IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 13, Issue 9 Ser. II (September 2020), PP 32-38
www.iosrjournals.org

Effect of Cropping Systems and Manure on Growth and Seeds Quality of Sigupai Abdya Local Rice on Dry Land

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Abstract:
Background *: In the past, Aceh Barat Daya farmers were familiar with various types of rice varieties of local varieties which in general had been lost, there were some remaining varieties such as Sigupai varieties. Sigupai varieties can be planted in rice fields and dry land. Rice planting in dry land is one way out of the problem of agricultural land is decreasing from year to year. However, the use of dry land needs to be balanced with the use of organic material that can be sourced from manure. In addition to the use of manure, the cropping system or planting distance can also affect the growth and yield of rice in dry land. Based on the description, the research on the growth and quality of Sigupai Abdya's Local Rice yields due to the treatment of the cropping system and manure on dry land needs to be done. This study aims to determine the effect of the cropping system and manure as well as the interaction of these two factors on the growth and seeds quality of local Sigupai Abdya rice on dry land.*
Materials and Methods*: This research was carried out in Babahrot sub-district, Southwest Aceh District from February - September 2018 and the seed quality test was conducted at the Seed Laboratory of Seed Certification and Supervision Agency of Aceh Province, in September 2020. The experimental design used was a 3 x 3 factorial randomized block design with 3 replications, where the cropping system consisted of Tegel, Jarwo 2: 1, and Jarwo 4: 1. Manure consists of 5 tons ha^{-1}, 10 tons ha^{-1}, and 10 tons ha^{-1}. Plant growth parameters observed included plant height, number of tillers, number of grain and panicle length. The physiological quality parameters of seeds observed include germination, maximum growth potential, vigor index, simultaneous growth, relative growth rate, time needed to reach 50% of total germination relative.*
Results and conclusion*: The cropping system had no significant effect on some of the parameters of plant growth, plant yield and physiological quality test of seeds. The cropping system has a significant effect on simultaneous growth and relative growth rate and has a very significant effect on plant height of 30 DAP phases, number of tillers 30 DAP, number of tillers of primordia phase, number of tillers, and number of empty grains. Manure had no significant effect on most of the parameters of plant growth, plant yield and physiological quality test of seeds. Manure had a significant effect on the number of pithy grain, germination, vigor index, and relative growth rate and had a very significant effect on plant height in the 30 DAP phase, the number of tillers in the 30 DAP phase, and the weight of 1000 seeds, maximum growth potential, and simultaneous growth. There was a significant interaction between the treatment of the cropping system and manure based on the parameters of plant height in the 30 DAP phase, plant height in the primordia phase, plant height of the mature phase, and maximum growth potential.*
Key Word*: local rice, manure, cropping systems, seed quality*

Date of Submission: 04-09-2020 Date of Acceptance: 19-09-2020

I. Introduction

The development of agricultural cultivation in an area can not be separated from the past history of the existence of local wisdom. Local wisdom of an area in agricultural cultivation can be in the form of farming patterns, the sources of the seeds used, and agricultural products. Along with the times, traditional agricultural farming patterns slowly began to be abandoned. Land management which used the livestock, now using a machine, curently farmers have switch to using certified superior seeds than local rice seeds in the cultivation system especially rice. Prior to the green revolution technology, farmers in each region planted local rice that adapted to specific agroecosystems. The local varieties have been cultivated for centuries by generations.In generally, local variety has a high quality in terms of great taste (Sitaresmi *et al*., 2013).

There are several varieties remaining in the Southwest Aceh area, which are known by farmers as the Sigupai variety. According to the society, Sigupai variety has several advantages compared to the other local varieties that have existed, including the delicious taste of rice, distinctive fragrance and shorter life. This information was confimed by the community, which at that time just started working on land when other local variety plants have been planted, with the aim of getting simultaneous.

Sigupai variety can be planted in paddy fields and dry land. Rice planting in dry land is one of the solutions to the problem of decreasing agricultural land from year to year. However, the use of dry land needs to be balanced with the use of organic materials to get the maximum results. One source of organic material that can be used in rice cultivation in dry land is manure. Barus (2012) states that the application of manure as much as 4 tons ha^{-1} is able to increase the growth and yield of upland rice in acid dry land.

In addition to the use of manure, on the planting system or spacing were affect the growth and yield of dryland rice. According to the research of Putra (2011), legowo spacing can increase yields of upland rice compared to spacing of tiles. Barus (2012) also states that the legowo planting system combined with manure able to increase the yield of upland rice plants on dry land.

Treatment techniques for the cultivation and the using of fertilizers can be classified as external factors or environmental factors that can affect the quality of rice seeds. Santana et al. (2017) revealed that fertilizing through leaves with macro and micro nutrients could improve yield and physiological quality of upland rice seeds. On the other hand, the results of research by Wijaya et al. (2019) showed that fertilization using the microbial *Bacillus* sp. can improve the quality of rice seeds vigor index that is better than other treatments. *Basillus* sp. gives the best effect on the character of seed filling, filling the seeds maximally causing the seeds to have a good structure with food reserves. In the treatment of cultivation techniques, the study of Singh et al. (2013) showed that there were differences in seed quality due to treatment of cropping patterns where the cropping patterns using the SRI method resulted in very good seed quality compared to traditional planting patterns.

Based on the description above, it is important to conduct further research to determine the growth, yield and seeds quality of Sigupai Abdya Local Rice due to the treatment of cropping systems and manure on dry land.

II. Material And Methods

The research began with a field study conducted in Babahrot Sub-District, Southwest Aceh District and then continued with the study of the physiological quality of seeds in the Seed Laboratory of Seed Certification and Supervision Agency of Aceh Province.

Study Design: Field research using factorial randomized block design (RBD) with 3 replications with the first factor of the Cropping system with 3 treatments (S0, S1, and S2) and the second factor of Manure with 3 treatments (P1, P2 and P3) with 3 replications. Whereas the physiological quality test of seeds uses the rolled-up paper test is established in plastic with the number of seeds tested as many as 100 seeds per plot.

Study Location: field research carried out in Babahrot Subdistrict, Aceh Barat Daya District then continued with research on seed physiological quality testing at the Seed Laboratory of Seed Certification and Supervision Agency of Aceh Province.

Study Duration: Field research in February - September 2018, physiological quality test of seeds in September 2018.

Sample size: 270 sampel.

Research Implementation

Land Management

Land that will be used is cleaned from the remnants of grass or plants before, then processed using a hoe and made beds with a size of 4 m x 3 m. The distance between Deuteronomy and between plots is 50 cm.

Planting

Before planting, the seeds are germinated by soaking for 3x24 hours, and then planted in the field. Spacing is adjusted according to the cropping system, including: Tegel cropping system: 20 cm x 20 cm; Jarwo 2: 1: 20 cm x 20 cm cropping system with 4 aisles and Jarwo 4: 1: 20 cm x 20 cm with 2 aisles. Plants were sampled as much as 10% of the plant population in one experimental plot.

Fertilization

At the time of planting fertilization was carried out with basic fertilizer at a dose of 125 kg ha^{-1} Urea, 100 kg ha^{-1} SP 36 and 100 kg ha^{-1} KCl. Supplementary fertilizer is given at the age of 30 HST at a dose of 125 kg ha^{-1} Urea. Fertilization is done by sowing.

Manure is applied at the time of tillage by sowing throughout the land area according to the treatment plot and then leveled by means of hoeing.

Planting Maintenance

Plant maintenance in this study includes replanting done no later than 10 DAP, weeding is very dependent on the condition of weeds and done at least 2 times at 14 DAP and 45 DAP, while controlling pests and diseases in plants is done if there are symptoms of attack.

Harvesting

Harvesting is done simultaneously if 90% of panicles have turned yellow. Harvesting was done by cutting the plant right above the ground.

Observation Parameters

1. Plant height (cm), observed in 3 growth phases namely the vegetative phase, the primordia phase and the mature phase. Measurements were made starting from the base of the stem to the highest growing point.
2. The number of tillers, calculated in the vegetative phase, primordia phase, and harvest phase.
3. The number of filled graind per panicle
4. The number of empty grains per panicle
5. Panicle length(cm)
6. Weight of 1000 seeds (g)
7. Yields (t ha^{-1})
8. Physiological quality test of seeds, carried out following the Rolled Paper Test method established in plastic with the number of seeds tested as many as 100 seeds per plot. Physiological quality test parameters of seeds include: maximum growth potential (MGP), Germination (G), vigor index (VI), simultanous of growth (SG), relative growth rate (RGR), time needed to reach 50% germination relative total (T50).

Statistical analysis

Data were analyzed using Analisis of varians (Anova) and followed by DMRT at the 95% level, data were analyzed using SPSS application software.

III. Result

Table 1. The average plant height of Sigupai rice due to the influence of the interaction between the cropping system and manure.

Cropping System		Manure		
		5 t ha^{-1}	10 t ha^{-1}	20 t ha^{-1}
		---------- cm ----------		
30 DAP	Tegel	30.25 Aa	29.87 Aa	33.18 Ab
	Jarwo 2 : 1	31.18 Aa	31.80 Ba	33.83 Ab
	Jarwo 4 : 1	30.67 Aa	33.55 Cb	34.05 Ab
Primordia phase	Tegel	120.53 Aa	122.81 Ba	123.83 Ba
	Jarwo 2 : 1	123.62 Ab	123.46 Bb	117.60 Aa
	Jarwo 4 : 1	120.25 Aab	117.21 Aa	122.50 Bb
Mature phase	Tegel	140.25 Aa	143.89 Bb	144.36 Bb
	Jarwo 2 : 1	144.25 Bb	143.85 Bb	138.41 Aa
	Jarwo 4 : 1	140.42 Aa	139.15 Aa	143.92 Bb

Information : Numbers followed by the same letter (uppercase in the same column, lowercase in the same row) show no significant difference at the 0.05 probability level (DMRT 5%)

Table 2. Effect of cropping system (S) and manure (P) on the number of tillers per hills of local Sigupai rice.

Treatment	Number of Tillers per Hills		
	30 DAP	Primordia Phase	Mature Phase
Cropping System			
Tegel	4.21a	15.24a	8.54a
Jarwo 2 : 1	4.22a	18.79b	11.53c
Jarwo 4 : 1	4.78b	17.49b	10.36b
Manure			
5 t ha^{-1}	3.96a	16.94	9.99
10 t ha^{-1}	4.26a	17.03	10.14
20 t ha^{-1}	5.00b	17.54	10.30

Information : Numbers followed by the same letter in the same column are not significantly different at the 5% chance level (DMRT test)

Table 3. Effect of cropping system (S) and manure (P) on panicle length.

Treatment	Panicle Length
	---------- cm ----------
Cropping System	
Tegel	21.46
Jarwo 2 : 1	21.86

Jarwo 4 : 1	21.59
Manure	
5 t ha^{-1}	21.41
10 t ha^{-1}	21.63
20 t ha^{-1}	21.88

Information : Numbers followed by the same letter in the same column are not significantly different at the 5% chance level (DMRT test)

Table 4. Effect of cropping system (S) and manure (P) on the number of filled grain and the number of empty grain.

Treatmen	Number of Filled Grain	Number of Empty Grain
Cropping System		
Tegel	245.29	10.68b
Jarwo 2 : 1	263.04	9.23a
Jarwo 4 : 1	255.63	10.08ab
Manure		
5 t ha^{-1}	244.53	10.00
10 t ha^{-1}	254.11	10.26
20 t ha^{-1}	265.32	9.73

Information : Numbers followed by the same letter in the same column are not significantly different at the 5% chance level (DMRT test)

Table 5. Effect of cropping system (S) and manure (P) on the weight of 1000 seeds and yields..

Treatment	the weight of 1000 seeds (gr)	Yields (t ha^{-1})
Cropping System		
Tegel	21.59	8,42
Jarwo 2 : 1	21.55	7,96
Jarwo 4 : 1	21.50	8,49
Manure		
5 t ha^{-1}	21.38a	7,79a
10 t ha^{-1}	21.51a	8,27a
20 t ha^{-1}	21.74b	8,81a

Information : Numbers followed by the same letter in the same column are not significantly different at the 5% chance level (DMRT test)

Table 6. Effect of cropping system (S) and manure (P) on maximum growth potential (MGP), germination (G), and vigor index (VI).

Treatment	MGP	G	VI
	---------- % ----------		
Cropping System			
Tegel	88.11	88.11	2.11
Jarwo 2 : 1	85.89	85.67	2.67
Jarwo 4 : 1	88.56	88.33	1.78
Manure			
5 t ha^{-1}	85.22a	85.00a	1.33a
10 t ha^{-1}	88.22a	88.00a	1.78a
20 t ha^{-1}	89.11b	89.11b	3.44a

Information : Numbers followed by the same letter in the same column are not significantly different at the 5% chance level (DMRT test)

Table 7. Effect of cropping system (S) and manure (P) on simultanous growth (SG), relative growth rate (RGR), and Time needed to reach 50% relative total germination (T_{50}).

Treatment	SG (%)	RGR (%/*etmal*)	T_{50} (day)
Cropping System			
Tegel	59.22a	6.29	8.60
Jarwo 2 : 1	63.78a	6.12	9.00
Jarwo 4 : 1	69.00a	6.31	8.18
Manure			
5 t ha^{-1}	55.00a	6.07a	8.89
10 t ha^{-1}	62.33a	6.29a	9.01
20 t ha^{-1}	74.67b	6.37a	7.88

Information : Numbers followed by the same letter in the same column are not significantly different at the 5% chance level (DMRT test)

IV. Discussion

Plant Growth and Yield

Plant height

The results of the analysis of variance showed that the cropping system and manure had a very significant effect on the plant heigth 30 DAP. There is an interaction effect between cropping system and manure on the plant heigth 30 DAP. Table 1 shows that the planting height of the Jarwo 4 : 1 is better than the Tegel and Jarwo 2 : 1 for the 10 ton ha^{-1} and 20 ton ha^{-1} manure. While on treatment of manure 5 tons ha^{-1}, better plant height in treatment Jarwo 2: 1 compared with other treatments although statistically not significant. The lowest average plant height at 30 DAP was obtained in the Tegel cropping system with 5 tons ha^{-1} of manure, namely 29.87 cm, while the highest plant height was obtained in the Jarwo 4: 1 with 20 tons ha^{-1} manure with value 34.05 cm.

According to observations in the primordia phase, it shows that the interaction between the cropping system and manure affects the plants height (Table 1). Analysis of further statistical tests on the interaction between the cropping system and manure showed very varied results. Based on the results of the analysis, it was found that the lowest and highest plant height values were obtained in the same treatment combination even though it was analyzed from different treatments. In 5 tons ha^{-1} manure, the lowest value of plant height was obtained in Tegel and the highest value was obtained in Jarwo 2 : 1, for 10 t ha^{-1} manure the lowest value was obtained in Jarwo 4 : 1 and The highest value was obtained in Jarwo 2 : 1, while for the treatment of manure 20 ton ha^{-1}, the lowest value was obtained in the Jarwo 2 : 1 and the highest was in the Jarwo 4 : 1. Jarwo 4 : 1 with 10 t ha^{-1} manure with a value of 117.21 cm and the highest value of plant height was obtained in the Tegel with 20 t ha^{-1} of manure with a value of 123.83 cm

Based on the results of the analysis of variance, it shows that there is an interaction effect between the cropping system and manure on the height of rice plants in the mature phase. The average the plant height in the mature phase is presented in Table 1. According to the results of the observations in the table, it is found that the Tegel with 5 t ha^{-1} manure shows a lower plant height value compared to other cropping systems with the same treatment although the statistics are not different from the Jarwo 4 : 1 and for the highest value obtained in the Jarwo 4 : 1. The value of the crop height in the Jarwo 2 : 1 with a 10 t ha^{-1} manure is lower than that of other cropping systems. While the plant height value in Jarwo 4 : 1 with 20 t ha^{-1} manure looks lower compared to two Tegel and Jarwo 4 : 1. The combination of treatments with the lowest plant height values is obtained in the interaction between Jarwo 2 : 1 with 20 t ha^{-1} manure with a value of 138.41 cm and the highest value of plant height was obtained in the Tegel with 20 t ha-1 manure.

According to the results of observations in Table 1 shows that an increase in rice plant height from observations at 30 DAP to the primordia phase and subsequent observations in the mature phase. The increase in the plant height was quite high between 30 DAS to the primordia phase, namely an average of 89 cm, while the plant height from the primordia phase to the mature phase increased an average of 21 cm.

The height of the rice clump is influenced by cultivation management (changing the spacing), although genetic factors also determine the expression of the plant itself (Hermawati, 2012). According to Afiat *et al.* (2017) the change in cultivation method from semi-organic to organic causes a decrease in plant height. Semi-organically grown crops are higher. Spacing dense or tenuous does not affect plant height. Azalika *et al*. (2018) that giving manure has an increase in the height of rice plants quantitatively.

Number of Tillers per Hills

Based on the analysis of variance, it is known that the interaction between cropping system and manure has no effect on the number of tillers in three phases (30 DAP phase, primordia phase, and mature phase). Based

on the analysis of variance, it was found that the cropping system had a very significant effect on the number of tillers in the three observation phases. Meanwhile, manure had a very significant effect on the number of tillers in the 30 DAP phase and had no significant effect on the number of tillers in the primordia phase and the mater phase.

The results of the observations in table 1 show that in the 30 DAP phase, the Tegel and Jarwo 2 : 1 was different from the Jarwo 4 : 1 based on statistical tests. The highest number of tillers was obtained in the 4 : 2 Jarwo, namely 4.78 tillers and the lowest tillers were obtained in the Tegel, namely 4.21 tillers. While the number of tillers in the treatment of manure 5 t ha^{-1} and 10 t ha^{-1} is different from the treatment of manure 20 t ha^{-1}. The lowest number of tillers was obtained in 5 t manure ha^{-1} ie 3.96 tillers and the highest number was obtained in 20 t of ha^{-1} which was 5.00 tillers.

Observations in the primordia phase showed that the number of tillers in the Tegel was different from the Jarwo 2 : 1 and Jarwo 4 : 1. that is 18.79 tillers although not statistically different from the Jarwo 4 : 1.

The results of observations during the mature phase indicated that there were statistical differences in the number of tillers in each cropping system. The highest number of tillers was obtained in the Jarwo 2 : 1, namely 11.53 tillers and the lowest in the Tegel, namely 8.54 tillers.

Panicle Length

Based on the results of analysis of variance, it was found that there was no significant effect treatment of cropping system and manure on panicle length. There was also no interaction effect between cropping system and manure on panicle length. The observations in Table 3 show that the length of the Local Sigupai Rice panicles ranged from 21.41 cm to 21.88 cm.

Yield of Sigupai Local Rice

Number of Filled Grain and Empty Grain

The results of the analysis of variance showed that the treatment of cropping system and manure did not affect the number of filled grain. The interaction between cropping system and manure also had no effect on the amount of filled grain. Table 4 shows the average value of the number of filled grains in each treatment. While the number of filled grains ranges from 244.53 seeds to 265.32 seeds.

Based on the results of analysis of the variety showed the cropping system has a very significant effect on the number of empty grain. More over, manure did not significantly affect the number of empty grain. In addition, there is also no interaction effect between cropping system and manure on the number of empty grain. The average number of empty grains is shown in Table 4. The observations in Table 6 show that the number of empty grains in the Jarwo 2 : 1 is different from the number of empty grains with other cropping systems although it is not statistically different from the Jarwo 4 : 1. Similarly, the Jarwo 4 : 1 is not statistically different from the Tegel. The highest number of empty grains was obtained in the Tegel with a total of 10.68 seeds and the lowest number of empty grain was obtained in the Jarwo 2 : 1 with a total of 9.23 seeds.

Weight of 1000 Seeds and Yields

Based on the analysis of variance, it was found that the cropping system had no significant effect on the weight of 1000 seeds, while manure had a very significant effect on the weight of 1000 seeds. The interaction between cropping system and manure did not affect the weight of 1000 seeds. The results of the observations in Table 5 show that the weight of 1000 seeds with manure of 5 t ha^{-1} and 5 t ha^{-1} is different from the manure of 20 t ha^{-1}. The highest weight of 1000 seeds was obtained in the manure of 20 t ha^{-1} with a value of 21.74 gr, while the lowest was obtained in the manure of 5 t ha^{-1} with a value of 21.38 g.

The results of the analysis of variance showed that the manure had no significant effect on yields, while the cropping system had a significant effect on yields. Analysis of variance also showed that there was no effect of interaction between cropping system and manure on the yields of Sigupai local rice. Based on the observations in Table 5, it is known that the manure of 20 t ha^{-1} produced the highest rice yields, reaching 8.88 t ha^{-1} although it was not statistically different from other treatments.

According to Atman *et al.* (2018) there is a positive relationship between the dosage of organic fertilizers and organic rice yields. According to him, the addition of manure as organic fertilizer as much as 1 t ha^{-1} can be increase seed yield by as much as 0.097 t ha^{-1}.

Seeds Physiological Quality of Sigupai Local Rice

Germination (G), Maximum Growth Potential (MGP), and Vigor Index (VI) of Sigupai Local Rice Seeds.

Based on the analysis of variance, it shows that the manure has a significant effect on germination (G), maximum growth potential (MGP), and vigor index (VI), while the cropping system has no effect on G and MGP and has a very significant effect on VI. The interaction between cropping system and manure did not

affect the G, MGP, and VI of the Sigupai local rice seeds. The average G, MGP and VI values are presented in Table 6.

The results of the observations in Table 6 show that the rice seeds treated with 20 t ha^{-1} had the best G and were statistically different compared to other manure treatments. According to the observations, the G of Sigupai local rice seeds ranged from 88.11% to 89.11%.

The average percentage VI shown in Table 6 shows that the highest VI was obtained in the manure 20 t ha^{-1} although it was not statistically different from other treatments. The VI percentage of Sigupai local rice seeds ranged from 1.33-3.44%.

Simultaneous Growth (SG), Relative Growth Rate (RGR), and T_{50}

Based on analysis of variance, it was found that the cropping system had a significant effect on SG and had no effect on RGR and T_{50}. While manure has a very significant effect on SG and has a significant effect on SG and has no effect on T_{50}. The interaction between cropping system and manure had no effect on SG, RGR and T_{50}.

The results of the observations in Table 7 show that in the cropping system, the percentage of SGwas not statistically different. The lowest SG value was obtained in the Tegel, namely 59.22% and the highest was the Jarwo 4 : 1, namely 69.00%. Whereas in the effect of manure, there was a statistical difference in the percentage of SG where the manure 20 t ha^{-1} had a higher percentage of SG and was statistically different from the other two treatments with a value of 74.67%.

The average relative growth rate (RGR) which is presented in Table 7 shows that although the results of analysis of variance show that there is a significant effect of adding manure to RGR, but statistically there is no difference between manure. The mean RGR values ranged from 6.07% / etmal to 6.37% / etmal.

The time needed to reach 50% relative total germination (T_{50}) was not affected by the manure and cropping system. The average T_{50} was obtained on day 7.88 to day 9.01.

V. Conclusion

The cropping system had no significant effect on some of the plant growth, yield and physiological quality of seeds. The cropping system has a significant effect on SG and RGS and has a very significant effect on plant height of 30 DAP phases, number of tillers 30 DAP, number of tillers of primordia phase, number of tillers, and number of empty grains.

Manure treatment had no significant effect on most of the parameters of plant growth, plant yield and physiological quality of seeds. But manure treatment had a significant effect on the number of filled grain, germination (G), vigor index (VI), and relative growth rate (RGR) and had a very significant effect on plant height in the 30 DAP phase, the number of tillers in the 30 DAP phase, and the weight of 1000 seeds, maximum growth potential (MGP), and simultaneous growth (SG).

There was a significant interaction between the treatment of the cropping system and manure based on the parameters of plant height in the 30 DAP phase, plant height in the primordia phase, plant height of the mature phase, and MGP.

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Mirza Jaya, et. al. "Effect of Cropping Systems and Manure on Growth and Seeds Quality of Sigupai Abdya Local Rice on Dry Land." *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)*, 13(9), 2020, pp. 32-38.