

# The Effect of Organic Matter Combination and Azola Dosage (*Azolla pinnata*) On Growth and The Production of Paddy (*Oryza sp.*) Ciherang Variety

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**Abstract:** The study aims to determine the effect of the application of organic matter in the form of cow feces and urine, *Tithonia diversivolia*, and mycorrhizal fungi with various doses of azola (*Azolla pinnata*) on the growth and yield of Ciherang paddy variety. The treatment in this study include: (P1) feces + urine + titionia + mycorrhiza + azola 1kg, (P2) feces + urine + titionia + mycorrhiza + azola 2kg, (P3) feces + urine + titionia + mycorrhiza + azola 3kg, (P4) titionia + mycorrhiza + Azola 1kg, (P5) titionia + mycorrhiza + azola 2kg, (P6) titionia + mycorrhiza + azola 3 kg, (P7) 334 kg ha<sup>-1</sup> ZA + 334 kg ha<sup>-1</sup> NPK 15:15:20 + SP36 334 kg ha<sup>-1</sup> + azola 1kg, (P8) 334 kg ha<sup>-1</sup> ZA + 334 kg ha<sup>-1</sup> NPK 15:15:20 + SP36 334 kg ha<sup>-1</sup> + azola 2kg, (P9) 334 kg ha<sup>-1</sup> ZA + 334 kg ha<sup>-1</sup> NPK 15:15:20 + SP36 334 kg ha<sup>-1</sup> + azola 3kg. The parameters observed are: plant length, number of leaves, number of tillers, leaf area, leaf area index, number of panicles, total dry weight, crop growth rate (CGR), weight of 1000 seeds, the percentage of empty seed, the weight of grain per hectare, and the harvest index. Results showed that the treatment effect of organic matter (feces + urine + titionia + mycorrhiza + Azola 2 kg (P2) and 3kg (P3), showed a significant increase on all vegetative observations, with the best influence on plant leaf area which amounted to 2098.12 cm<sup>2</sup> (P3) which is showed a higher results compared with control (P9) 1587.40 cm<sup>2</sup>, also from the harvest observation showed that the P3 treatment is able to increase the weight of grain per hectare to 7.56 tons ha<sup>-1</sup> when compared to the control treatment (P9) which only 5.38 tons ha<sup>-1</sup>.

**Keywords:** Ciherang Paddy, Cow urine, Cow Feses, *Tithonia*, Azolla

## 1. Introduction

Paddy is the main commodity which is cultivated by Indonesian people. Ciherang variety is a superior rice seeds with plant age 116 -125 days. It has an upright stem morphology with height around 107-115 cm and could yield 14-17 productive tillers, with the potential result around 6 - 8 ton ha<sup>-1</sup> and a weight of 1000 grains ranges between 27-28 g (Pujiharti *et al.*, 2008; Center Of Crop Research and Development, 2007).

The age of paddy which relatively short make the farmers planted it very intensively up to three to four times a year. This is exacerbated by the application of synthetic chemicals fertilizers and pesticides that excess on the field. Based from the survey by the Central Statistics Agency (BPS) said that rice production in 2012 milled rice increased by 3.30 million tonnes (5,02 percent) compared to 2011. Added low production is an indication that the quality of the land have decreased or degraded. Based on this, an ecological farming system approach on rice cultivation system is indispensable. Waste cattle, *Tithonia*

*diversivolia*, and *Azolla Pinata* is an organic substance that is plentiful and easy to get around the neighborhood. Besides the materials also have a high macro nutrients value, especially macro nutrients nitrogen (N) and phosphorus (P) (Hartatik *et al.*, 2005; Rachman *et al.*, 2005). To optimize the function of the liquid organic fertilizer additions mycorrhizal fungi sp. necessary to improve the fixation of phosphorus in the soil of nutrients, so that the development of generative rice plants could be promoted to it's maximum (Nainggolan, 2001).

## 2. Material and Methodes

The experiment was conducted in February to June 2014 in the paddy field Pendem Village ,Batu (with the altitude 600 meters above sea level ). Soil pH studies have 7.0-7,2 the nutrient content of N 0.02 % , 22.01 % P and 0.2 % K . Research using randomized complete block design with nine combination treatment was repeated three times as follows

- P1: Cow urine 1 l + Cow feces 1 kg + Titionia 1 kg+ 0.25 kg Mycorrhiza + 0.25 kg Sugar + water 20 l + Azola 1 kg  
P2: Cow urine 1 l + Cow feces 1 kg + Titionia 1 kg+ 0.25 kg Mycorrhiza + 0.25 kg Sugar + water 20 l + Azola 2 kg  
P3: Cow urine 1 l + Cow feces 1 kg + Titionia 1 kg+ 0.25 kg Mycorrhiza + 0.25 kg Sugar + water 20 l + Azola 3 kg  
P4: Titionia 1 kg + 0.25 kg Mycorrhiza + 0.25 kg Sugar + water 20 l + Azola 1kg  
P5: Titionia 1 kg + 0.25 kg Mycorrhiza + 0.25 kg Sugar + water 20 l + Azola 2kg  
P6: Titionia 1 kg + 0.25 kg Mycorrhiza + 0.25 kg Sugar + water 20 l + Azola 3 kg  
P7: NPK 15:15:20 334 kg ha<sup>-1</sup> + ZA 334 kg ha<sup>-1</sup> + SP 36 334 kg ha<sup>-1</sup> + Azola 1 kg  
P8: NPK 15:15:20 334 kg ha<sup>-1</sup> + ZA 334 kg ha<sup>-1</sup> + SP 36 334 kg ha<sup>-1</sup> + Azola 2 kg  
P9: NPK 15:15:20 334 kg ha<sup>-1</sup> + ZA 334 kg ha<sup>-1</sup> + SP 36 334 kg ha<sup>-1</sup> + Azola 3 kg (control)

Basic fertilization is given at the age of 14 DAP then continued at the age of 35 DAP and 50 DAP, while the application of organic materials such as fermented mixture of feces, urine, *Tithonia diversivolia*, and mycorrhizal given at age 28 DAP (100 l ha<sup>-1</sup>), 42 DAP (200 l ha<sup>-1</sup>), 64 DAP (300 l ha<sup>-1</sup>), and 78 DAP (400 l ha<sup>-1</sup>) with a total dose of 1000 l ha<sup>-1</sup> by spraying the leaves using sprayer.

Watering is done by flooding until the age of 50 DAP, then dried at regular intervals until harvest. The weeding was done by removing potential weeds such as, quest (*Echinochloa spp.*), passing water (*Ishchaemum rugosum*), velvetleaf (*Limnocharis flava*), and hyacinth (*Monochoria vaginalis*) manually using a small hoe or hand. Azola dose treatment is done at the age of 14 DAP by giving 1 kg, 2 kg, 3 kg and fresh Azola on each plot planting appropriate treatment.

Observation of plants is done by direct measurement in plant organs every two weeks (35 DAP, 49 DAP, 63 DAP, 77 DAP and 91 DAP), with destructive of two plants and non-destructive of five plants. The parameters observed: plant length, number of leaves, number of tillers, leaf area, leaf area index, number of panicles, total dry weight of plants, plant growth rate (CGR), the weight of 1000 seeds, the percentage of empty, grain weight ha<sup>-1</sup> and harvest.index

The data were then analyzed using analysis of variance f test on 5 % level, followed by LSD test at 5% level if the parameters indicate a significant response to treatment.

### 3. Results and Discussion

#### Effect of combination treatment on vegetative parameters

The results of 63 DAP presented relates to the pattern of growth of the rice plant is likely to decline entering the generative phase after passing the age of the plant 2/3 (Makarim *et al.*, 2003; Sitompul and Guritno,1995; Wijaya, 2008). The results showed that treatment of organic materials P2 (feces + urine + titonia + mycorrhiza + Azola 2kg) and P3 (feces + urine + titonia + mycorrhiza + Azola 3 kg) showed significant values in all growth parameters when compared to the control treatment P9 (Table 1).

Such differences may be caused by the application of organic materials that include urine and feces, which directly provide supplemental intake of macro and micro nutrients in plants, so the plants can grow to more optimally, according to research results Naswir (2003) which showed that the cow urine fermented containing high nutrient and auxin capable of supporting plant growth, so that the value of crop length, number of leaves, number of tillers and leaf area showed a significant increase. These results are consistent with studies Arumingtyas *et al.* (2014) which indicates that the application biourin able to increase leaf area and leaf area index of 29.7 % and 19.09 %. Azola also giving increasing doses showed significant effect on plant growth, where the combination treatment with Azola 3kg (P3)

**Table 1:** Effect of treatment on each parameter observation at 63 DAP

Treatment	Plant Lenght (cm)	Leaf Amount (strand)	Amount Of tiller (stalk)	Leaf area (cm <sup>2</sup> )	Leaf are index
P1	111,36 c	79,33 c	20,00 c	1938,51 c	4,85 c
P2	116,15 c	82,00 c	20,33 c	1983,08 c	4,96 c
P3	121,09 c	85,67 c	21,33 c	2098,12 c	5,25 c
P4	94,89 b	63,33 ab	17,33 b	1709,83 ab	4,27 bc
P5	93,26 b	67,67 b	17,00 ab	1738,58 b	4,35 bc
P6	105,22 bc	74,67 bc	17,67 b	1824,44 bc	4,56 bc
P7	76,43 a	62,67 ab	15,33 a	1544,00 a	3,86 a
P8	81,30 a	61,67 ab	16,00 ab	1576,83 a	3,94 a
P9	83,63 ab	55,00 a	16,67 ab	1587,40 ab	3,97 a
LSD 5%	10,5	7,6	1,77	172,82	0,43
CV	11,04	11,16	10,18	10,03	10,03

\* Means within columns followed by same letters are not significantly different at 5% level using LSD test. 8LSD (0,05)= Least significant difference. \*NS=Not significant .\*CV=Coefficient of variance

**Table 2:** Effect of treatment on each generative parameter observation and crop production.

Treatment	Green panicles (stalk)	Dry Weight (g)	CGR (g m <sup>-2</sup> day <sup>-1</sup> )	Empty grain percentage (%)	1000 grain weighth (g)	Harvest weight (ton ha <sup>-1</sup> )	Harvest index
P1	17,33 c	93,00 b	0,44	16,17	31,60	6,87 d	0,03
P2	17,33 c	113,23 c	2,67	13,11	29,57	7,35 de	0,03
P3	19,00 d	115,00 c	2,53	13,90	30,36	7,56 e	0,03
P4	15,33 b	94,67 b	1,48	13,99	30,8	6,33 c	0,03
P5	16,00 b	114,53 c	2,73	16,54	29,56	5,75 b	0,03
P6	16,00 b	94,80 b	1,11	16,25	31,15	6,11 b	0,02
P7	13,33 a	73,72 a	0,67	16,44	23,18	5,25 ab	0,03
P8	14,00 a	81,58 ab	1,23	19,67	25,09	5,24 a	0,03
P9	14,67 a	85,50 b	0,85	17,91	29,90	5,38 ab	0,27
LSD 5%	1,56	10,47	NS	NS	NS	0,51	-
CV	10,12	11,23	83,5	20,99	11,41	8,62	8,62

\* Means within columns followed by same letters are not significantly different at 5% level using LSD test. 8LSD (0,05)= Least significant difference. \*NS=Not significant.\*CV=Coefficient of variance showed the highest yield is relates to it's ability to create a symbiosis with the cyanobacteria in N<sub>2</sub> fixation, followed by it's high nutrient content of N, P and K (Batan, 2006; Rahman *et al.* 2004). The *Tithonia diversivolia* and mycorrhizal application also contribute in providing a complete nutrient N, P, K and increase nutrient penyerpaan with symbiosis on the roots of plants (Anggarini *et al.*, 2011; Gachengo *et al.*, 1999; Nainggolan, 2001; Khadir, 2007).

Results from the P3 showed a difference of up to 37 cm on the plant lenght when compared with controls (P9) (Table 1), also showed higher values when compared with the results of research Astuti (2010) who at the age of 8 WAP (56 DAP) average plant height Ciharang highest rice only able to achieve along 75.80 cm, followed by the results Candrasari (2012), which shows that the average harvest age average, plant height Ciharang rice varieties can only reach 88.13 cm.

Leaf area index value of observations of 5.25 (P3), 4.26 (P6), and 3.97 (P9) shows a relatively ideal value when compared with the results of research Habibie *et al.* (2012) amounted to 3.04, while according Sutoro *et al.* (1997) the amount of rice leaf itself is strongly influenced by the number of tillers, where LAD optimal range between 4-7.

#### Effect of combination treatment on plant total dry weight.

The observation on the dry weight of the total crop showed that the type of organic material P2 (feces + urine + titonia + mycorrhiza + Azola 2kg) and P3 (feces + urine + titonia + mycorrhiza + Azola 3 kg) and P5 (titonia+ mycorrhizal + Azola 2kg) capable increasing the total dry weight of the plant amounted to 29.50 (P3) g or up 25.6% when compared to the control P9 (Table 2).

The increase can be caused by the application of cow urine and feces that in addition to providing nutrients it also provide auxin hormone, and followed by the addition of Azola that can improve fixation of N by, so it can stimulate and promote the growth of plants optimally. (Naswir, 2003; Ohorella, Z, 2012; Princess *et al.*, 2013; Arumingtyas *et al.*, 2014). The role of mycorrhizal with plant roots also showed a marked influence in increasing the uptake of plant nutrients, especially phosphorus (P), so as to increase plant growth. (Anggarini *et al.*, 2011; Nainggolan, 2001; Gachengo *et al.*, 1999).

However, based on the analysis of crop growth rate (CGR) plant dry weight gain on a daily basis does not show significant differences, this can be caused by the plant in general is already the met nutrient requirements with the amount of an organic fertilizer that is given at each treatment (ZA 334 kg ha<sup>-1</sup> + NPK 15:15:20 334 kg ha<sup>-1</sup> + SP36 334 kg ha<sup>-1</sup>), according to the results of research Agus *et al.*, (2004) which states nutrient requirements per tons of paddy crop harvest is about 15 kg N, 2.7 kg P, 3.7 K, so that the plant is not generally deficient in nutrients and can grow optimally.

#### Treatment effect on crop production plant generative parameters.

Generative observations indicate that treatment P3 type of organic matter (feces + urine + titionia + mycorrhiza + Azola 3kg) shows significant value in the number of panicles plants with an increase of 6.47 stalk or more than 22.79 % when compared to the control P (9) (Table 2). The corresponding results can be influenced by the addition of Azola is able to provide supplemental nutrients phosphorus (P) of 0.16 to 1.59 % which is relatively high, so the potential to improve the growth of plant generative (Amilia, 2011); Prihatini *et al.*, 1980; Carrapico *et al.*, 2000) . Furthermore, the results showed values greater number of panicles when compared with the results of the research Utama (2009), which shows that Ciharang only able to generate productive tillers 9.4 and also Candrasari (2012) with 8.33 per plant. .

Parameter percent of empty grain and weight of 1000 did not show a different value in each treatment combination , it is shown that the whole plant is relatively under optimum conditions so as to produce generative organs normally in terms of both quantity and quality. While the grain yield per hectare shows significant value by combination treatment P3 28.83 % when compared to the

control P9. This increase is demonstrated that administration of feces and urine of cattle to supplement nutrients and hormones to plants affect significantly in improving crop yields in accordance with the results of research Arumingtyas *et al.* (2014) and Mardalena (2007).

#### Soil conditions

Based on the soil conditions of the results of soil analysis (Table 3) showed that the pH of the soil after planting relative decline, but that happened not too low of 7.1 (neutral) to 6.14 - 5.94, with the highest decrease was shown by all organic combination treatment materials

feces, urine, titionia, mycorrhiza (P1, P2 ,P3). On fluctuation of nutrients in the soil, all treatments showed a realtive decreases on the P, and K. The highest decrease by the nutrient phosphorus from 8 to 10.3 ppm to 22.6 ppm indicates that the application of mycorrhiza as a nutrients absorption enhancer, especially the immobilized nutrient like the phosphorus (P) can play an optimal role in improving the absorption of nutrients and showed a signifikan effect on the crop yields (Nainggolan *et al.*, 2001).

**Table 3:** After planting soil analysis.

Treatment	pH	BO(%)	C/N rasio	N (%)	P2O5(%)	K(%)	KEC (me)
P1	5,93	2,45	14,2	0,1	8	0,26	9,6
P2	5,94	2,69	15,29	0,1	8,8	0,27	10,1
P3	5,94	2,76	15,38	0,1	10,7	0,3	14
P4	5,97	2,79	15,28	0,1	8,4	0,17	16,9
P5	6,04	2,86	15,66	0,1	8,8	0,17	17
P6	6,05	2,89	15,85	0,1	9	0,25	25
P7	6,14	2,45	13,4	0,1	8	0,42	9,4
P8	6,07	2,58	13,76	0,1	8,8	0,17	9,8
P9	5,99	2,65	14,13	0,1	10,3	0,13	12,9

Nutrients in the soil is relatively decreased, but the cation exchange capacity (CEC) actually showed a high value of up to 25 me by *Tithonia diversivolia* and mycorrhiza treatment at all doses Azola (P4, P5, P6). The improvement of the soil physical and biological properties, is indicated by the increases of C/N ratio of the soil from 13 to 15.66, also in organic material from 2.65% to 2.89% or 11.94 percent increase. This indicates that the application of a combination of organic materials are able to significantly improve the physical, chemical and biological of soil (Agustina, 2011).

#### 4. Conclusion

Combination treatment of organic materials P2 (feces + urine + titionia + mycorrhiza + Azola 2kg) and P3 (feces + urine + titionia + mycorrhiza + Azola 3 kg) showed significant value on plant vegetative organs, with the highest increase in the plant lenght by 37 cm or 19.57 % by P3 treatment effect at 63 DAP, when compared to the control treatment of inorganic fertilizer with the addition of the same azoladosage P9.

The highest increase in crop productivity is also indicated by P3 treatment with weight value of grain yield per hectare of 7.56 tonnes ha<sup>-1</sup> (28.83%) when compared to the control treatment with the addition of synthetic fertilizers and azola dosage with just only 5.38 tons ha<sup>-1</sup> (P9).

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