

# Effect of Integration Rice, Duck and Azolla on Growth and Yield of Paddy Crop (*Oryza sativa* L.)

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## Abstract

The application of integrated agricultural technology of duck and azolla rice can increase nutrients for plants from duck manure, loosen the soil, minimize weeding, and reduce farmers' production costs. Azolla protein content is about 23 to 30% and has a low lignin content so it is easily digested by livestock. This study aims to examine the effect of the number of ducks and azolla on the growth and yield of rice plants. The research will be conducted in Paloh Village, Samalanga District, Bireuen Regency from July to October 2024. This study used a factorial pattern Randomized Group Design (RGD) consisting of two factors. The first factor is the dose of azolla (A0: control, A1: 2 t ha<sup>-1</sup>, A2: 4 t ha<sup>-1</sup>), the second factor is the number of ducks per hectare (I0: control, I1: 800 heads ha<sup>-1</sup>, I2: 1200 heads ha<sup>-1</sup>, I3: 1600 heads ha<sup>-1</sup>). The observed variables were plant height, number of tillers, potential yield ha<sup>-1</sup> and rice yield. The results showed that azolla treatment on rice plants had a very significant effect on plant height at 45 days after transplanting, yield potential and rice yield but no significant effect on plant height at 30 and 45 days after transplanting, number of tillers at 30, 45 and 60 days after transplanting. The treatment of ducks in rice plants had a very significant effect on plant height at 45 days after transplanting, number of tillers at 45 days after transplanting and yield potential, significantly affected plant height at 60 days after transplanting and rice yield but had no significant effect on plant height at 30 days after transplanting, number of tillers at 30 and 60 days after transplanting. The best results were found at 4 tons of azolla ha<sup>-1</sup> and 1600 heads ha<sup>-1</sup>.

Keywords: Integrated, Azolla, Duck, Rice, Potential.

## 1. Introduction

Rice (*Oryza sativa* L.) is a plant that produces rice and is a source of carbohydrates for some people globally, almost 95% of Indonesians consume rice as the main food source, which causes the demand for rice to increase every year. Along with population growth, meeting this demand is a challenge for Indonesia with its large population [1] The increase in population makes rice production unable to rely solely on increasing land area [2].

The approach through an integrated farming system, which combines agricultural and livestock activities on the same land, so as to increase land productivity, triggers an increase in community welfare with a diversity of food sources [3]. Azolla itself is Azolla plants contain relatively high levels of crude protein, which is between 23 to 30%. In addition, the lignin content in Azolla is relatively low so that it facilitates the digestive process in livestock. In addition, azolla is part of a water fern that is symbiotic with the *Anabaena Anabaena azollae* bacteria which is a type of blue green algae that lives in the cavity between leaf chlorophyll.

These bacteria function to bind free nitrogen from the atmosphere by utilizing solar energy, so that nitrogen can be used by rice plants. [4]. Research results [5] showed the use of Azolla in rice cultivation with high soil salinity conditions can increase N uptake and affect the dry weight of rice plants. Farmers' interest is not only limited to the benefits of azolla as organic fertilizer, but azolla as animal feed.. The advantages obtained by implementing the integration of ducks and rice plants

include being a source of fertilizer from duck manure, duck activities in search of food also contribute to soil loosening, minimizing weeding activities in the fields due to duck activities and reducing the use of pesticides because weeds and pests in paddy fields become feed for ducks and reduce farmers' operational costs [6]. [7] *Azolla pinnata* contains essential amino acids, protein, vitamin B12, vitamin A, betacarotene and minerals (calcium, phosphorus, potassium, iron, magnesium). This content in azolla can be useful for livestock growth.

[8] reported that the rice duck farming system reduces the use of pesticides, herbicides, and fertilizers. In addition, duck manure serves as organic fertilizer, to support rice growth. The activity of ducks in rice plants can improve soil physical properties [8], loosen paddy soil, increase the accumulation and translocation of nutrients in rice, reduce N leakage, change the oxidized layer of the soil surface, reduce the bottom layer, support nitrification and denitrification of N fertilizers resulting in increased accumulation of N in the soil and microbial activity around the roots [9], increase soil biodiversity [10] and can increase the productivity of rice plants [11].

## 2. Material and Methods

The research materials consisted of Ciherang variety rice seeds (5 kg), 120 ducks, Urea, SP-36 and KCl, and poultry feed. The research tools consisted of tractors, hoes, machetes, buckets, sprayers, scissors, bamboo, transparent agricultural plastics, meters, analytical scales, research nameplates, writing instruments, and cameras, seed blowers, mini hullers.

This study aims to examine the effect of the number of ducks and azolla on the growth and yield of rice plants. The research was conducted in Paloh Village, Samalanga District, Bireuen Regency from July to October 2024. This study used a factorial pattern randomized block design (RBD) consisting of two factors. The first factor is the dose of azolla (A0: control, A1: 2 t ha<sup>-1</sup>, A2: 4 t ha<sup>-1</sup>), the second factor is the number of ducks per hectare (I0: control, I1: 800 heads ha<sup>-1</sup>, I2: 1200 heads ha<sup>-1</sup>, I3: 1600 heads ha<sup>-1</sup>). The observed variables were plant height, number of tillers, potential yield ha<sup>-1</sup> and rice yield.

## 3. Results and Discussion

### 3.1 Effect of azolla on paddy

The results of the F test analysis showed that azolla treatment on rice plants had a very significant effect on plant height at 45 days after transplanting, yield potential and rice yield but had no significant effect on plant height at 30 and 45 days after transplanting, the number of tillers at 30, 45 and 60 days after transplanting.

Table 1.  
Average height of rice plants at 30, 45 and 60 days after transplanting due to the treatment of the amount of azolla.

Treatment Azolla ha <sup>-1</sup>	Plant Height (cm)		
	30 days after transplanting	45 days after transplanting	60 days after transplanting
control	60,67	80,75 a	108,58
2 Ton	63,92	87,58 b	101,83
4 Ton	66,17	95,58 c	111,58
HSD 0,05		6,23	

Description: The numbers followed by the same letter in the same column are not significantly different in Duncan's 5% test.

Table 1 shows that the highest plant height at 45 days after transplanting was found in the treatment of 4 tons of azolla ha<sup>-1</sup> which was 95.58 which was significantly different compared to other treatments. It is suspected that azolla is able to increase the content of nutrients so that it has

an impact on the growth ability of rice plants. This agreed with [12] Azolla given is able to increase C-organic N, P, K, it is even estimated that the use of Azolla is able to meet half the nitrogen needs of paddy rice, estimated at 90 to 120 kg N/ha.

The highest plant height at 30 and 60 days after transplanting was found in the treatment of 4 tons of azolla ha<sup>-1</sup>, namely 66.12 and 111.58 which were not significantly different from all treatments. It is suspected that the application of azolla is able to increase N levels in the soil but at certain levels it still cannot support the development process in rice plants. This agreed with [13] the process of absorption of N in the late vegetative most of it is still in the crown so that it affects the translocation of N from the organ even though it has not been maximized, The use of 20 tons/ha of Azolla can save 60 kg/ha of Nitrogen fertilizer and increase wet grain yield by 21%.

Table 2.

The average number of tillers of rice plants aged 30, 45 and 60 days after transplanting due to the treatment of the amount of azolla.

Treatment Azolla ha <sup>-1</sup>	Number of tillers		
	30 days after transplanting	45 days after transplanting	60 days after transplanting
control	20,83	29,83	31,58
2 Ton	20,50	30,42	32,92
4 Ton	21,75	30,67	33,50

Description: The numbers followed by the same letter in the same column are not significantly different in Duncan's 5% test.

Table 2 shows that the highest number of rice tillers at the age of 30, 45, and 60 days after transplanting was found in the treatment of 4 tons of azolla ha<sup>-1</sup>, namely 21.75, 30.65 and 33.50 which were not significantly different from the other treatments. It is suspected that the ability of nutrient absorption by plants in the soil is inhibited due to soil ph which ranges from 4-5, thus affecting the ability of roots to absorb free nutrients in the soil. This agreed with [14] the ability to absorb elements and nutrient allocation can directly affect production and growth in plants because optimal absorption of nutrients in the vegetative phase will affect the ability to grow and plant production in the generative phase. [23] azolla can contribute N to the planting media for plant growth and in research states that the application of azolla can reduce NaCl salt stress.

Table 3.

Average potential yield and rice yield due to azolla amount treatment.

Treatment Azolla ha <sup>-1</sup>	Yield potential (ton/ha <sup>-1</sup> )	Rice yield(%)
control	7,27 a	64,35 a
2 Ton	9,03 ab	71,34 ab
4 Ton	10,97 bc	75,82 bc
HSD 0,05	1,85	6,18

Description: The numbers followed by the same letter in the same column are not significantly different in Duncan's 5% test.

Table 3 shows that the highest potential yield was found in the treatment of 4 tons of azolla ha<sup>-1</sup> which was 10.97 which was significantly different compared to the other treatments.

It is suspected that the azolla treatment restores physiological and environmental conditions to be in good condition so as to support rice plants to produce high yields. This agreed with [15] that changes that occur in panicle weight are influenced by panicle length and panicle number, besides that environmental factors are also important factors in panicle formation.

The highest rice yield was found in the treatment of 4 tons of azolla ha<sup>-1</sup>, namely 75.82, which was significantly different compared to other treatments. It is suspected that the treatment of

ducklings restores physiological and environmental conditions to be in good condition so as to support rice plants to produce high yields. This agreed with [16] that changes that occur in panicle weight are influenced by panicle length and panicle number, besides environmental factors are also important factors in panicle formation. [17] added that the application of duck rice can increase the growth and production of rice. The use and utilization of azolla as a source of soil organic matter is currently not optimal and not widely known by the community, especially farmers [22].

### 3.2 Effect of ducklings on paddy

The results of the F test analysis showed that the treatment of ducks on rice plants had a very significant effect on plant height at 45 days after transplanting, number of tillers at 45 days after transplanting and yield potential, significantly affected plant height at 60 days after transplanting and rice yield but had no significant effect on plant height at 30 days after transplanting, number of tillers at 30 and 60 days after transplanting.

Table 4.  
The plant heights of rice crops in the treatment of the number of duck.

Treatments Ducks ha <sup>-1</sup>	Plant Height (cm)		
	30 days after transplanting	45 days after transplanting	60 days after transplanting
kontrol	49,25	63,75 a	76,58 ab
800	46,17	64,17 ab	81,92 abc
1200	46,92	67,50 c	76,00 a
1600	48,42	68,50 cd	87,50 cd
HSD 0,05		2,85	8,85

Description: The numbers followed by the same letter in the same column are not significantly different in Duncan's 5% test.

Table 4 shows that the highest plant height at 45 days after transplanting is found in the treatment of 1600 ducks ha<sup>-1</sup> which is 68.50 which was not significantly different from 1200 ducks ha<sup>-1</sup> which was 67.50 but very significantly different compared to other treatments. At 60 days after transplanting the highest value was found in 1600 ducks ha<sup>-1</sup> which was 87.50 which was significantly different from all treatments. It is suspected that the treatment of ducklings restore physiological and environmental conditions are in good condition so as to support rice plants to produce high. This agreed with [18] The use of 600 ducks/hectare in rice cultivation can increase rice growth and production by 28% compared to the cultivation method without ducks. In addition, the use of ducks also plays a role in reducing the number and attack of major pests that attack rice plants.

Table 5  
The number of tillers of rice crops in the treatment of the number of duck.

Treatments Ducks ha <sup>-1</sup>	Number of tillers		
	30 days after transplanting	45 days after transplanting	30 days after transplanting
kontrol	15,50	22,83 b	23,92
800	15,00	23,42 bc	23,67
1200	15,83	23,67 bcd	25,58
1600	16,75	21,00 a	24,83
HSD 0,05		1,56	

Description: The numbers followed by the same letter in the same column are not significantly different in Duncan's 5% test.

The highest plant height at 30 days after transplanting was found in the control treatment which was 49.25 which was significantly different from all treatments. It is suspected that the treatment of ducklings restores physiological and environmental conditions to be in good condition so as to support rice plants for high production. This agreed with [19] The availability of nitrogen

nutrients in accordance with the needs and stages of development can spur plants to absorb nitrogen, the role of nitrogen in plants including increasing growth, internode elongation, photosynthesis, metabolism and production of plant assimilation.

Table 5 shows that the highest number of rice tillers at the age of 45 days after transplanting was found in the 1200 ducks ha<sup>-1</sup> treatment which was 23.67 which was not significantly different from 800 ducks ha<sup>-1</sup> which was 23.42 but very significantly different compared to other treatments. It is suspected that the treatment of ducklings restores physiological and environmental conditions to be in good condition so as to support rice plants to produce high yields. This agreed with [15] that in the late vegetative most of the N that is successfully absorbed by rice plants is still stored in the canopy and there has been a process of translocation of N from leaf organs during grain filling although not yet maximum.

The highest number of rice tillers at 30 and 60 days after transplanting was found in the treatment of 1600 and 1200 ducks ha<sup>-1</sup>, namely 16.75 and 25.28 which were not significantly different from all treatments. It is suspected that the treatment of ducklings restore physiological and environmental conditions are in good condition so as to support rice plants to produce high. This agreed with [20] The availability of appropriate and balanced nutrients can increase and maintain production, a long time is needed for the decomposition of micro-nutrients in organic matter so that they can be absorbed by plant roots to support rice plant growth.

Tabel 6.  
The Yield potential, Rice yield in the treatment of the number of duck.

Treatments Ducks ha <sup>-1</sup>	Yield potential (ton/ha-1)	Rice yield(%)
kontrol	6,24 a	50,59 a
800	6,34 ab	53,21 abc
1200	7,11 bc	52,81 ab
1600	7,57 cd	54,90 bcd
HSD 0,05	0,84	2,82

Description: The numbers followed by the same letter in the same column are not significantly different in Duncan's 5% test.

Table 6 shows that the highest potential yield was found in the treatment of 1600 ducks ha<sup>-1</sup> at 7.57 which was not significantly different from 1200 ducks ha<sup>-1</sup> but was significantly different compared to other treatments. It is suspected that the azolla treatment restores physiological and environmental conditions to be in good condition so as to support rice plants to produce high yields. This agreed with [15] that ducklings treatment can maintain nitrogen availability and increase absorption in plants due to ducklings treatment in rice plants so that the need for grain formation in rice plants can be fulfilled. [24] Ducks are active by eating weeds, weed seeds, insects, and pests, and their activity and droppings can reduce the need for manual weeding, chemical pesticides.

The highest rice yield was found in the treatment of 1600 ducks ha<sup>-1</sup> which was 54.90 which was significantly different compared to the other treatments. It is suspected that the treatment of ducklings restores physiological and environmental conditions to be in good condition so as to support rice plants to produce high yields. This agreed with [21] the treatment of ducklings restores physiological and environmental conditions to be in good condition so as to support rice plants for high production. [11] added that the application of duck rice can increase the growth and production of rice. [25] The process of photosynthesis greatly affects the high or low weight of 1000 grains in rice plants.

#### 4. Conclusion

Azolla treatment on rice plants had a very significant effect on plant height at 45 days after transplanting, yield potential and rice yield but no significant effect on plant height at 30 and 45 days

after transplanting, number of tillers at 30, 45 and 60 days after transplanting. The treatment of ducks in rice plants had a very significant effect on plant height at 45 days after transplanting, number of tillers at 45 days after transplanting and yield potential, significantly affected plant height at 60 days after transplanting and rice yield but had no significant effect on plant height at 30 days after transplanting, number of tillers at 30 and 60 days after transplanting. The best results were found at 4 tons of azolla ha<sup>-1</sup> and 1600 heads ha<sup>-1</sup>

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