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Optimization of Planting Range and Seed Age Toward the Growth and Production Rice Paddy (Oryza Sativa L.)

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Abstract

This research is based on field experiment, it was conducted in Purwodadi village, Padangsidimpuan Batunadua, Padangsidimpuan, North Sumatera from July up to October 2017. The aim of this research was to obtain the most optimal of planting range and seeds age toward the growth and production of rice paddy. This experiment used Randomized Block Design (RBD) with factorial pattern which was done by three repetitions. The first factor was planting range with four steps that consist of comparison 2:1 (20 x 10 x 40 cm), comparison 3:1 (20 x 10 x 40 cm), 20 x 20 cm, 30 x 30 cm. The second was seeds age with 14 days experiment after sowing, 21 days after sowing, 28 days after sowing. The result of the research showed that there was interaction between the treatment of planting range 30 x 30 cm and seed age in 21 days after sowing on plant potential production. It is 13.58 ton/ha. The comparison of planting range 30 x 30 gave better result toward the number of seedlings, planting height, and plant potential production 13,58 ton/ha.

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The age of the seed in 28 days after sowing gave higher result toward the index of leaf area, assimilation net rate, planting growth rate, planting height, the number of seedlings, the number of grain per panicle and the weight of 1000 rice paddy. While the treatment of 21 days seeds age after sowing gave result in plant potential production (ton/ha).

Keywords**:** Planting range; seed age; comparison; rice paddy.

1. Introduction

Rice is a staple food for most of the Indonesian population. Although rice can be replaced by other foods, rice has its own value for them who usually eat rice and cannot be easily replaced by other food ingredients. The availability of food from year to year shows a widening gap between increased production of rice commodities and population growth which is always inversely proportional.

Based on [1] in 2025 the growth rate of Indonesian population is about more than 300 million people with a consumption of rice per capita of 139 kg / year. To fulfill the huge amount of rice demanding, it has been determined the target of domestic rice production in 2015 was 73,400,000 tons of dry milled grain.

Based on fixed numbers issued by the Ministry of Agriculture in coordination with the Central Statistics Agency (CSA) 2016, the rice production reached 79,141,325 tons of DUP or an increase of 3,743,511 tons (4.97%) from the Unique Figures. Java is 1.22 million tons and outside of Java is 2.52 million tons. he increase in production occurred due to an increase in harvested area of 919,098 ha or an increase of 6.51% from 14,116,638 ha to 15,035,736 ha[2].

North Sumatra has a big potential in devoloping staple food. Based on the CSA in 2016, the staple food in North Sumatra reached 4,610,097 tons, an increase of 565,265 tons compared to 2015 is 4,044,832 tons. The achievement was the highest for the last 12 years and made North Sumatra as a rice surplus it is 1,171,355 tons [3].

Optimization of rice productivity in paddy fields according to [4] is one of the good steps in increasing national grain production. It is possible to associated between rice variation production and low locations while its potential can be increased. The development of agricultural commodities in areas that are in accordance with the requirements of crop agro-climate, which includes climate, soil, and topography, will provide optimal results with prime quality.

The increasing rice production can also be affected by planting range. It provides a good growing environment, reduces competition between and within plants so that plants have optimal ability to utilize environmental factors according to morphological and physiological characteristics. According to [5] wide of planting range can improve the total capture of light by plants and increase seed production.

Besides, to increasee the rice production, to improve the age of seedlings and the number of seedlings for planting and the type of fertilizer used. Seedlings are a component of production technology that is very important to get an optimal level of production. According to [6] The younger seedlings are moved, they will accelerate the formation of tillers, it can reach 40-80 stems. In Indonesia the habits of farmers to plant seeds are 3 weeks, with a maximum number of tillers productive is 25.

Reference [7] stated that older seedling age treatments produce higher plant height than younger seedlings, it is because plants grown with young seedlings grow more slowly than old seedlings. In line with [8] stated that the highest plant height was produced by seedling age treatment 4 weeks after dispersing.

In general, the cropping system and seedling ageat rice field are known influenced the growth and production of rice. Nevertheless, the age of the seed and the optimum planting system has not known precisely. In Padangsidimpuan, the society still uses a conventional system with irregular spacing and relatively old age of seedling usage more than 21 days after the seedlings, it can be seen from the cropping patterns commonly practiced by them. Besides they are also still familiar with the usage of hereditary seeds.

2. Research Materials And Method

This research was conducted in Purwodadi Village, Sub Distric Padangsidimpuan Batunadua, Padangsidimpuan City in ± 350 m altitude. It has been conducted in July 2017 up to October 2017. The material that has been used for this research were were, varieties of IPB4S rice seeds, Urea, Sp36, KCl, herbicides DMA6, Conzene and Sidametrin insecticides, Nordox fungicides. While the tools that has used are scanner canoon printers, hoes, machetes, soaking buckets, meters, scales, digital cameras, leaf color charts, and stationery.This research used Factorial Design in Randomized Block Design (RBD). The first factor was planting range with four steps that consist of comparison 2:1 (20 x 10 x 40 cm), comparison 3:1 (20 x 10 x 40 cm), 20 x 20 cm, 30 x 30 cm. The second was seeds age with 14 days experiment after sowing, 21 days after sowing, 28 days after sowing. Thus, there are 12 treatment combinations were obtained and each combination was repeated 3 times, as the result, there are 36 units were tested.

3. Results And Discussion

3.1. Number of productive tillers (stems)

Based on variance analysis, it can be seen that the treatment of planting range, seed age and interaction did not show any influence on the number of productive of tillers.

Tabel 1: Number of productive tillers (stems) at planting range and Seed Age

Planting Range (cm)	Seed Age (DAS)			Average
	14	21	28	
Comparison (2:1)	14.07	13.60	13.13	13.60
Comparison (3:1)	12.73	13.27	12.07	12.69
20 x 20	12.47	13.27	12.73	12.82
30 x 30	12.53	12.20	12.80	12.51
Average	12.95	13.08	12.68	

Table 6 showed that the treatment of seed age, planting range and interaction is not significantly different. It also showed that the range and age of the seeds did not affect the number of tillers production. The highest average was obtained at comparison 2: 1 range and the lowest was at range of 30 x 30 cm, while for the age of seedlings showed the highest production was at the age of 21 DAS seedlings and the lowest in seedlings 28 DAS.

It can be caused by genetic influences and interactions between genetics and the environment. According to [8] the number of tillers will be maximal if the plant has good genetic traits added by the environmental conditions or in accordance with the growth and development of plants. Furthermore, it stated that the maximum number of tillers is also determined by the range, because it determines solar radiation, mineral nutrients and the cultivation of the plants. The number of productive tillers tends to be closely related to rice production, the greater the number of productive tillers, the more it will increase the amount of grain production. An increase in the number of productive tillers associated with the amount of nutrients contained in the soil. But genetic factors and environmental factors also determine the productivity of rice.

3.2. The number of grain per panicle (item)

Based on variance analysis can be seen that the treatment of spacing, age of seedlings and interaction between spacing and age of seedlings did not have a significant effect on the number of grain per panicle.

Tabel 2: The Number of Grain Per Panicle (grain) in Plant Spacing and Seed Age

Planting Range (cm)	Seed age (DAS)			Average
	14	21	28	
Comparison (2:1)	212.66	209.18	269.07	230.31
Comparison (3:1)	226.01	206.40	237.65	223.35
20 x 20	204.13	223.00	216.83	214.65
30 x 30	189.16	226.99	214.00	210.05
Average	207.99	216.39	234.39	

The results average in Table 7 showed that none of the treatment factors showed significant differences in the number of grains per panicle. This is caused by genetic and environmental factors that affect the ability of plants to produce photosynthates for panicle formation and filling of seeds per panicle is the same. In the process of filling photosynthate, seeds allocated to the seeds derived from photosynthesis at a generative time coupled with the remobilization of food reserves formed in the vegetative phase.

Genetic factors are related to the ability of rice plants to optimize production in the arrangement of seed filling by allocating photosynthesis results appropriately, while environmental factors are related to photosynthesis, namely absorption of nutrients, water and light. The availability of water plays a role in the formation of the amount of grain per panicle. If there is a long dry season, it will disturb the formation of grain. This is in accordance with [9;10] which states that there are two seasons in Indonesia, dry and rainy seasons.

Planting rice in the dry season will be better than in the rainy season, provided the irrigation system is good. The process of pollination and fertilization of rice in the dry season will not be disturbed by rain so that the rice produced becomes more. However, if the rice is planted in the rainy season, the pollination and fertilization process becomes disturbed by rain. As a result, many rice seeds are empty.

3.3. The number of empty grain per panicle (item)

Based on variance analysis, it can be seen that the treatment of the interaction between Planting and Age Distance of Planting range, seedling age did not show the effect on theNumber of Empty Grain Per panicle.

Tabel 3: The number of empty grain per panicle (item) at planting range and seed age

Planting Range (cm)	Seed Age (DAS)			Average
	14	21	28	
Comparison (2:1)	7.94	9.16	11.60	9.57
Comparison (3:1)	9.41	8.43	9.77	9.20
20 x 20	8.13	9.80	9.11	9.01
30 x 30	11.28	9.00	13.80	11.36
Average	9.19	9.10	11.07	

The average results in Table 8 showed that none of the treatment factors showed significant differences in the number of empty grains per panicle. It can be influenced by the appropriate temperature in the research area so that the influence of planting range and age did not indicate a difference. Temperature plays a role in the formation of seeds, if the temperature is not suitable it will increase the number of empty grains per panicle due to failure of seed filling. Temperature very affects the filling of rice seeds at low temperatures and high humidity at the time of flowering will interfere with the process of fertilization which results in grain becoming empty. This happens due to not opening the designate seeds.The percentage of empty grain will affect the yield of rice plants, because the high percentage of empty grain can result in low rice production. Empty grains show the inability of plants to replenish plant grains, which are caused by environmental factors [11].

3.4. Weight of 1000 items (g)

Based on variance analysis, it can be seen that the treatment of plant spacing, seed age and interaction showed no significant difference at 1000 weight.

Tabel 4: Weight of 1000 items (g) at Planting Range and Seed Age

Planting Range (cm)	Seed Age (DAS)			Average
	14	21	28	
Comparison (2:1)	32.90	32.51	32.55	32.65
Comparison (3:1)	33.15	34.65	32.72	33.51
20 x 20	31.97	32.64	31.91	32.17
30 x 30	33.31	34.24	32.58	33.38
Average	32.83	33.51	32.44	

The average results in Table 9 showed that none of the treatment factors showed a significant difference in the average number of 1000 weight items. The shape and size of the seeds are determined by genetic factors so that the weight of 1000 seeds is the same. High and low weight of seeds depends on the amount or amount of dry matter contained in the seeds. Dry matter in seeds is obtained from photosynthesis which can then be used for seed filling. According to opinion. The results of [12] showed similar results where 1000 grain weight was not affected by plant spacing. The weight of 1000 grains is more influenced by genetic so that the weight of 1000 produced is the same.

3.5. Plant production potential (ton / ha)

Based on the results of variance analysis showed that the interaction between the treatment of planting range and seed age had a significant influence. It is on the potential of crop production in planting range of 30 cm x 30 cm and age of seedlings 21 days after seedling (DAS). Planting Distance Treatment shows a significant effect on Planting Distance of 30 cm x 30 cm. Treatment of Seed Age also affects the Production Potential Per Ton of Seed Age 21 days after seedling (DAS).

Tabel 5: Plant Production Potential (ton / ha) at Planting Range and Seed Age

Planting range (cm)	Seed Age (DAS)		
	14	21	28
Comparisoon (2:1)	11.49 a A	11.15 a C	7.34 c B
Comparison (3:1)	12.50 a A	12.76 a B	11.25 b B
20 x 20	12.50 a A	6.19 b D	12.63 a A
30 x 30	9.08 b B	13.58 a A	5.69 c D

Description : The numbers with capital letters in the same column and lowercase letters in the same row show insignificant differences according to Duncan's test at 5% α level

Based on Table 10 it can be seen that the highest interaction average is found in range of 30 cm x 30 cm with seedling age of 21 DAS which is significantly different from the interaction between spacing of 30 cm x 30 cm with seedling age of 14 DAS and 28 DAS, while the lowest production is found in interaction between spacing of 30 cm x 30 cm with age of seedlings 28 DAS.

It can be caused by the influence of the availability of nutrients in the soil and the ability of plants to utilize light. Reference [13] explained that nutrients in the soil have a significant effect on crop production. [5] stated that wide spacing can improve the total capture of light by plants and can increase seed yield. The wider distance between rows can improve the total light radiation captured by plants and can increase production.

Production potential will reach the highest value if planted using 21 DAS seeds. This can be due to the ability of adaptation to the age of seedlings 21 DAS better than the age of seedlings at 14 DAS and 28 DAS, when the seedlings are transferred from the nursery to the field the plant will experience stress and need time to adapt.

4. Conclusions And Suggestion

4.1. Conclusion

In this study shows that planting range of 30 x 30 cm with seedling age 21 days after seedling (DAS) on crop production potential gives the best yield of 13.58 tons / ha. 30 x 30 comparison range gives better results for the number of tillers, plant height, and crop production potential of 13.58 tons / ha. Seed age at 28 days after seedling (DAS) gave higher yields on leaf area index, net assimilation rate, plant growth rate, plant height, number of tillers, number of grains per panicle, and 1000 grain weight. Whereas in the treatment of seedling age 21 days after seedling (DAS) results in crop production potential (ton / hectare).

4.2. Suggestion

Based on the result of this research, rice cultivation activity by using 30 X 30cm with 21 days after seedlings is suggested. Because, it can increase the potential of production. This research can be continued by using different variety of planting range and seed age to obtain improved yield technology.

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