Original Research Article

Yield Performance of Three Sulawesi Local Aromatic Upland Rice Varieties at Various Planting Distances with Alley Cropping System

ABSTRACT

To maintain the preservation of several local varieties of brown rice upland rice in Luwu district, South Sulawesi, planting is carried out by utilizing empty space between Clove plantations, but the agronomic characteristics of upland rice local varieties in addition to long-lived, less responsive to fertilization and low production. Appropriate application of cultivation technology is needed in the agroecological conditions of plants planted between clove plantations. Plant spacing and selection of more adaptive varieties is one aspect that needs to be tested. The research was conducted in Sampano Village, South Larompong District, Luwu Regency, South Sulawesi from February to June 2022. The research was carried out with Split Plots Design (SPD) pattern of Randomized Completely Block Design (RCBD). The main plots (MP) were 3 local varieties of Ngapa, Sassa, and Latimojong. Subplots (SP) are planting distances consisting of random spacing (spread), 25 cm x 25 cm, 20 cm x 20 cm, and 15 cm x 15 cm. The results showed that the best recommended spacing for planting local aromatic upland rice varieties in the alley cropping system was 15 cm x 15 cm which produced the highest dry grain weight per hectare with an average of 1,433.24 Kg/Ha, while the highest production was produced by the Ngappa variety with an average of 1,350 Kg/ha

Keywords: Upland Rice, Aromatic, Planting distance, Local Varieties.

1. INTRODUCTION

Upland rice is a rice variety that can grow and develop well on land that has limited water, sloping land, or other environmental conditions that do not support rice/paddy farming. By developing upland rice, farmers can utilize previously unproductive lands for rice cultivation, in the sense that the utilization of sub-optimal land can be done without disturbing the cultivation of paddy rice. Upland rice is also a source of hope to support the sustainability of rice production to maintain food security, especially in areas prone to drought stress because one of the advantages of upland rice is its resistance to drought stress. Indonesia is rich in various local upland rice varieties in several regions including in the South Sulawesi region, in Luwu district farmers cultivate several aromatic upland rice varieties including Ngappa, Sassa and Latimojong [1]. Local aromatic upland rice generally has a strong root system and is able to withstand water shortages for a longer period of time compared to rice paddy varieties. This allows farmers to continue producing rice despite the long dry season. The weakness of local aromatic upland rice is that it is generally long-lived and less responsive to fertilization, and has lower productivity compared to other rice varieties so that appropriate cultivation technology needs to be applied in the process of plant growth and yield, especially if planting in an alley cropping system.

The cultivation of aromatic upland rice of local Sulawesi varieties carried out with Alley Cropping system still needs to be studied, especially on aspects of appropriate cultivation techniques such as the selection of varieties and proper plant spacing arrangements so that the resulting production becomes more optimal. Alley Cropping is one model of sustainable agriculture that seeks to find alternatives to monoculture rice farming which is globally an important issue of modern agriculture where monoculture rice cropping systems are considered to be increasingly threatening the sustainability of agricultural production because they rely on very high chemical inputs.

Planting distances is one of the factors that determine the high yield of a rice crop. Plant spacing is influenced by the nature of rice varieties and soil fertility. Rice varieties that have the ability to produce high tillers require a wider planting distance when compared to varieties with lower tillering potential. Data on overall upland rice production in Indonesia is still low, which averages only 3.091 tons/ha for monoculture plantings, much lower than the productivity of paddy rice which reaches 5,179 tons/ha [2].

The importance of studying local aromatic rice varieties to be developed will encourage rice production on sub-optimal lands in the future. The spacing of local aromatic upland rice in the alley cultivation system is expected to increase the efficiency of absorption of solar intensity for the photosynthesis process so that plant production can be optimized. [3], has suggested that to reduce competition and maximize yields in plants grown under tree stands (*Alley Cropping*) can be done several ways including setting the number of populations (spacing). In addition, the relationship between cultivation aspects and the genetic characteristics of plant varieties has a close relationship. One variety with certain genetic traits can adapt to certain planting distances in different cropping systems where in this study what is wanted to know is the response of plants to the cultivation of the Alley Cropping system, therefore this study examines the production performance of 3 local Sulawesi aromatic upland rice varieties planted with the alley cropping system at various planting distances pattern.

2. MATERIAL AND METHODS

The research was conducted in Sampano Village, South Larompong Sub-district, Luwu District, South Sulawesi for 5 months (February to June 2022). Using seeds from 3 local upland rice varieties of brown rice from Luwu district, South Sulawesi, namely Ngappa, Sassa and Latimojong varieties. The research was carried out with a Split Plots Design (SPD) which was arranged with a Factorial Completely Randomized Block Design (RCBD) of 2 factors each as the Main Plots (PU) Local varieties of red upland rice, Ngapa variety, Sassa variety, and Latimojong variety. As Subsidiary Plots (AP) is the planting distance (J) consisting of random spacing (Spread) (The number of seeds spread is adjusted to a spacing of 25 cm x 25 cm), 25 cm x 25 cm, 20 cm x 20 cm, and 15 cm x 15 cm.

Analysis of several agronomic parameters of the generative phase related to crop production was carried out destructively, namely calculating by taking 3 sample plants of each treatment from the field. The parameters observed were Number of panicles per clump, Number of grains per panicle, Grain weight per clump (g), Percentage of hulled grain per clump (%) and Grain weight per hectare (kg/ha). Data collected were subjected to statistical analysis (Anova), using STAR (Statistical Tools for Agricultural Research by IRRI) software (ver.2.0.1). The data analysis on parameters that have a significance is continued with a posthoc test of means separated using Duncan's Multple Rate Test (DMRT).

3. RESULTS AND DISCUSSION

The measurement results showed that the number of panicles per clump, the number of grains per panicle, and the percentage of empty grains were significantly different based on the varieties planted (Table 1), and the spacing also significantly affected the number of grains per panicle, grain weight per clump, and the percentage of empty grains (Table 2). The DMRT-0.05 test results showed that the Sassa variety had the highest average number of panicles per clump (6.44) significantly different from the Ngappa and Latimojong varieties, but the Sassa variety had fewer grains per panicle (83.31) significantly different from the Ngappa and Latimojong varieties. The percentage of empty grains of the Ngappa and Sassa

Table 1. Number of Panicles per Clump, Number of Grain per Panicle, Grain Weight per Clump, and percentage of Empty-Grain in 3 Local aromatic upland rice varieties in Alley Cropping system

Rice variety	Number of Panicles per Clump	Number of Grain per Panicle	Grain Weight per Clump	Percentage of Empty-Grain
Ngappa	4.72 [b]	**94.24** [a]	14.66 [a]	3.57 [b]
Sassa	**6.44** [a]	83.31 [b]	14.49 [a]	3.23 [b]
Latimojong	4.48 [b]	**95.57** [a]	13.82 [a]	4.34 [a]

Notes: Mean numbers followed by different letters mean significantly different in the DMRT-0.05 test

Based on the planting distance and its effect on plants, it shows that planting with a spacing of 15 cm x 15 cm has an average number of grains per panicle and grain weight per clump higher and significantly different from the results at a spacing of 25 cm x 25 cm and random (Spread Out). Planting distance of 15 cm x 15 cm and 20 x 20 cm has a lower percentage of empty grain which is only 2.22 and 2.65% respectively (Table 2).

Table 2. Number of panicles per clump, number of grains per panicle, grain weight per clump, and percentage of Empty grains in local aromatic upland rice at various spacing pattern in alley cropping system

Planting Distance Pattern	Number of Panicles per Clump	Number of Grain per Panicle	Grain Weight per Clump	Percentage of Empty-Grain
Random (Spread Out)	5.17 [a]	74.66 [b]	9.4 [b]	5.56 [a]
25 cm x 25 cm	5.44 [a]	82.59 [b]	12.55 [b]	4.42 [b]
20 cm x 20 cm	5.28 [a]	**99.14** [a]	**16.65** [a]	2.65 [c]
15 cm x 15 cm	4.97 [a]	**107.77** [a]	**18.7** [a]	2.22 [c]

Notes: Mean numbers followed by different letters mean significantly different in the DMRT-0.05 test

Differences in varieties and spacing have a significant effect on rice production (dry grain per hectare), but there is no interaction effect of both on production. Figure 1 and 2 shows the rice yield or weight of dry grain per hectare based on rice varieties and based on planting distance pattern where Ngappa and Latimojong varieties have better average yield while the best planting distance that gives the highest yield is 15 cm x 15 cm spacing.

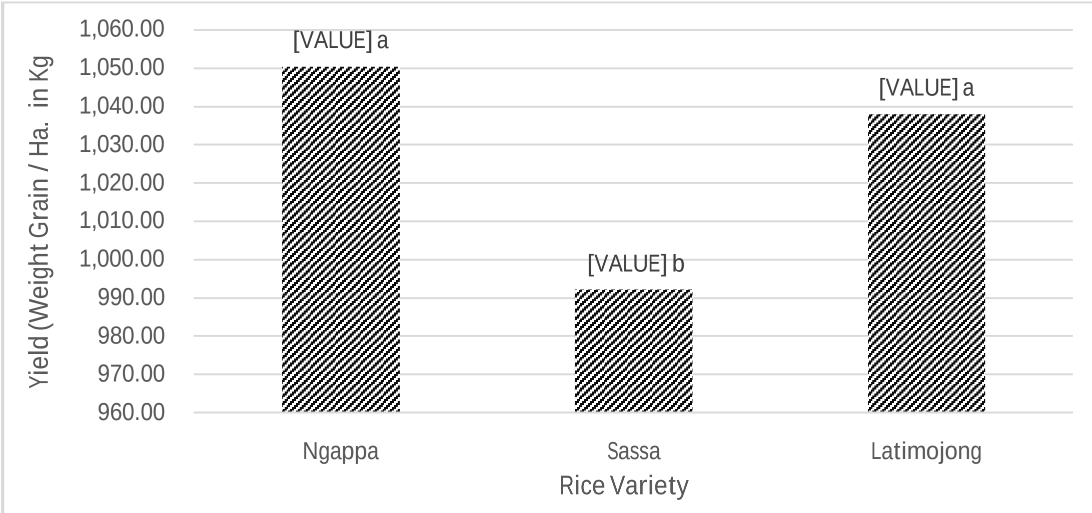

Figure 1. Dry Wight-grain of Local aromatic rice planted in Alley Cropping system by different variety

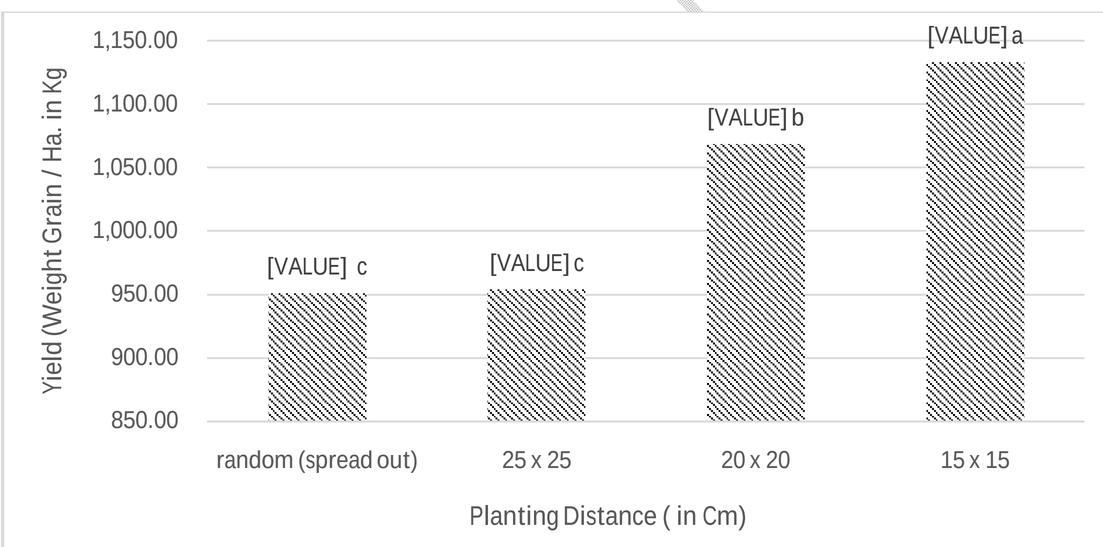

Fig 2. Dry Wight-grain of Local aromatic rice planted in Alley Cropping system by different Planting Distance Pattern

Differences in spacing and rice varieties can have a significant effect on yield and plant growth in monoculture cropping systems, as well as in intercropping or alley cropping systems in between annual crops. Plant spacing that is too tight can inhibit plant growth due to competition for resources such as water, nutrients, and sunlight. While too wide a spacing can make the plants too spread out thus affecting the use of resources and overall plant growth, of course by looking at the results in this study the random spacing (spread out) is not appropriate while the 15 cm x 15 cm spacing shows the best results, while in terms of variety selection for alley cropping, the Ngappa and Latimojong varieties are more responsive. Different rice varieties have different yield potentials. Some varieties can produce more grain per hectare compared to others under different cropping conditions [4].

Planting distance and population density play an important role, so that plants can utilize solar radiation more effectively and efficiently [5]. The successful management of a crop is strongly influenced by the availability and ability of plants to utilize the resources of the growing environment. This can be achieved, among others, through proper plant distances. Through proper plant distances, the level of competition between and among plants can be minimized as much as possible [6]. Plant distances affects root development which can affect plant growth and production. The ideal plant distances pattern is when the plant's need for environmental conditions (light, humidity, air aeration and rooting) can be fulfilled so as to affect the rate of photosynthesis and the rate of net assimilation of plants. The results of [7] research showed that the planting distance had a significant effect on the number of tillers, the number of filled grains per panicle, and the number of grains per panicle.

The influence of the type of rice varieties in intercropping systems with trees such as the Alley Cropping model agroforestry system and others causes the consequence of having to select the right type of rice varieties because of their response to the microclimate of rice plants that are usually grown in open areas in shaded areas greatly affects the growth, yield, productivity, and adaptation of plants [8]. Several agronomic and morphological characters need to be considered including shade tolerance, and plant density, as well as resistance to pests and diseases. The need for rice spacing is due to competition not only for nutrients but can be greater in competition for light [9][10], and Nutrient especially Nitrogen element [11] Trees can provide shade to surrounding rice plants. Proper spacing will affect the intensity of light received by rice plants.

4. CONCLUSION

The best recommended spacing for planting local aromatic upland rice varieties in the alley cropping system was 15 cm x 15 cm which produced the highest dry grain weight per hectare with an average of 1,433.24 Kg/Ha, while the highest production was produced by the Ngappa variety with an average of 1,350 Kg/ha

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