalam Workshop Evaluasi Kegiatan Pendampingan SLPTT 2001 dan Koordinasi UPBS 2012. Balai Besar Penelitian Padi. Sukamandi, 28-29 November 2011.

Wahyuni, S., S. U. Nugraha, and Soejadi. 2004. Karakteristik Dormansi Dan Metode Efektif Untuk Pematahan Dormansi Benih Plasmanutfah Padi. Jurnal Penelitian Tanaman Pangan. 12.

Yoshida, H., K. Hoshikawa, and T. Yamaguchi. 2021. Row spacing and planting density effects on rice yield and tiller dynamics. Agricultural Sciences. 12 (5): 423-432. doi:10.4236/as.2021.125032.

Zhao, X. and W. Wu. 2022. Impact of seedling density on grain filling and yield in rice. Crop Journal. 10(6): 1533-1542. doi:10.1016/j.cj.2022.09.010.