Original Research Article

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

ABSTRACT

The experiement was carried out to examine the production performance of 3 local Sulawesi aromatic upland rice varieties planted with the alley cropping system at various planting distances pattern ***in Sampano Village, South Larompong District, Luwu Regency, South Sulawesi from February to June 2022. Plant spacing and selection of more adaptive varieties was one aspect for testing. The plants were laid out in a Split Plots Design in a*** factorial ***Randomized Completely Block Design. The main plots were 3 local varieties of Ngapa, Sassa, and Latimojong. Subplots were planting spacing 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 15 cm x 15 cm was the best spacing for planting local aromatic upland rice varieties in the alley cropping system which produced 1,433.24 kg dry grain weight per hectare, while Ngappa variety outperformed Sassa and Latimojong by registering 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 experiencing low rainfall ~~prone to drought stress~~ because one of the characteristics 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 where farmers cultivate several aromatic upland rice varieties including Ngappa, Sassa and Latimojong (Kadir et al., 2023). 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.

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Planting distances is one of the factors that determine the high yield in rice production. Plant spacing is influenced by the morphology ~~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. Yield 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 (Santoso et al., 2022).

The importance of evaluating local aromatic rice varieties will encourage rice production on sub-optimal lands in the future. The spacing aspect 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 Cahyani and Suryanto 2018). [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. This study aimed to examine~~s~~ 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

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brown upland rice varieties from Luwu district, South Sulawesi, namely: Ngappa, Sassa and Latimojong. The research was laid out in a Split Plots Design (SPD) arranged in a Factorial Completely Randomized Block Design (RCBD) of 2 factors each as the Main Plots (PU) Local varieties of red upland rice. As Subsidiary Plots (AP) was the planting distance (J) consisting of random spacing (Spread). The number of seeds spread was adjusted to a spacing of 25 cm x 25 cm, 20 cm x 20 cm and 15 cm x 15 cm. Agronomic data of the generative phase related to crop production was carried out destructively, namely calculating by taking 3 sample plants from each treatment. 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 Statistical Tools for Agricultural Research (STAR) by IRRI software version 2.0.1. Significant means were separated using Duncan's Multple Rate Test (DMRT).

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3. RESULTS AND DISCUSSION

Growth and Yield Parameters

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The results in Table 1 showed significant differences in the number of panicles per clump, grains per panicle, and the percentage of empty grains against the varieties planted 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

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Table 1: Number of panicles, grain, 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]
Mean	?	**?**	?	?
Fprob	?	**?**	?	?
LSD (0.05)	?	**?**	?	?

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CV (%)	?	**?**	?	?

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 showed that spacing of 15 cm x 15 cm has a large number of grains per panicle and grain weight per clump compared to the spacing of 25 cm x 25 cm and 20 x 20 cm which recorded a lower percentage of empty grain (2.22 and 2.65%) respectively (Table 2).

Table 2: Number of panicles per clump, 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]
Mean	?	**?**	?	?
Fprob	?	**?**	?	?
LSD (0.05)	?	**?**	?	?
CV (%)	?	**?**	?	?

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

Variety and Spacing Differences

Differences in varieties and spacing have a significant effect on rice production (dry grain per hectare), but there was 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.

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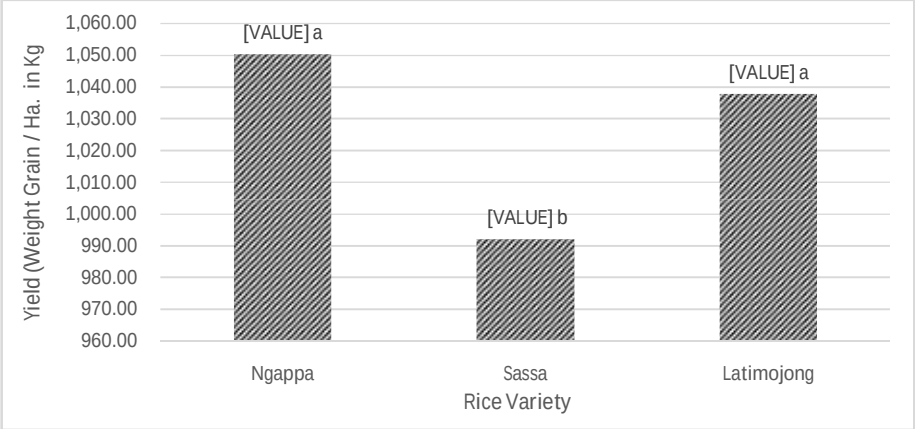

Figure 1: Dry weight-grain of local aromatic rice planted in Alley Cropping system by different variety

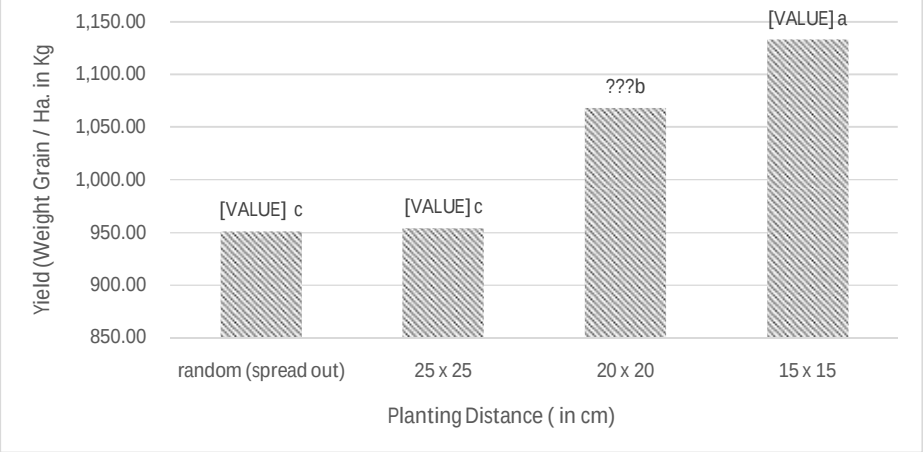

Fig 2: Dry weight-grain of local aromatic rice planted in Alley Cropping system by different pPlanting dDistance pPattern

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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. 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. Plant distances affect root development which could affect plant growth and production. Plant spacing that is

too tight could inhibit plant growth due to competition for resources such as water, nutrients and sunlight. Fischer et al. (2019) reported that through proper plant distances, the level of competition between and among plants can be minimized as much as possible. The findings are similar to Dejen (2018) who reported that planting distance and population density play an important role, so that plants can utilize solar radiation more effectively and efficiently. Too wide a spacing can make the plants too spread out thus affecting the use of resources and overall plant growth. The results in the random spacing (spread out) were not appropriate while the 15 cm x 15 cm spacing outperformed the others while in terms of variety selection for alley cropping, Ngappa and Latimojong varieties were more responsive. The results are in conformity with the findings of Anwari et al. (2019) who reported 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. Different rice varieties have different yield potentials and can produce more grain per hectare compared to others under different cropping conditions (Garba et al., 2013).

4. CONCLUSION

The best 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 Ngappa variety outperformed the others in ~~the highest~~ production with an average of 1,350 Kg/ha.

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5. REFERENCES

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